



**Agilio® LX
ISA-6480 Series
SmartNICs**

**Hardware User Manual
Version 007**

- Proprietary –

**Product code
130-00010-007**

Agilio LX ISA-6480 series SmartNIC Products

Hardware User Manual

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Revision History

Date	Revision	Description
17-Mar-2015	000	Initial Release.
21-Apr-2015	001	Revised minimum airflow specification for passive fan usage.
13-May-2015	002	Removed obsolete products. Updated product numberings.
24-June-2015	003	Added additional illustrations and descriptions.
19-Nov-2015	004	Updated product names to use “ISA-” prefix instead of “FlowNIC-”
05-Jan-2016	005	Added additional detail regarding LEDs
21-Jan-2016	006	Updated with new company logo and product branding
06-Jul-2018	007	Updated illustrations and product branding

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1 Introduction

Model Number	Part Number	Description
ISA-6480-40F-20-AA-x	AMDA0058-00xx	PCIe-compatible SmartNIC with 2x40G ports
ISA-6480-100CXP-10-AA-x	AMDA0078-00xx	PCIe-compatible SmartNIC with 1x100G port
ISA-PCIE-CBL-ADPT	AMDA0073-0001	PCIe-compatible adapter card for use with ISA-6480 SmartNIC

This document covers the Netronome Agilio LX Intelligent Server Adapter (ISA) ISA-6480 series SmartNIC products identified above. It includes part number, model number, product description, and power ratings for each model. Fields containing an “x” in the above table have more than one applicable variant that is covered by this manual, as described by the relevant product section.

Information in this document refers to all versions except as noted. Additional fields may appear on the end of any of the model numbers shown above, however these are strictly for software-defined configuration aspects only, and do not denote any hardware differences.

This document is intended for persons experienced with networking equipment and the installation of PCI Express (PCIe) cards in particular. It is very important to ensure your host platform's compatibility, both in terms of hardware and software, prior to starting the installation process.

Additional safety information is found in the Agilio LX ISA-6480 Series SmartNIC Safety Notice. Software, I/O configuration and operation are not covered in this document. If you should have any questions about the use of this product, please don't hesitate to contact Netronome, as described in Section 6.

Illustrations shown in this document are representative of these products, though not necessarily of currently-available colors and cosmetic finishes. For information about currently-available colors and cosmetic finishes for these products, please contact Netronome.

This document contains **Warnings!** and **Cautions!** Warnings are safety related. Failure to follow warnings may lead to injury or equipment damage. Cautions are requirements for proper function. Failure to follow cautions may result in improper operation.

Descriptions, warnings and/or cautions applicable to all cards of a particular type may be found at the beginning of the appropriate document section. Please read these, as well as the particular subsection applicable to your specific card's model number.

All products are low voltage PCIe cards (12V-, 3.3V-supplied per PCIe standard).

All lasers in optional transceiver plug-ins are Class 1 or Class 1M. See Laser Caution statements that follow.

Warning! No user serviceable parts are present.

Warning! Replacements must be performed by qualified personnel only. All installation instructions and requirements specified for the end-use system must be followed.

Caution! None of the units in this document are hot-swappable. Damage will result. Please disconnect all system power feeds before attempting to install or replace any of these products in a system.

Caution! These products may be vulnerable to static electricity (ESD). ESD mitigation controls (e.g. static straps) must be used while handling and installing these products. These products should be stored in antistatic bags or containers when not in use.



2 Agilio LX ISA-6480 Series SmartNICs

Agilio LX ISA-6480 Series SmartNICs are half-length, full-height, x8 PCIe 3.0 (“PCIe gen 3”) cards on the Netronome 6480 Network Flow Processor. They are available with a choice of external interface ports to suit a variety of application needs. The currently available models are:

- ISA-6480-40F-20-AA-x (2x40Gbps; accepts QSFP transceiver plug-ins)
- ISA-6480-100CXP-10-AA-x (1x100Gbps; accepts CXP transceiver plug-in)

There are currently two hardware versions of each of these cards: “x” is a “1” if an active heatsink (with integrated fan) is installed, “x” is a “2” if a passive heatsink (without integrated fan) is installed. Generally, cards equipped with passive heatsinks are suitable for rackmount server systems with high intra-system airflow, with cards equipped with active heatsinks better suited to “tower”-style workstations or rackmount systems with low internal airflow.

An illustration of an ISA-6480-40F-20-AB-1 card, equipped with active heatsink, is shown below in Figure 1. A card equipped with a passive heatsink has a solid top-plate cover, since a cutout is not required for the fan.

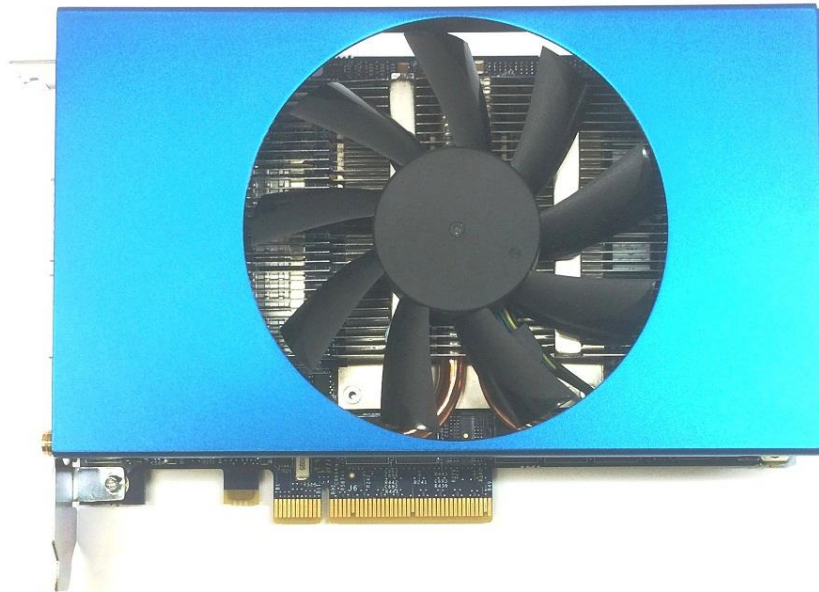


Figure 1 Agilio LX PCIe SmartNIC, equipped with active heatsink option

Power and Ratings Information:

Agilio LX SmartNICs each use of 3.3V at 0.5A max and 12V at 5A max (65W max). Power is provided through both host system's the PCIe slot and an auxiliary PCIe power cable from the host system. Further information is provided in Section 4.

Environmental rating for all Agilio LX SmartNICs is 5-50°C.

Operating humidity rating for all Agilio LX SmartNICs is 5-85% (non-condensing).

Passive heatsink option only: Minimum required airflow across the card during operation is 400 lfm (2 m/s) linear, or 40 cfm (1.13 m³/minute) by volume, at 50°C.

Warning! The cooling fan on an Agilio LX SmartNIC equipped with an active heatsink is not guarded. Please disconnect power to your host system while installing or removing a SmartNIC, and exercise extreme caution if removing your host system cover for any reason while an installed SmartNIC is energized. Keep away from moving fan blades! Please ensure that no cables or other objects can come into contact with the rotating fan blade during operation.

Caution! Agilio LX SmartNICs are available with active heatsink (with fan) and passive heatsink (no fan) options. A card equipped with a passive heatsink must be installed in a system with its own active cooling system, providing at least the rated amount of directed airflow across the card during operation. Otherwise, the card may not function correctly, or even be damaged. Consult your system specifications as to whether sufficient cooling is provided by the system to permit the use of a card equipped with passive heatsink. If in doubt, use an ISA-6480 series card with an active heatsink installed.

Caution! Agilio LX SmartNICs are supplied with a supplementary vented "blank" faceplate, in addition to the faceplate that is attached to the card assembly and shown in the following subsections. This vented "blank" must be installed at the card outlet in the PCIe slot location occupied by the card heatsink to ensure satisfactory airflow across the card heatsink and out of the chassis.

Caution! Agilio LX SmartNICs that are mounted with the heatsink face-down, adjacent to other heat-generating components, and/or with obstructed air flow paths may require system-applied airflow that is greater than the minimum rating. Netronome is not responsible for SmartNICs that fail due to insufficient system cooling.

Self-monitoring and self-limiting capabilities of the SmartNIC's operating temperature and power consumption are described in Section 5.

2.1 ISA-6480-40F-20-AA-x, 2x40G

ISA-6480-40F-20-AA-x cards have two 40Gbps QSFP interface ports.

An illustration of the ISA-6480-40F-20-AA-x faceplate with port and indicator locations is shown below in Figure 2. Please refer to Section 5 for further information regarding the configuration of these ports and indicators.

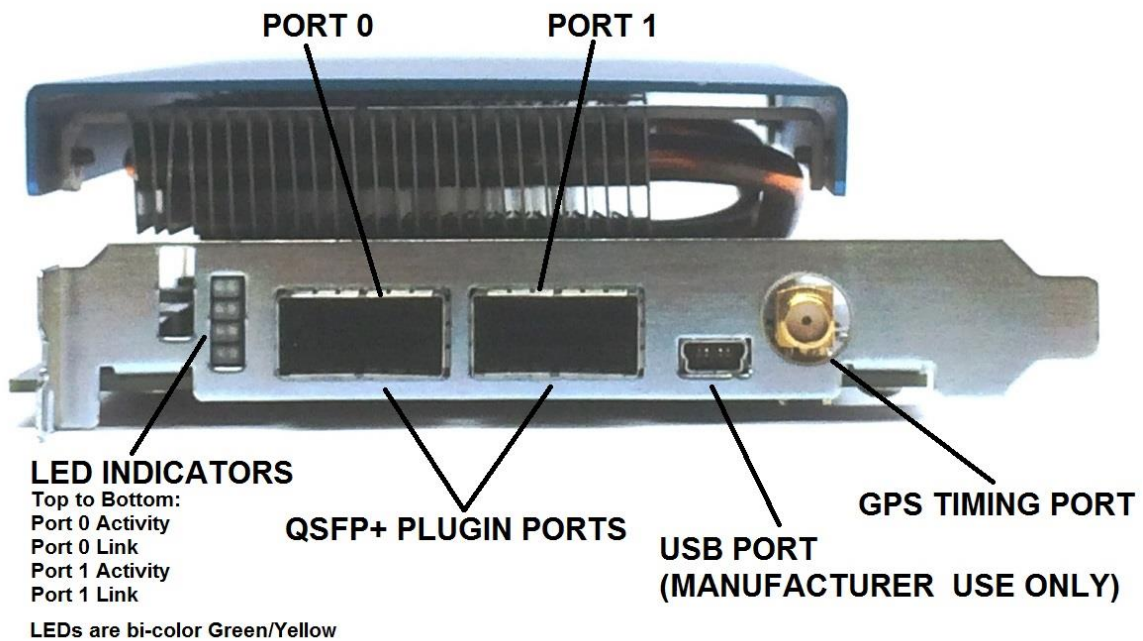


Figure 2 2x40G Agilio LX SmartNIC faceplate illustration

2.2 ISA-6480-100CXP-10-AA-x, 1x100G

ISA-6480-100CXP-10-AA-x cards have one 100Gbps CXP interface port.

An illustration of the ISA-6480-100CXP-10-AA-x faceplate is shown below in Figure 3. Please refer to Section 5 for further information regarding the configuration of these ports and indicators.

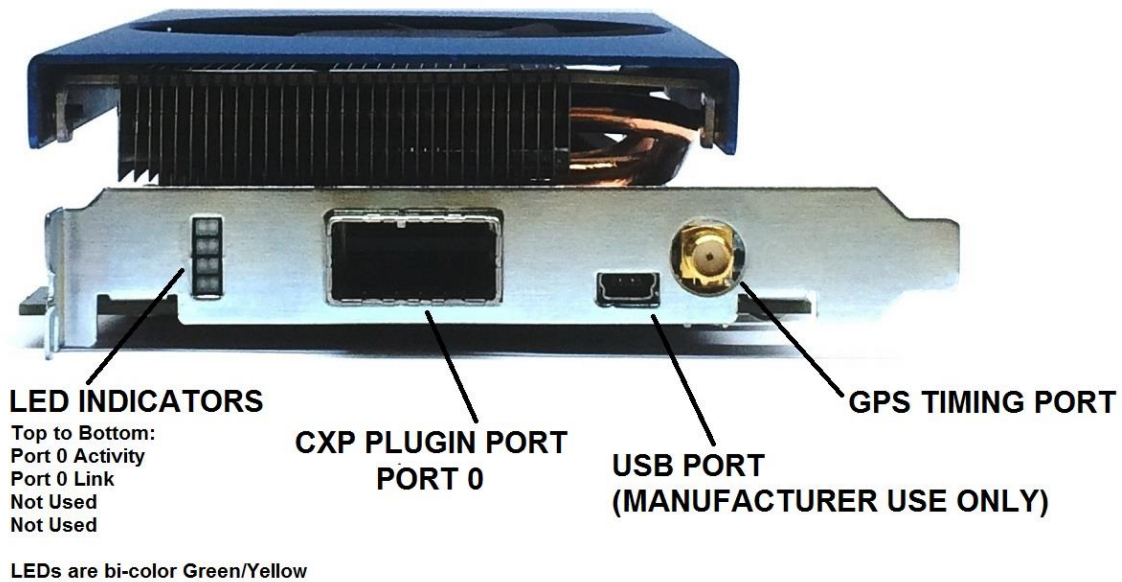


Figure 3 1x100G Agilio LX SmartNIC faceplate illustration

3 PCIe Adapter Cards

SmartNIC PCIe adapter cards are used to provide an additional PCIe link(s) to that of the SmartNIC's edge connector, and to link equipment together using PCIe over non-backplane connections.

3.1 ISA-PCIE-CBL-ADPT

The ISA-PCIE-CBL-ADPT Agilio LX PCIe Adapter card provides a supplementary PCIe interface into an Agilio LX SmartNIC over Netronome-supplied PCIE1 copper cables. This gives the Agilio LX SmartNIC two PCIe gen. 3, x8 interfaces, which doubles the card's throughput to and from the host CPU.

The Agilio LX PCIe adapter card can be used in systems that support a half-length, or longer, x8 PCIe 3.0 ("PCIe gen 3") card. This card is a half-height, half-length card, and occupies a single PCIe slot.

The ISA-PCIE-CBL-ADPT card can only be used in conjunction with an Agilio LX SmartNIC, and has no standalone function. One Agilio LX PCIe adapter card may be connected to one ISA-6480 series card only.

Caution! While the PCIE1 cables used to connect the Agilio LX SmartNIC and ISA-PCIE-CBL-ADPT card together use the same connector style as the OCulink cable specification, PCIE1 cables are not pin-compatible with the OCulink specification. Only Netronome-supplied PCIE1 cables may be used for this interface! Please contact Netronome support as described in Section 6 if you need further information about these PCIE1 cables, or if you need to order more. Two PCIE1 cables are provided with each ISA-PCIE-CBL-ADPT card.

Power and Ratings Information:

The Agilio LX PCIe Adapter card is powered from the host system's PCIe slot only, and uses less than 10W of power.

Environmental, operating humidity and airflow requirements for an ISA-PCIE-CBL-ADPT card may be considered the same as for the Agilio LX network processor card that it is installed with. (See Section 2).

4 Installation

Agilio LX SmartNICs are based on the Netronome 6480 Network Flow Processor. These cards are PCIe compatible, and can be used in systems that support a half-length, Full-Height, x8 PCIe 3.0 (“PCIe gen 3”) card.

Transceiver plug-in modules are not currently supplied with the SmartNIC. A user may use their own transceiver modules, provided they are sufficiently compatible. Contact Netronome, as described in Section 6, if you require any assistance in determining whether your host system and/or transceiver modules are compatible with the ISA platform. Lists of platform chipsets, operating systems and transceiver modules with which the ISA platform has been tested are available upon request.

Caution! A suitable host system must support SR-IOV Virtualization, and have that enabled in the system BIOS.

Caution! When handling Agilio LX SmartNICs, please take care to only touch the outer edges of the hardware and not any of the components!

Caution! The exact steps required for installation will vary depending on the intended host system. Please familiarize yourself with the installation required for PCIe add-in card installation in your target system’s documentation before attempting the installation of an Agilio LX card. Power should be disconnected from the system until installation is complete, and ESD mitigation precautions should be employed throughout.

Caution! Please ensure the necessary slots/bays are unoccupied in the target system before attempting to install the Agilio LX card(s) into the desired slot. Cover-plates may need to be removed from the installation slots/bays prior to installation. While an Agilio LX SmartNIC plugs into a single PCIe edge connector, it physically occupies the space allocated to two PCIe slots (“dual-width”). An ISA PCIe Adapter card physically occupies a single PCIe slot.

Caution! Regardless of whether the card comes equipped with an active or a passive heatsink, unimpeded airflow should be maintained around and across the card at all times. Please ensure no other components or cables obstruct the card outlet vent or card fan (if equipped), that the supplied vented “blank” faceplate is installed at the card outlet location, and that the host system is properly re-sealed after installation.

Caution! A 6-pin PCIe-specification power cable/harness is required to connect the 2x3 power connector on an ISA-6480 series network processor card to a 2x3 PCIe-specification power connector within the host system. Please consult the host system’s documentation for how this connection may be implemented, as the availability and location of both harnesses and connection points varies among different systems. Agilio LX SmartNICs will not function without this power cable connection! See Figure 4 and

Figure 5 below for the location of the 2x3 PCIe power connector on these cards, and the PCIe power connector pinout.

Please note that a 6-pin PCIe power cable has a different pinout to a 6-pin “CPU” power cable that may be available in some systems, and a “CPU” pinout power cable is not compatible for this power connection.

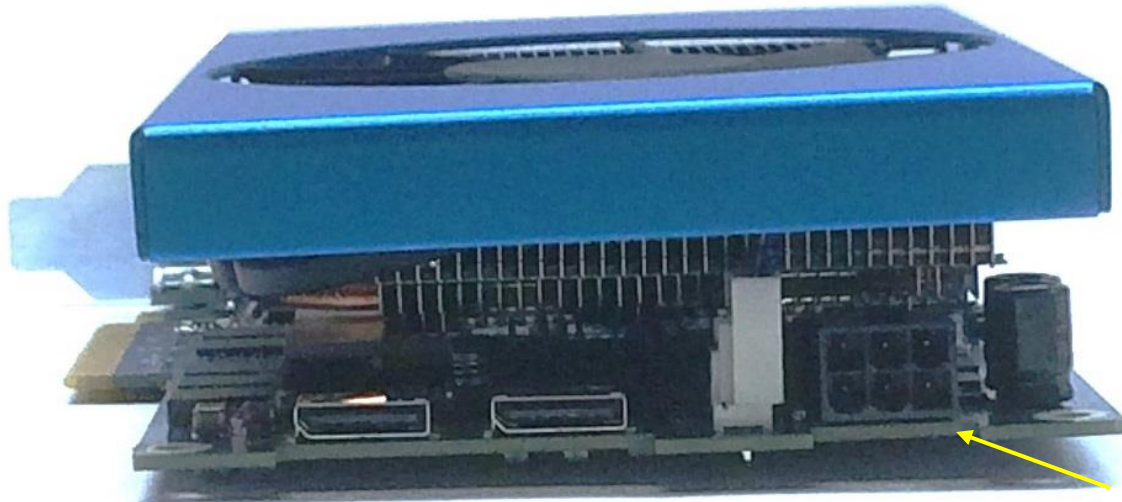


Figure 4 Location of 2x3 6-pin PCIe power connector on Agilio LX SmartNICs



Pin	Signal
1	+12V
2	+12V
3	+12V
4	Ground
5	Ground (Sense)
6	Ground

Figure 5 2x3 6-pin PCIe power connector pinout

4.1 ISA-PCIE-CBL-ADPT Connections

Caution! If installing an ISA PCIe Adapter card with an Agilio LX SmartNIC, both PCIE1 copper cables must be connected between the ISA PCIe Adapter card and the SmartNIC that it supports for correct functionality. The PCIE1 connector pair adjacent to the faceplate on each card are used for these connections. The cables must mate between corresponding connectors on each card without crossing. These connections are illustrated in Figure 6 below.

As long as the PCIE1 cables used can mate successfully and the minimum PCIe slot requirements described are met for each card, these cards do not have to be in the specific arrangement or orientations shown in the illustration.

Caution! Care must be taken to ensure that the PCIE1 cables are not interfered with by other system components or the system covers. Similarly, the PCIE1 cables should be routed such that they do not inhibit system cooling flow or the ability to properly reattach the system covers.

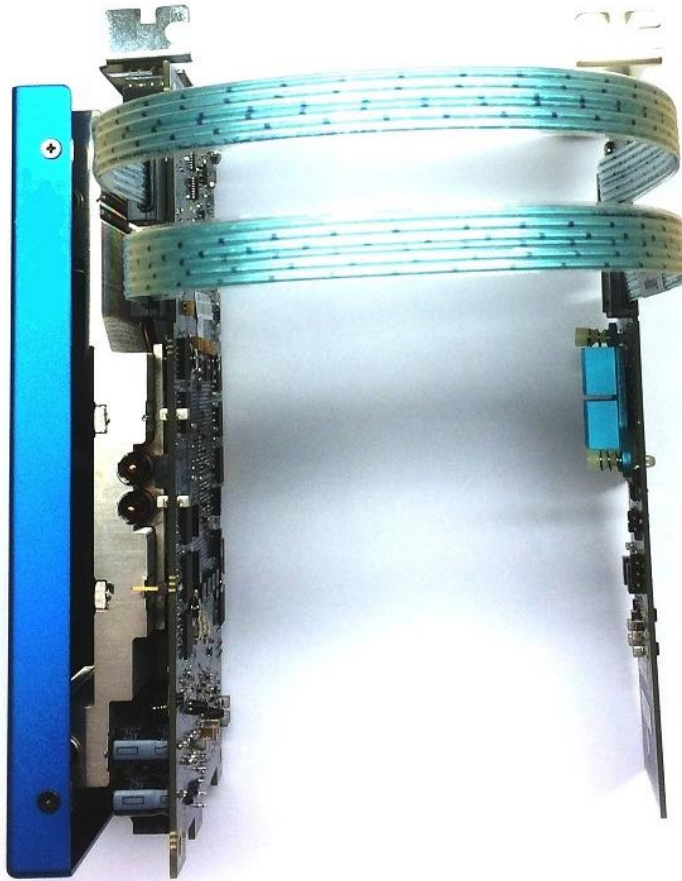


Figure 6 Correct OCulink cable connections between an Agilio LX SmartNIC (Left) and an Agilio LX PCIe Adapter card (Right)

5 Configuration

Typically a Netronome-provided driver is required for accessing the SmartNIC's Network Flow Processor (NFP) and to serve as an endpoint for the packet datapath. The standard driver for SmartNICs is kernel module `nfp.ko`. This driver may be found:

- In-tree (as of Linux Kernel Version 4.11)
- On the Netronome `nfp-driv-kmods` page on GitHub
- In the Netronome DKMS package, available from Netronome

Note that the in-tree version disables `nfp_dev_cpp`, one of the ways to access the SmartNIC. In this mode, the SmartNIC can be used only with the standard network management tools like `ifconfig` and `ethtool`. Temperature monitoring information can be obtained using the `sensors` command from the `lm-sensors` package.

Both the GitHub- and Netronome-provided packages enable `nfp_dev_cpp` access by default. Please see `modinfo nfp` for a list of options. With `nfp_dev_cpp` enabled, tools and libraries from the `nfp-bsp-6000-b0` package provided with your application software can be used. Temperature monitoring can be performed as described later in Section 5.1.

The following system tools are generally very useful:

- `lspci -vvv -d 19ee:` to confirm PCIe configuration of SmartNIC(s)
- `dmesg | grep nfp` to check for system-generated messages the SmartNIC
- `ethtool` for basic SmartNIC management

Netronome SmartNIC applications have been integrated into several popular distributions like RHEL 7.6 and Ubuntu 18.04. Please refer to CoreNIC user manual or OVS-TC user manual for more information.

For advanced application guidance, please refer to the following, all available from Netronome, for installing and using platform software:

- For Agilio OvS-based applications
 - Agilio OvS Getting Started Guide
 - Agilio OvS User's Guide
- For custom applications
 - Netronome Software Development Kit and Programmer's studio (SDK)
 - NFP BSP Release Notes

It is critical to use Optics or Direct Attach Cables that have been tested and certified by **Netronome** to work with **Netronome** Agilio CX SmartNICs. A list of certified Optics and Direct Attach cables can be found on our website at the following URL:

<https://www.netronome.com/products/cable-matrix/>

Contact Netronome Systems, as described in Section 6, if you require any assistance with obtaining or using any of the resources described in this section.

5.1 Integrated Temperature Monitoring

Agilio LX SmartNICs have a feature whereby the SmartNIC monitors its thermal condition and takes action if needed. Up to two forms of action may be taken, depending on the operating condition:

1. If the SmartNIC is approaching its critical operating temperature, it will automatically start recording thermal events once it senses that an internal junction temperature of 95°C has been reached. This recording will stop this once this temperature returns below 95°C.
2. If the SmartNIC reaches or exceeds its critical internal operating temperature of 103°C, the SmartNIC will initiate some internal self-mitigating actions. This will result in degraded performance and undefined behavior. The most likely symptom is the loss of traffic and access to the NIC from PCIe. In this situation, the user is advised to shut down the host system and address the cause of the thermal condition before normal operation can resume.

The integrated temperature monitoring and self-mitigation is independent of the user's platform application software. It is strongly recommended that, however the user is operating the card, the operating temperature is periodically checked using either `lm-sensors` or `nfp_cpp_dev` enabled tools, with system-level actions taken accordingly to ensure the SmartNIC stays well below its critical operating temperature. Examining the temperatures logged in step 1 above does require `nfp_cpp_dev` support to be enabled in order to run `nfp-temp --displaylog`.

6 Technical Support

To obtain additional information, or to provide feedback, please email help@netronome.com, visit Netronome's SmartNIC support site at <https://help.netronome.com>, or contact your nearest **Netronome Systems, Inc.** technical support representative.