Solarflare® Server Adapter User Guide

Information in this document is subject to change without notice.

SF-103837-CD

Last revised: December 2013

Issue 10

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Chapter 1: Introduction

This is the User Guide for Solarflare® Server Adapters. This chapter covers the following topics:

NOTE: Throughout this guide the term Onload refers to both OpenOnload® and EnterpriseOnload® unless otherwise stated. Users of Onload should refer to the **Onload User Guide**, SF-104474-CD, which describes procedures for download and installation of the Onload distribution, accelerating and tuning the application using Onload to achieve minimum latency and maximum throughput.

1.1 Virtual NIC Interface

Solarflare's VNIC architecture provides the key to efficient server I/O and is flexible enough to be applied to multiple server deployment scenarios. These deployment scenarios include:

- **Kernel Driver** – This deployment uses an instance of a VNIC per CPU core for standard operating system drivers. This allows network processing to continue over multiple CPU cores in parallel. The virtual interface provides a performance-optimized path for the kernel TCP/IP stack and contention-free access from the driver, resulting in extremely low latency and reduced CPU utilization.

- **Accelerated Virtual I/O** – The second deployment scenario greatly improves I/O for virtualized platforms. The VNIC architecture can provide a VNIC per Virtual Machine, giving over a thousand protected interfaces to the host system, granting any virtualized (guest) operating system direct access to the network hardware. Solarflare's hybrid SR-IOV technology, unique to Solarflare Ethernet controllers, is the only way to provide bare-metal I/O performance to virtualized guest operating systems whilst retaining the ability to live migrate virtual machines.

- **OpenOnload™** – The third deployment scenario aims to leverage the host CPU(s) to full capacity, minimizing software overheads by using a VNIC per application to provide a kernel bypass solution. Solarflare has created both an open-source and Enterprise class high-performance application accelerator that delivers lower and more predictable latency and higher message rates for TCP and UDP-based applications, all with no need to modify applications or change the network infrastructure. To learn more about the open source

OpenOnload project or EnterpriseOnload, download the Onload user guide (SF-104474-CD) or contact your reseller.

Advanced Features and Benefits

Virtual NIC support	The core of Solarflare technology. Protected VNIC interfaces can be instantiated for each running guest operating system or application, giving it a direct pipeline to the Ethernet network. This architecture provides the most efficient way to maximize network and CPU efficiency. The Solarflare Ethernet controller supports up to 1024 vNIC interfaces per port. On IBM System p servers equipped with Solarflare adapters, each adapter is assigned to a single Logical Partition (LPAR) where all VNICS are available to the LPAR.
PCI Express	Implements PCI Express 3.0.
High Performance	Support for 40G Ethernet interfaces and a new internal datapath micro architecture.
Hardware Switch Fabric	Full hardware switch fabric in silicon capable of steering any flow based on Layer 2, Layer 3 or application level protocols between physical and virtual interfaces. Supporting an open software defined network control plane with full PCI-IOV virtualization acceleration for high performance guest operating systems and virtual applications.
Improved flow processing	The addition of dedicated parsing, filtering, traffic shaping and flow steering engines which are capable of operating flexibly and with an optimal combination of a full hardware data plane with software based control plane.
TX PIO	Transmit Programmed input/output is the direct transfer of data to the adapter without CPU involvement. As an alternative to the usual bus master DMA method, TX PIO improves latency and is especially useful for smaller packets.
Multicast Replication	Received multicast packets are replicated in hardware and delivered to multiple receive queues.
Sideband management	NCSI RMII interface for base board management integration. SMBus interface for legacy base board management integration.

PCI Single-Root-IOV, SR-IOV, capable	127 Virtual functions per port. Flexible deployment of 1024 channels between Virtual and Physical Functions. Support Alternate Routing ID (ARI). SR-IOV is not supported for Solarflare adapters on IBM System p servers.
10-gigabit Ethernet	Supports the ability to design a cost effective, high performance 10 Gigabit Ethernet solution.
Receive Side Scaling (RSS)	IPv4 and IPv6 RSS raises the utilization levels of multi-core servers dramatically by distributing I/O load across all CPUs and cores.
Stateless offloads	Through the addition of hardware based TCP segmentation and reassembly offloads, VLAN, VxLAN and FCOE offloads.
Transmit rate pacing (per queue)	Provides a mechanism for enforcing bandwidth quotas across all guest operating systems. Software re-programmable on the fly to allow for adjustment as congestion increases on the network.
Jumbo frame support	Support for up to 9216 byte jumbo frames.
MSI-X support	1024 MSI-X interrupt support enables higher levels of performance. Can also work with MSI or legacy line based interrupts.
Ultra low latency	Cut through architecture. < 7µs end to end latency with standard kernel drivers, < 3µs with Onload drivers.
Remote boot	Support for PXE boot 2.1 and iSCSI Boot provides flexibility in cluster design and diskless servers (see Solarflare Boot ROM Agent on page 360). Network boot is not supported for Solarflare adapters on IBM System p servers.
MAC address filtering	Enables the hardware to steer packets based on the MAC address to a VNIC.
Hardware timestamps	The Solarflare Flareon™ SFN7000 series adapters can support hardware timestamping for all received network packets - including PTP. The SFN5322F and SFN6322F adapters can generate hardware timestamps of PTP packets.

1.2 Product Specifications

Solarflare Flareon™ Network Adapters

Solarflare Flareon™ Ultra SFN7322F Dual-Port 10GbE PCIe 3.0 Server I/O Adapter

Part number	SFN7322F
Controller silicon	SFC9120
Power	5.9W typical
PCI Express	8 lanes Gen 3 (8.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes (factory enabled)
PTP and hardware timestamps	Yes (factory enabled)
1PPS	Optional bracket and cable assembly - not factory installed.
SR-IOV	Yes
Network ports	2 x SFP+ (10G/1G)

Solarflare Flareon™ Ultra SFN7122F Dual-Port 10GbE PCIe 3.0 Server I/O Adapter

Part number	SFN7122F
Controller silicon	SFC9120
Power	5.9W typical
PCI Express	8 lanes Gen 3 (8.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes (factory enabled)
PTP and hardware timestamps	AppFlex™ license required
1PPS	Optional bracket and cable assembly - not factory installed.
SR-IOV	Yes
Network ports	2 x SFP+ (10G/1G)

Solarflare Flareon™ SFN7022F Dual-Port 10GbE PCIe 3.0 Server I/O Adapter

Part number	SFN7022F
Controller silicon	SFC9120
Power	5.9W typical
PCI Express	8 lanes Gen 3 (8.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	AppFlex™ license required
PTP and hardware timestamps	AppFlex™ license required
1PPS	Optional bracket and cable assembly - not factory installed.
SR-IOV	Yes
Network ports	2 x SFP+ (10G/1G)

Solarflare Onload Network Adapters

Solarflare SFN5121T Dual-Port 10GBASE-T Server Adapter

Part number	SFN5121T
Controller silicon	SFL9021
Power	12.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes
Network ports	2 x 10GBASE-T (10G/1G/100M)

Solarflare SFN5122F Dual-Port 10G SFP+ Server Adapter

Part number	SFN5122F
Controller silicon	SFC9020
Power	4.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes
Network ports	2 x SFP+ (10G/1G)

Solarflare SFN4112F Single-Port SFP+ Server Adapter

Part number	SFN4112F
Controller silicon	SFC4000
Power	< 4.5W typical, <5.2W max (with direct attach module) < 5.3W typical, <6.1W max (with 10GBASE-SR SFP+ module)
PCI Express	8 lanes Gen1 (2.5GT/s)
Virtual NIC support	1024 vNIC interfaces
Supports OpenOnload	Yes

SR-IOV	No
Network ports	1 x SFP+ (10G)

Solarflare SFN5322F Dual-Port 10GbE Precision Time Stamping Server Adapter

Part number	SFN5322F
Controller silicon	SFC9020
Power	4.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes
Network ports	2 x SFP+ (10G/1G)

Solarflare SFN6122F Dual-Port 10GbE SFP+ Server Adapter

Part number	SFN6122F
Controller silicon	SFC9020
Power	5.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes[1]
Network ports	2 x SFP+ (10G/1G)
Regulatory Product Code	S6102

1. SR-IOV is not supported for Solarflare adapters on IBM System p servers.

Solarflare SFN6322F Dual-Port 10GbE SFP+ Server Adapter

Part number	SFN6122F
Controller silicon	SFC9020
Power	5.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes
Network ports	2 x SFP+ (10G/1G)

Solarflare SFA6902F Dual-Port 10GbE SFP+ ApplicationOnload™ Engine

Part number	SFA6902F
Controller silicon	SFC9020
Power	25W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes
Network ports	2 x SFP+ (10G/1G)

Solarflare Performant Network Adapters

Solarflare SFN5161T Dual-Port 10GBASE-T Server Adapter

Part number	SFN5161T
Controller silicon	SFL9021
Power	12.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s)
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	No
SR-IOV	Yes
Network ports	2 x 10GBASE-T (10G/1G/100M)

Solarflare SFN5151T Single-Port 10GBASE-T Server Adapter

Part number	SFN5151T
Controller silicon	SFL9021
Power	7.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s)
Virtual NIC support	1024 vNIC interfaces
Supports OpenOnload	No
SR-IOV	Yes
Network ports	1 x 10GBASE-T (10G/1G/100M)

Solarflare SFN5162F Dual-Port 10G SFP+ Server Adapter

Part number	SFN5162F
Controller silicon	SFC9020
Power	4.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s)
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	No
SR-IOV	Yes[1]

Network ports	2 x SFP+ (10G/1G)

Solarflare SFN5152F Single-Port 10G SFP+ Server Adapter

Part number	SFN5152F
Controller silicon	SFC9020
Power	4.0W typical
PCI Express	8 lanes Gen2 (5.0GT/s)
Virtual NIC support	1024 vNIC interfaces
Supports OpenOnload	No
SR-IOV	Yes
Network ports	1 x SFP+ (10G/1G)

1. SR-IOV is not supported for Solarflare adapters on IBM System p servers.

Solarflare Mezzanine Adapters

Solarflare SFN5812H Dual-Port 10G Ethernet Mezzanine Adapter

Part number	SFN5812H
Controller silicon	SFC9020
Power	3.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes
Ports	2 x 10GBASE-KX4 backplane transmission

Solarflare SFN5814H Quad-Port 10G Ethernet Mezzanine Adapter

Part number	SFN5814H
Controller silicon	2 x SFC9020
Power	7.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes
Ports	4 x 10GBASE-KX4 backplane transmission

Solarflare SFN5802K Dual-Port 10G Ethernet Mezzanine Adapter

Part number	SFN5802K
Controller silicon	SFC9020
Power	7.8W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes

Ports	2 x 10GBASE-KR backplane transmission

Solarflare SFN6832F Dual-Port 10GbE SFP+ Mezzanine Adapter

Part number	SFN6832F-C61 for DELL PowerEdge C6100 series SFN6832F-C62 for DELL PowerEdge C6200 series
Controller silicon	SFC9020
Power	5.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes
Ports	2 x SFP+ (10G/1G)
Regulatory Product Code	S6930

Solarflare SFN6822F Dual-Port 10GbE SFP+ FlexibleLOM Onload Server Adapter

Part number	SFN6822F
Controller silicon	SFC9020
Power	5.9W typical
PCI Express	8 lanes Gen2 (5.0GT/s), 127 SR-IOV virtual functions per port
Virtual NIC support	1024 vNIC interfaces per port
Supports OpenOnload	Yes
SR-IOV	Yes
Ports	2 x SFP+ (10G/1G)

1.3 Software Driver Support

- Windows® Server 2003 (32 bit and 64 bit).
- Windows® Server 2008 (32 bit and 64 bit) - including R2 release.
- Windows® Server 2012.
- Windows® 7 (32 bit and 64 bit).
- Windows® XP (32 bit and 64 bit).
- Microsoft® Hyper-V™ Server 2008 R2.
- Linux® 2.6 and 3.x Kernels (32 bit and 64 bit) for the following distributions: RHEL 5, 6 and MRG. SLES 10, 11 and SLERT.
- VMware® ESX™ 5.0 and ESXi™ 5.1, vSphere™ 4.0 and vSphere™ 4.1.
- Citrix XenServer™ 5.6, 6.0 and Direct Guest Access.
- Linux® KVM.
- Solaris™ 10 updates 8, 9 and 10 and Solaris™ 11 (GLDv3).
- Mac OS X Snow Leopard 10.6.8 (32 bit and 64 bit), OS X Lion 10.7.0 and later releases, OS X Mountain Lion 10.8.0 and later, OS X Mavericks 10.9.

Solarflare SFN5162F and SFN6122F adapters are supported on the IBM POWER architecture (PPC64) running RHEL 6.4 on IBM System p servers.

Drivers supporting the SFN7000 series adapters are currently only available for Linux platforms.

The Solarflare accelerated network middleware, OpenOnload and EnterpriseOnload, is supported on all Linux variants listed above, and is available for all Solarflare Onload network adapters. Solarflare are not aware of any issues preventing OpenOnload installation on other Linux variants such as Ubuntu, Gentoo, Fedora and Debian variants.

1.4 Solarflare AppFlex™ Technology Licensing.

Solarflare AppFlex technology allows Solarflare server adapters to be selectively configured to enable on-board applications. AppFlex licenses are required to enable selected functionality on the Solarflare Flareon™ adapters and the AOE ApplicationOnload™ Engine.

Customers can obtain access to AppFlex applications via their Solarflare sales channel by obtaining the corresponding AppFlex authorization code. The authorization code allows the customer to generate licenses at the MyAppFlex page at https://support.solarflare.com/myappflex.

The sfkey utility application is used to install the generated license key file on selected adapters. For detailed instructions for sfkey and license installation refer to License Install with sfkey on page 75.

1.5 Open Source Licenses

1.4.1 Solarflare Boot Manager

The Solarflare Boot Manager is installed in the adapter's flash memory. This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

The latest source code for the Solarflare Boot Manager can be download from https://support.solarflare.com/. If you require an earlier version of the source code, please e-mail support@solarflare.com.

1.4.2 Controller Firmware

The firmware running on the SFC9xxx controller includes a modified version of libcoroutine. This software is free software published under a BSD license reproduced below:

Copyright (c) 2002, 2003 Steve Dekorte

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1.6 Support and Download

Solarflare network drivers, RPM packages and documentation are available for download from https://support.solarflare.com/.

Software and documentation for OpenOnload is available from www.openonload.org.

1.7 Regulatory Information

Warnings

Do not install the Solarflare network adapter in hazardous areas where highly combustible or explosive products are stored or used without taking additional safety precautions. Do not expose the Solarflare network adapter to rain or moisture.

The Solarflare network adapter is a Class III SELV product intended only to be powered by a certified limited power source.

The equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. The equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If the equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by Solarflare Communications, the party responsible for FCC compliance, could void the user's authority to operate the equipment.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

Underwriters Laboratory Inc ('UL') has not tested the performance or reliability of the security or signaling aspects of this product. UL has only tested for fire, shock or casualty hazards as outlined in the UL's Standard for Safety UL 60950-1. **UL Certification does not cover the performance or reliability of the security or signaling aspects of this product. UL makes no representations, warranties or certifications whatsoever regarding the performance or reliability of any security or signaling related functions of this product.**

Laser Devices

The laser safety of the equipment has been verified using the following certified laser device module (LDM):

Manufactuer	Model	CDRH Accession No	Mark of conformity	File No
Avago Technologies	AFBR-703SDZ	9720151-072	TUV	R72071411
Finisar Corporation	FTLX8571D3BCL	9210176-094	TUV	R72080250

When installed in a 10Gb ETHERNET NETWORK INTERFACE CARD FROM THE Solarflare SFN5000, SFN6000 or SFN7000 SERIES, the laser emission levels remain under Class I limits as specified in the FDA regulations for lasers, 21 CFR Part 1040.

The decision on what LDMs to use is made by the installer. For example, equipment may use one of a multiple of different LDMs depending on path length of the laser communication signal. This equipment is not basic consumer ITE.

The equipment is installed and maintained by qualified staff from the end user communications company or subcontractor of the end user organization. The end product user and/or installer are solely responsible for ensuring that the correct devices are utilized in the equipment and the equipment with LDMs installed complies with applicable laser safety requirements.

1.8 Regulatory Approval

The information in this section is applicable to SFN5121T, SFN5151T, SFN5161T, SFN5152F and SFN5162F Solarflare network adapters:

Category	Specification	Details
EMC	Europe	BS EN 55022:2006
		BS EN 55024:1998 +A1:2001 +A2:2003
	US	FCC Part 15 Class B
	Canada	ICES 003/NMB-003 Class B
Safety[1]	Europe	BS EN 60950-1:2006 +A11:2009
	US	UL 60950-1 2nd Ed.
	Canada	CSA C22.2 60950-1-07 2nd Ed.
	CB	IEC 60950-1:2005 2nd Ed.
RoHS	Europe	Complies with EU directive 2002/95/EC

1. The safety assessment has been concluded on this product as a component/sub-assembly only.

Additional Regulatory Information for SFN5122F, SFN5322F, SFN6122F, SFN6322F , SFA6902F, SFN7022F,SFN7122F and SFN7322F adapters.

これは情報処理装置等電波障害自主規制協議会（VCCI）の標準に基づくクラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。そのような障害が発生した際、使用者は適切な対応が必要となる場合があります

警告使用者：

這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻 干擾，在這種情況下，使用者會被要求採取某些適當的對策

A 급 기기 (업무용 방송통신기기): 이 기기는 업무용 (A 급) 으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며 , 가정외의 지역에서 사용하는 것을 목적으로 합니다

Category	Specification	Details
EMC	Europe	BS EN 55022:2010 + A1:2007
		BS EN 55024:1998 +A1:2001 +A2:2003
	US	FCC Part 15 Class B
	Canada	ICES 003/NMB-003 Class B
	Taiwan	CNS 13438:2006 Class B
	Japan	VCCI Regulations V-3:2010 Class B
	South Korea	KCC KN-22, KN-24
	Australia	AS/NZS CISPR 22:2009
Safety[1]	Europe	BS EN 60950-1:2006 +A11:2009
	US	UL 60950-1 2nd Ed.
	Canada	CSA C22.2 60950-1-07 2nd Ed.
	CB	IEC 60950-1:2005 2nd Ed.
RoHS	Europe	Complies with EU directive 2011/65/EU

1. The safety assessment has been concluded on this product as a component/sub-assembly only.

Additional Regulatory Information for SFN5812H, SFN5814H SFN5802K and SFN6832F adapters.

これは情報処理装置等電波障害自主規制協議会（VCCI）の標準に基づくクラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。そのような障害が発生した際、使用者は適切な対応が必要となる場合があります

警告使用者：

這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻 干擾，在這種情況下，使用者會被要求採取某些適當的對策

Category	Specification	Details
EMC	Europe	BS EN 55022:2006
		BS EN 55024:1998 +A1:2001 +A2:2003
	US	FCC Part 15 Class B
	Canada	ICES 003/NMB-003 Class B
	Taiwan	CNS 13438:2006 Class A
	Japan	VCCI Regulations V-3:2010 Class A
	Australia	AS/NZS CISPR 22:2009
Safety[1]	Europe	BS EN 60950-1:2006 +A11:2009
	US	UL 60950-1 2nd Ed.
	Canada	CSA C22.2 60950-1-07 2nd Ed.
	CB	IEC 60950-1:2005 2nd Ed.
RoHS	Europe	Complies with EU directive 2002/95/EC

1. The safety assessment has been concluded on this product as a component/sub-assembly only.

Chapter 2: Installation

This chapter covers the following topics:

CAUTION: Servers contain high voltage electrical components. Before removing the server cover, disconnect the mains power supply to avoid the risk of electrocution.

Static electricity can damage computer components. Before handling computer components, discharge static electricity from yourself by touching a metal surface, or wear a correctly fitted anti-static wrist band.

2.1 Solarflare Network Adapter Products

Solarflare Flareon™ adapters

- Solarflare Flareon Ultra SFN7322F Dual-Port 10GbE PCIe 3.0 Server I/O Adapter
- Solarflare Flareon Ultra SFN7122F Dual-Port 10GbE PCIe 3.0 Server I/O Adapter
- Solarflare Flareon SFN7022F Dual-Port 10GbE PCIe 3.0 Server I/O Adapter

Solarflare Onload adapters

- Solarflare SFN6322F Dual-Port 10GbE Precision Time Stamping Server Adapter
- Solarflare SFN6122F Dual-Port 10GbE SFP+ Server Adapter
- Solarflare SFA6902F Dual-Port 10GbE ApplicationOnload™ Engine
- Solarflare SFN5322F Dual-Port 10GbE Precision Time Stamping Server Adapter
- Solarflare SFN5122F Dual-Port 10G SFP+ Server Adapter
- Solarflare SFN5121T Dual-Port 10GBASE-T Server Adapter
- Solarflare SFN4112F Single-Port SFP+ Server Adapter

Solarflare Performant network adapters

- Solarflare SFN5161T Dual-Port 10GBASE-T Server Adapter
- Solarflare SFN5151T Single-Port10GBASE-T Server Adapter
- Solarflare SFN5162F Dual-Port 10G SFP+ Server Adapter
- Solarflare SFN5152F Single-Port 10G SFP+ Server Adapter

Solarflare Mezzanine adapters

- Solarflare SFN5802K Dual-Port 10G Ethernet Mezzanine Adapter for HP BladeSystem c-Class
- Solarflare SFN5812H Dual-Port 10G Ethernet Mezzanine Adapter for IBM BladeCenter
- Solarflare SFN5814H Quad-Port 10G Ethernet Mezzanine Adapter for IBM BladeCenter
- Solarflare SFN6832F-C61 Dual-Port 10GbE SFP+ Mezzanine Adapter for DELL PowerEdge C6100 series servers.
- Solarflare SFN6832F-C62 Dual-Port 10GbE SFP+ Mezzanine Adapter for DELL PowerEdge C6200 series servers.
- Solarflare SFN6822F Dual-Port 10GbE SFP+ FlexibleLOM Onload Server Adapter

Solarflare network adapters can be installed on Intel/AMD x86 based 32 bit or 64 bit servers. The network adapter must be inserted into a PCIe x8 OR PCIe x 16 slot for maximum performance. Refer to PCI Express Lane Configurations on page 241 for details.

Solarflare SFN5162F and SFN6122F adapters are supported on the IBM POWER architecture (PPC64) running RHEL 6.4 on IBM System p servers.

2.2 Fitting a Full Height Bracket (optional)

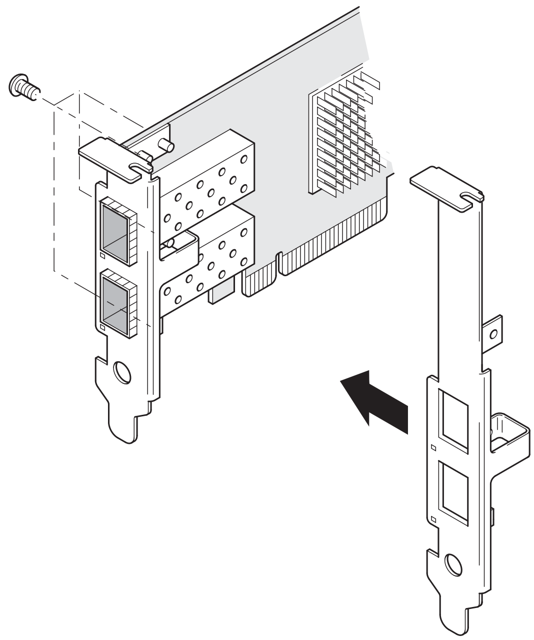
Solarflare adapters are supplied with a low-profile bracket fitted to the adapter. A full height bracket has also been supplied for PCIe slots that require this type of bracket.

To fit a full height bracket to the Solarflare adapter:

1 From the back of the adapter, remove the screws securing the bracket.

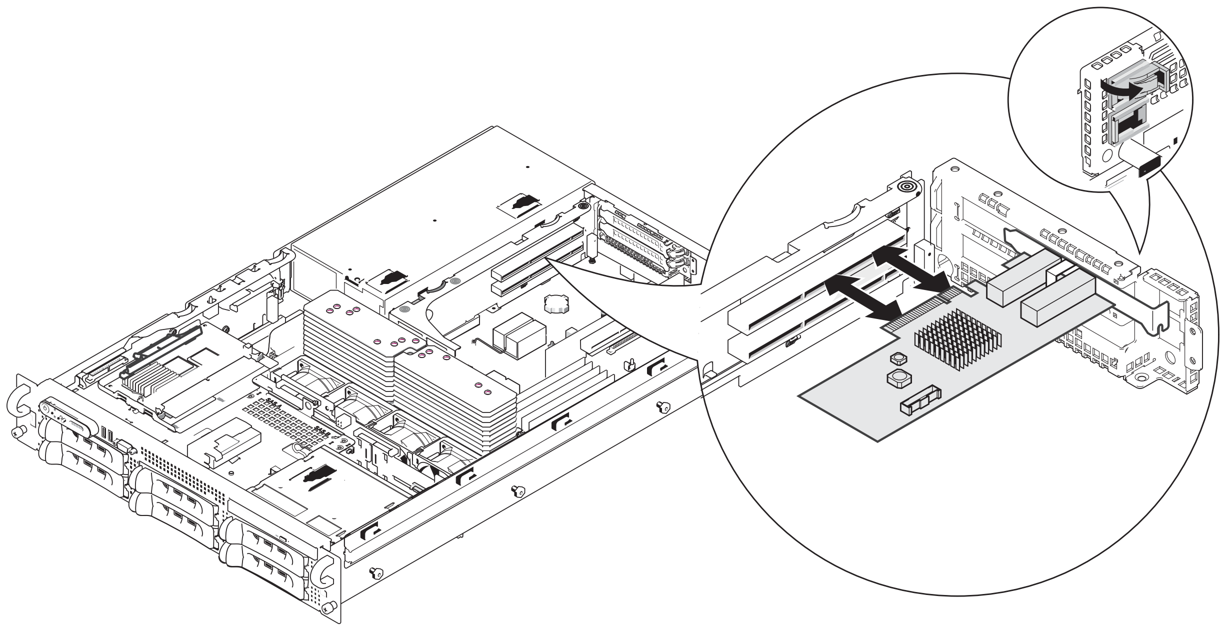
2 Slide the bracket away from the adapter.

3 Taking care not the overtighten the screws, attach the full height bracket to the adapter.



2.3 Inserting the Adapter in a PCI Express (PCIe) Slot

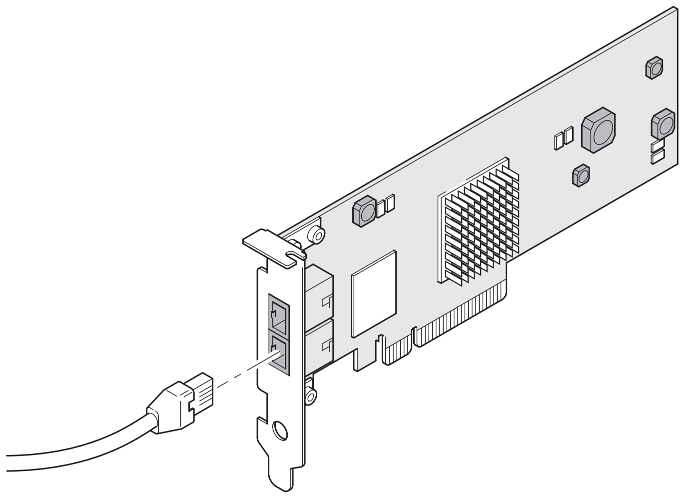
1. Shut down the server and unplug it from the mains. Remove the server cover to access the PCIe slots in the server.
2. Locate an 8-lane or 16-lane PCIe slot (refer to the server manual if necessary) and insert the Solarflare card.
3. Secure the adapter bracket in the slot.
4. Replace the cover and restart the server.



5. After restarting the server, the host operating system may prompt you to install drivers for the new hardware. Click Cancel or abort the installation and refer to the relevant chapter in this manual for how to install the Solarflare adapter drivers for your operating system.

2.4 Attaching a Cable (RJ-45)

The Solarflare SFN5121T 10GBASE-T Server Adapter connects to the Ethernet network using a copper cable fitted with an RJ-45 connector (shown below).



RJ-45 Cable Specifications

Table 1 below lists the recommended cable specifications for various Ethernet port types. Depending on the intended use, attach a suitable cable. For example, to achieve 10 Gb/s performance, use a Category 6 cable. To achieve the desired performance, the adapter must be connected to a compliant link partner, such as an IEEE 802.3an-compliant gigabit switch.

Table 1: RJ-45 Cable Specification

Port type	Connector	Media Type	Maximum Distance
10GBASE-T	RJ-45	Category 6A	100m (328 ft.)
		Category 6 unshielded twisted pairs (UTP)	55m (180 ft.)
		Category 5E	55m (180 ft.)
1000BASE-T	RJ-45	Category 5E, 6, 6A UTP	100m (328 ft.)
100BASE-TX	RJ-45	Category 5E, 6, 6A UTP	100m (328 ft.)

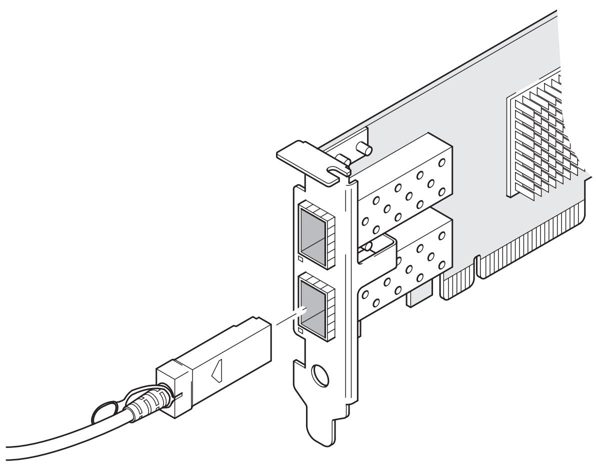
2.5 Attaching a Cable (SFP+)

The Solarflare SFP+ Server Adapters can be connected to the network using either an SFP+ Direct Attach cable or a fiber optic cable.

Attaching the SFP+ Direct Attach Cable:

1 Turn the cable so that the connector retention tab and gold fingers are on the same side as the network adapter retention clip.

Push the cable connector straight in to the adapter socket until it clicks into place.



Removing the SFP+ Direct Attach Cable:

1 Pull straight back on the release ring to release the cable retention tab. Alternatively, you can lift the retention clip on the adapter to free the cable if necessary.

2 Slide the cable free from the adapter socket.

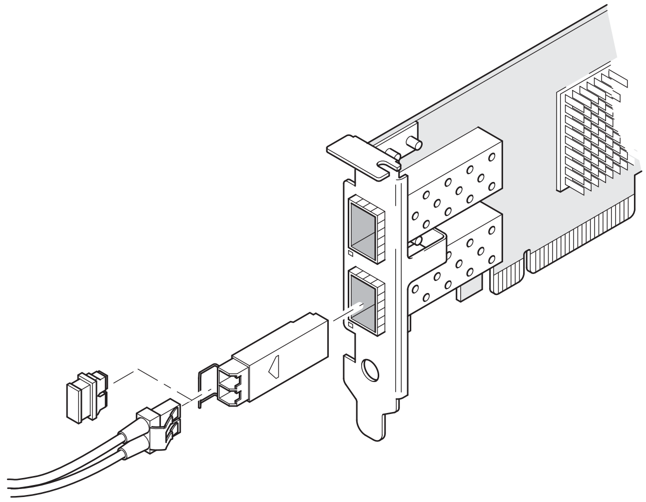
Attaching a fiber optic cable:

	WARNING Do not look directly into the fiber transceiver or cables as the laser beams can damage your eyesight.

1 Remove and save the fiber optic connector cover.

2 Insert a fiber optic cable into the ports on the network adapter bracket as shown. Most connectors and ports are keyed for proper orientation. If the cable you are using is not keyed,

check to be sure the connector is oriented properly (transmit port connected to receive port on the link partner, and vice versa).



Removing a fiber optic cable:

	WARNING Do not look directly into the fiber transceiver or cables as the laser beams can damage your eyesight.

1 Remove the cable from the adapter bracket and replace the fiber optic connector cover.

2 Pull the plastic or wire tab to release the adapter bracket.

3 Hold the main body of the adapter bracket and remove it from the adapter.

2.6 Supported SFP+ Cables

Table 2 is a list of supported SFP+ cables that have been tested by Solarflare. Solarflare is not aware of any issues preventing the use of other brands of SFP+ cables (of up to 5m in length) with Solarflare network adapters. However, only cables in the table below have been fully verified and are therefore supported.

Table 2: Supported SFP+ Direct Attach Cables

Manufacturer	Product Code	Cable Length	Notes
Arista	CAB-SFP-SFP-1M	1m	
Arista	CAB-SFP-SFP-3M	3m	
Cisco	SFP-H10GB-CU1M	1m	
Cisco	SFP-H10GB-CU3M	3m	
Cisco	SFP-H10GB-CU5M	5m	
HP	J9283A/B Procurve	3m	
Juniper	EX-SFP-10GE-DAC-1m	1m	
Juniper	EX-SFP-10GE-DAC-3m	3m	
Molex	74752-1101	1m	Not supported on SFN4112F adapters – due to cable being non-compliant with the SFP+ spec with respect to I2C.
Molex	74752-2301	3m	
Molex	74752-3501	5m	
Molex	74752-9093	1m	37-0960-01 / 0K585N
Molex	74752-9094	3m	37-0961-01 / 0J564N
Molex	74752-9096	5m	37-0962-01 / 0H603N
Panduit	PSF1PXA1M	1m	
Panduit	PSF1PXA3M	3m	
Panduit	PSF1PXD5MBU	5m	
Siemon	SFPP30-01	1m	
Siemon	SFPP30-02	2m	
Siemon	SFPP30-03	3m	
Siemon	SFPP24-05	5m	

Table 2: Supported SFP+ Direct Attach Cables

Manufacturer	Product Code	Cable Length	Notes
Tyco	2032237-2 D	1m	
Tyco	2032237-4	3m	

The Solarflare SFA6902F adapter has been tested and certified with direct attach cables up to 3m in length.

2.7 Supported SFP+ 10G SR Optical Transceivers

Table 3 is a list of supported SFP+10G SR optical transceivers that have been tested by Solarflare. Solarflare is not aware of any issues preventing the use of other brands of 10G SR transceivers with Solarflare network adapters. However, only transceivers in the table below have been fully verified and are therefore supported.

Table 3: Supported SFP+ 10G Optical SR Transceivers

Manufacturer	Product Code	Notes
Avago	AFBR-703SDZ	10G
Avago	AFBR-703SDDZ	Dual speed 1G/10G optic. Not supported on SFN4112F adapters.
Avago	AFBR-703SMZ	10G
Arista	SFP-10G-SR	10G
Finisar	FTLX8571D3BCL	10G
Finisar	FTLX8571D3BCV	Dual speed 1G/10G optic. Not supported on SFN4112F adapters.
HP	456096-001	Also labelled as 455883-B21 and 455885-001
Intel	AFBR-703SDZ	10G
JDSU	PLRXPL-SC-S43-22-N	10G
Juniper	AFBR-700SDZ-JU1	10G
MergeOptics	TRX10GVP2010	10G
Solarflare	SFM-10G-SR	10G

2.8 Supported SFP+ 10G LR Optical Transceivers

Table 4 is a list of supported SFP+10G LR optical transceivers that have been tested by Solarflare. Solarflare is not aware of any issues preventing the use of other brands of 10G LR transceivers with Solarflare network adapters. However, only transceivers in the table below have been fully verified and are therefore supported.

Table 4: Supported SFP+ 10G LR Optical Transceivers

Manufacturer	Product Code	Notes
Avago	AFCT-701SDZ	10G single mode fiber
Finisar	FTLX1471D3BCL	10G single mode fiber

2.9 Supported SFP 1000BASE-T Transceivers

Table 5 is a list of supported SFP 1000BASE-T transceivers that have been tested by Solarflare. Solarflare is not aware of any issues preventing the use of other brands of 1000BASE-T transceivers with the Solarflare network adapters. However, only transceivers in the table below have been fully verified and are therefore supported.

NOTE: 1000BASE-T transceivers are not supported on the SFN4112F SFP+ server network adapter.

Table 5: Supported SFP 1000BASE-T Transceivers

Manufacturer	Product Code
Arista	SFP-1G-BT
Avago	ABCU-5710RZ
Cisco	30-1410-03
Dell	FCMJ-8521-3-(DL)
Finisar	FCLF-8521-3
Finisar	FCMJ-8521-3
HP	453156-001 453154-B21
3COM	3CSFP93

2.10 Supported 1G Optical Transceivers

Table 6 is a list of supported 1G transceivers that have been tested by Solarflare. Solarflare is not aware of any issues preventing the use of other brands of 1G transceivers with Solarflare network adapters. However, only transceivers in the table below have been fully verified and are therefore supported.

NOTE: 1G optical transceivers are not supported on the SFN4112F SFP+ server network adapter.

Table 6: Supported 1G Transceivers

Manufacturer	Product Code	Type
Avago	AFBR-5710PZ	1000Base-SX
Cisco	GLC-LH-SM	1000Base-LX/LH
Finisar	FTLF8519P2BCL	1000Base-SX
Finisar	FTLF8519P3BNL	1000Base-SX
Finisar	FTLF1318P2BCL	1000Base-LX
Finisar	FTLF1318P3BTL	1000Base-LX
HP	453153-001 453151-B21	1000Base-SX

2.11 Supported Speed and Mode

Solarflare network adapters support either SFP/SFP+ or Base-T standards.

On Base-T adapters three speeds are supported 100Mbps, 1Gbps and 10Gbps. The adapters use auto negotiation to automatically select the highest speed supported in common with the link partner.

On SFP+ adapters the currently inserted SFP module (transceiver) determines the supported speeds, typically SFP modules only support a single speed. Some Solarflare SFP+ adapters support dual speed optical modules that can operate at either 1Gbps or 10Gbps. However, these modules do not auto-negotiate link speed and operate at the maximum (10G) link speed unless explicitly configured to operate at a lower speed (1G).

The tables below summarizes the speeds supported by Solarflare network adapters.

Table 7: SFN4112F SFP+ Adapter

Supported Modes	Auto neg speed	Speed	Comment
SFP+ direct attach cable	No	10G	
SFP+ optical module (10G)	No	10G	

Table 8: SFN5xxx,SFN6xxx and SFN7xxx SFP+ Adapters

Supported Modes	Auto neg speed	Speed	Comment
SFP+ direct attach cable	No	10G	
SFP+ optical module (10G)	No	10G	
SFP optical module (1G)	No	1G	
SFP+ optical module (10G/1G)	No	10G or 1G	Dual speed modules run at the maximum speed (10G) unless explicitly configured to the lower speed (1G)
SFP 1000BASE-T module	No	1G	These modules support only 1G and will not link up at 100Mbps

Table 9: SFN5121T, SFN5151T, SFN5161T 10GBASE-T Adapters

Supported Modes	Auto neg speed	Speed	Comment
100Base-T	Yes	100Mbps	Typically the interface is set to auto negotiation speed and automatically selects the highest speed supported in common with it's link partner. If the link partner is set to 100Mbps, with no autoneg, the adapter will use "parallel detection" to detect and select 100Mbps speed. If needed any of the three speeds can be explicitly configured
1000Base-TX	Yes	1Gbps	
10GBase-T	Yes	10Gbps	

100Base-T in a Solarflare adapter back-to-back (no intervening switch) configuration will not work and is not supported.

2.12 LED States

There are two LEDs on the Solarflare network adapter transceiver module. LED states are as follows:

Table 10: LED States

Adapter Type	LED Description	State
SFP/SFP+	Link	Green (solid) at all speeds
	Activity	Flashing green when network traffic is present
		LEDs are OFF when there is no link present
BASE-T	Speed	Green (solid) 10Gbps Yellow (solid) 100/1000Mbps
	Activity	Flashing green when network traffic is present
		LEDs are OFF when there is no link present

2.13 Solarflare Mezzanine Adapter: SFN5802K

The Solarflare SFN5802K is a Dual-Port 10G Ethernet Mezzanine Adapter for the HP BladeSystem c-Class.

The HP BladeSystem blade supports up to two Solarflare mezzanine adapters.

Inserting the Mezzanine Adapter into the BladeSystem Server.

1 The blade should be extracted from the server in order to install the mezzanine adapter.

2 Remove the blade top cover and identify the screw posts towards the rear of the blade (Figure 1) where the adapter will be secured (two screw posts per adapter - refer to the BladeSystem manual if necessary).

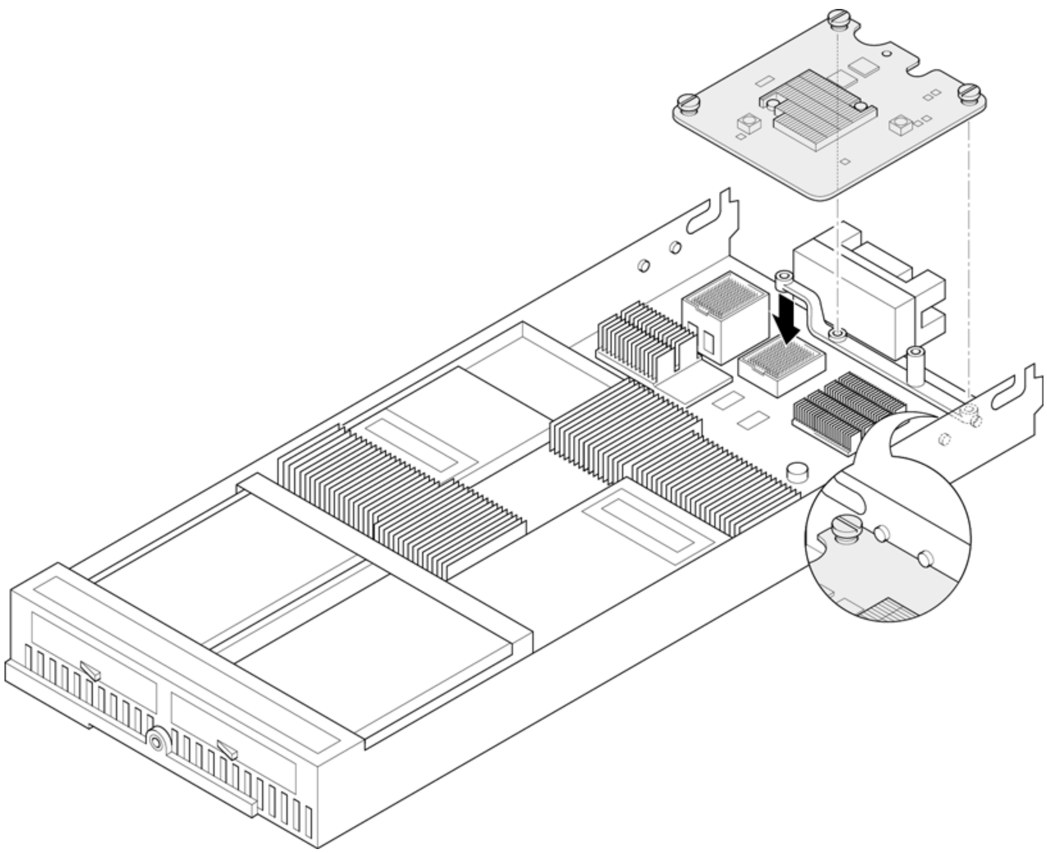


Figure 1: Locate the Mezzanine Adapter screw posts

3 It may be necessary to remove the internal battery tray if fitted. Align the mezzanine port connector with the backplane connector block and screw posts. Press home gently ensuring that the adapter is firmly and correctly seated in the connector block.

4 Hand tighten the adapter retaining screws.

5 Replace the internal battery tray and replace the blade top cover.

With a mezzanine adapter installed into the lower connector block, a second adapter can be installed into the remaining connector block (see Figure 2)

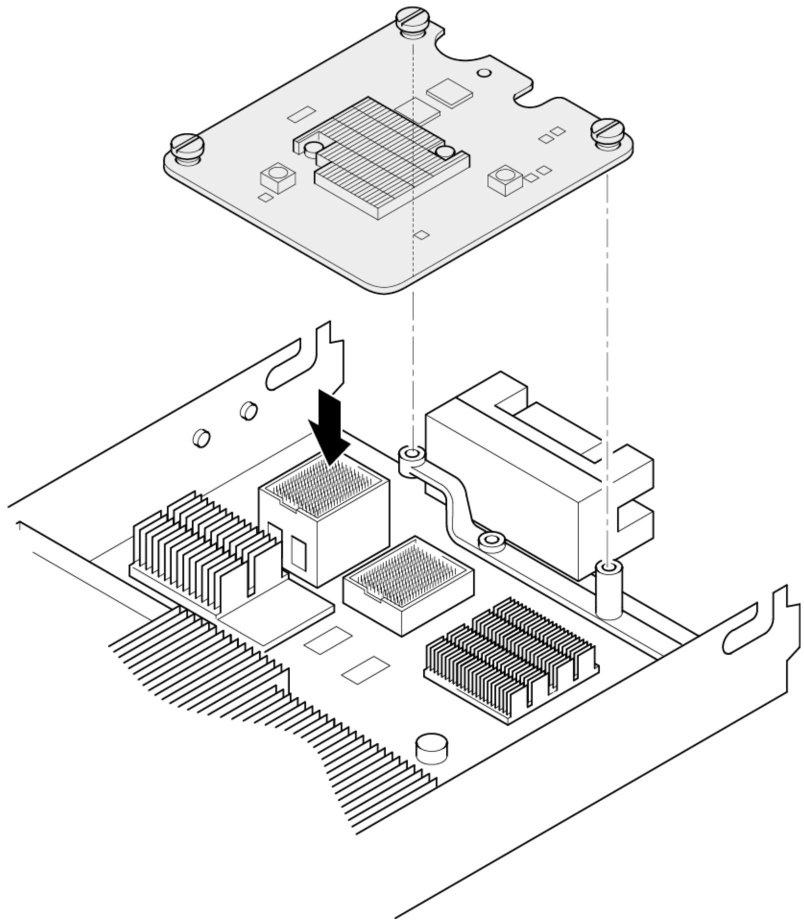


Figure 2: Installing a second mezzanine adapter

CAUTION: It is important that the spring loaded screws are not over tightened to avoid damage to the adapter.

2.14 Solarflare Mezzanine Adapters: SFN5812H and SFN5814H

The Solarflare SFN5812H Dual-Port and SFN5814H Quad-Port are 10G Ethernet Mezzanine Adapters for the IBM BladeCenter.

Solarflare mezzanine adapters are supported on the IBM BladeCenter E, H and S chassis, HS22, HS22V and HX5 servers. The IBM BladeCenter blade supports a single Solarflare mezzanine adapter.

1 The blade should be extracted from the BladeCenter in order to install the mezzanine adapter.

2 Remove the blade top cover and locate the two retaining posts towards the rear of the blade - (Figure 3). Refer to the BladeCenter manual if necessary.

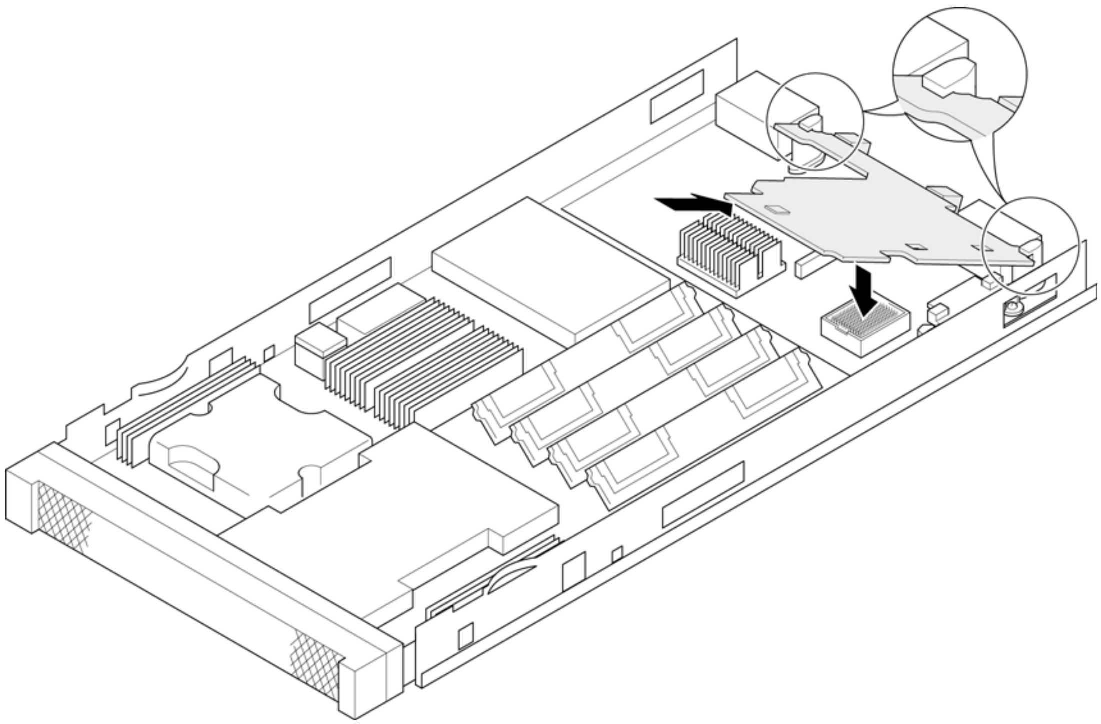


Figure 3: Installing the Mezzanine Adapter

3 Hinge the adapter under the retaining posts, as illustrated, and align the mezzanine port connector with the backplane connector block.

4 Lower the adapter, taking care to align the side positioning/retaining posts with the recesses in the adapter. See Figure 4.

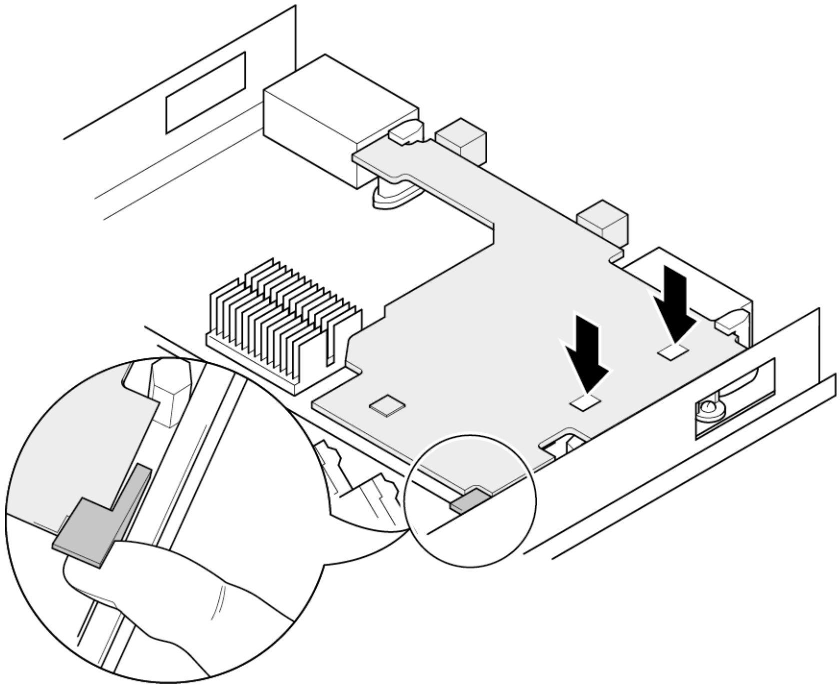


Figure 4: In position mezzanine adapter

5 Press the port connector gently into the connector block ensuring that the adapter is firmly and correctly seated in the connector block.

6 Replace the blade top cover.

7 When removing the adapter raise the release handle (shown on Figure 4) to ease the adapter upwards until it can be freed from the connector block.

2.15 Solarflare Mezzanine Adapter SFN6832F-C61

The Solarflare SFN6832F-C61 is a Dual-Port SFP+ are 10GbE Mezzanine Adapters for the DELL PowerEdge C6100 series rack server. Each DELL PowerEdge node supports a single Solarflare mezzanine adapter.

1 The node should be extracted from the rack server in order to install the mezzanine adapter. Refer to the PowerEdge rack server manual if necessary.

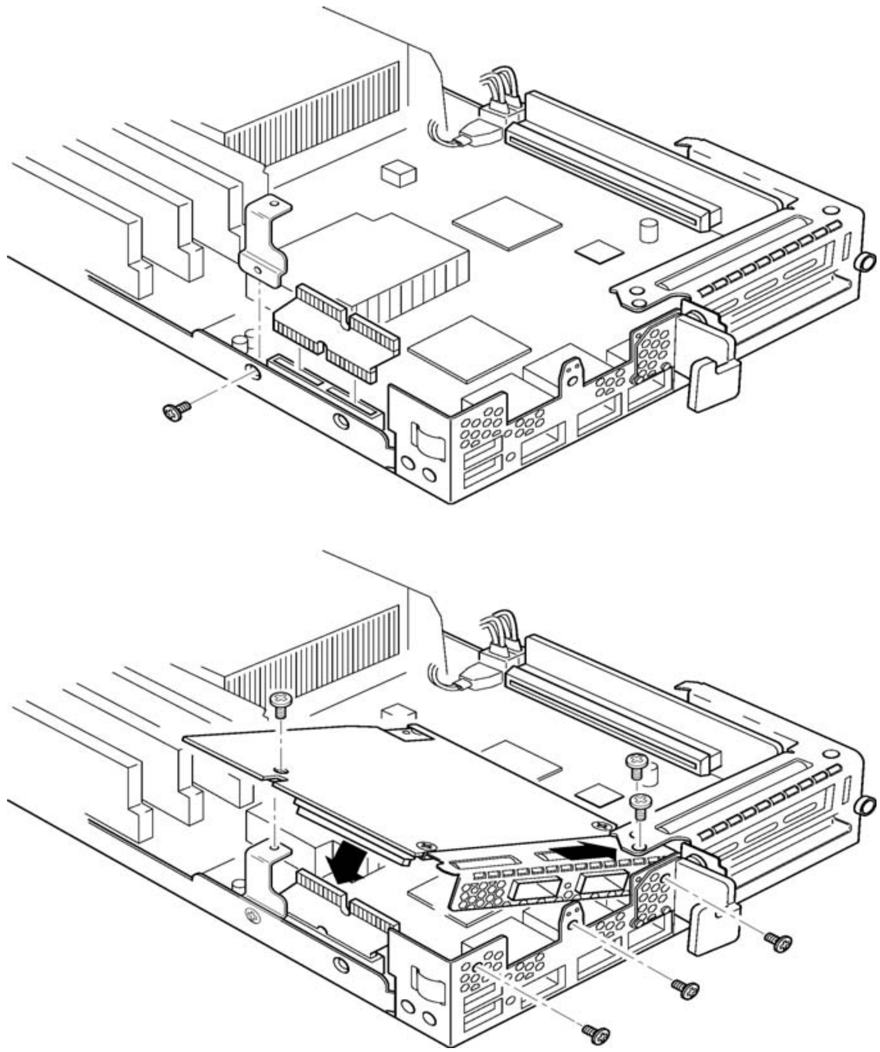


Figure 5: SFN6832F-C61 - Installing into the rack server node

2 Secure the side retaining bracket as shown in Figure 5 (top diagram)

3 Fit riser PCB card into the slot as shown in Figure 5 (top diagram). Note that the riser card only fits one way.

4 Offer the adapter to the node and ensure it lies underneath the chassis cover.

5 Lower the adapter into position making sure to connect the adapter slot with the to of the PCB riser card.

6 Secure the adapter using the supplied screws at the positions shown in the diagram.

2.16 Solarflare Mezzanine Adapter SFN6832F-C62

The Solarflare SFN6832F-C61 is a Dual-Port SFP+ are 10GbE Mezzanine Adapters for the DELL PowerEdge C6200 series rack server. Each DELL PowerEdge node supports a single Solarflare mezzanine adapter.

1 The node should be extracted from the rack server in order to install the mezzanine adapter. Refer to the PowerEdge rack server manual if necessary.

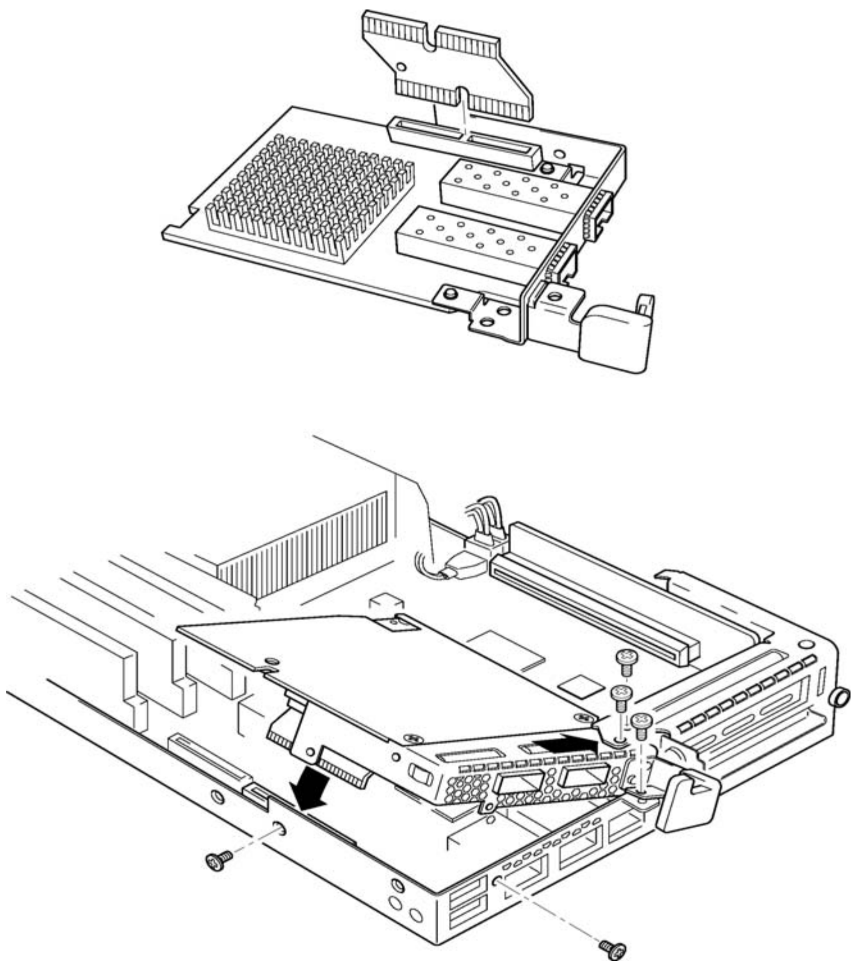


Figure 6: SFN6832F-C62 - Installing into the rack server node

2 Fit the PCB riser card to the underside connector on the adapter.

3 Offer the adapter to the rack server node ensuring it lies underneath the chassis cover.

4 Lower to adapter to connect the riser PCB card into the slot in the node.

5 Secure the adapter with the supplied screws at the points shown in the diagram.

2.17 Solarflare Precision Time Synchronization Adapters

The Solarflare SFN7122F[1], SFN7322F, SFN6322F and SFN5322F adapters are dual-port SFP+ 10GbE adapters that can generate hardware timestamps for PTP packets in support of a network precision time protocol deployment compliant with the IEEE 1588-2008 specification.

Customers requiring configuration instructions for these adapters and Solarflare PTP in a PTP deployment should refer to the Solarflare Enhanced PTP User Guide SF-109110-CD.

1. Requires an AppFlex™ license - refer to Solarflare AppFlex™ Technology Licensing. on page 13.

2.18 Solarflare SFA6902F ApplicationOnload™ Engine

The ApplicationOnload™ Engine (AOE) SFA6902F is a full length PCIe form factor adapter that combines an ultra-low latency adapter with a tightly coupled 'bump-in-the-wire' FPGA.

For details of installation and configuring applications that run on the AOE refer to the Solarflare AOE User's Guide (SF-108389-CD). For details on developing custom applications to run on the FPGA refer to the AOE Firmware Development Kit User Guide (SF-108390-CD).

Chapter 3: Solarflare Adapters on Linux

This chapter covers the following topics on the Linux® platform:

3.1 System Requirements

Refer to Software Driver Support on page 13 for supported Linux Distributions.

> **NOTE:** SUSE Linux Enterprise Server 11 includes a version of the Solarflare network adapter Driver. This driver does not support the SFN512x family of adapters. To update the supplied driver, see SUSE Linux Enterprise Server Distributions on page 44

NOTE: Red Hat Enterprise Linux versions 5.5 and 6.0 include a version of the SFN4112F Solarflare adapter driver. This driver does not support the SFN512x family of adapters. Red Hat Enterprise Linux 5.6 and 6.1 includes a version of the Solarflare network driver for the SFN512x family of adapters. To update the supplied driver, see Installing Solarflare Drivers and Utilities on Linux on page 43

3.2 Linux Platform Feature Set

Table 11 lists the features supported by Solarflare adapters on Red Hat and SUSE Linux distributions.

Table 11: Linux Feature Set

Fault diagnostics	Support for comprehensive adapter and cable fault diagnostics and system reports. • See Running Adapter Diagnostics on page 53
Firmware updates	Support for Boot ROM, Phy transceiver and adapter firmware upgrades. • See Upgrading Adapter Firmware with Sfupdate on page 70
Hardware Timestamps	Solarflare Flareon SFN7122F[1] and SFN7322F adapters support the hardware timestamping of all received packets - including PTP packets. The Linux kernel must support the SO_TIMESTAMPING socket option (2.6.30+) to allow the driver to support hardware packet timestamping. Therefore hardware packet timestamping is not available in RHEL 5 1. SFN7122F requires an AppFlex license - for details refer to Solarflare AppFlex™ Technology Licensing. on page 13.
Jumbo frames	Support for MTUs (Maximum Transmission Units) from 1500 bytes to 9216 bytes. • See Configuring Jumbo Frames on page 51
PXE and iSCSI booting	Support for diskless booting to a target operating system via PXE or iSCSI boot. • See Configuring the Boot ROM with sfboot on page 56 • See Solarflare Boot ROM Agent on page 360 PXE or iSCSI boot are not supported for Solarflare adapters on IBM System p servers.

Table 11: Linux Feature Set

Receive Side Scaling (RSS)	Support for RSS multi-core load distribution technology. • See Receive Side Scaling (RSS) on page 83
SR-IOV	Support for XenServer6 PCIe Single Root-IO Virtualization and Linux KVM SR-IOV. • See SR-IOV Virtualization for XenServer on page 340 • See SR-IOV Virtualization Using KVM on page 323 SR-IOV is not supported for Solarflare adapters on IBM System p servers.
Standby and Power Management	Solarflare adapters support Wake On LAN on Linux. These settings are only available if the adapter has auxiliary power supplied by a separate cable.
Task offloads	Support for TCP Segmentation Offload (TSO), Large Receive Offload (LRO), and TCP/UDP/IP checksum offload for improved adapter performance and reduced CPU processing requirements. • See Configuring Task Offloading on page 50
Teaming	Improve server reliability and bandwidth by combining physical ports, from one or more Solarflare adapters, into a team, having a single MAC address and which function as a single port providing redundancy against a single point of failure. • See Setting Up Teams on page 52
Virtual LANs (VLANs)	Support for multiple VLANs per adapter. • See Setting Up VLANs on page 51

3.3 Solarflare RPMs

Solarflare supply RPM packages in the following formats:

- DKMS
- Source RPM

Where possible, it is recommended that you use the DKMS RPM if you have DKMS installed.

DKMS RPM

Dynamic Kernel Module Support (DKMS) is a framework where device driver source can reside outside the kernel source tree. It supports an easy method to rebuild modules when kernels are upgraded.

Execute the command `dkms --version` to determine whether DKMS is installed.

To install the Solarflare driver DKMS package execute the following command:

```
rpm -i sfc-dkms-<version>.noarch.rpm
```

Building the Source RPM

These instructions may be used to build a source RPM package for use with Linux distributions or kernel versions where DKMS or KMP packages are not suitable.

> **NOTE:** RPMs can be installed for multiple kernel versions.

1. First, the kernel headers for the running kernel must be installed at `/lib/modules/<kernel-version>/build`. On Red Hat systems, install the appropriate `kernel-smp-devel` or `kernel-devel` package. On SUSE systems install the `kernel-source` package.
2. To build a source RPM for the running kernel version from the source RPM, enter the following at the command-line:

   ```
   rpmbuild --rebuild <package_name>
   ```

   Where `package_name` is the full path to the source RPM (see the note below).
3. To build for a different kernel to the running system, enter the following command:

   ```
   rpmbuild --define 'kernel <kernel version>' --rebuild <package_name>
   ```
4. Install the resulting RPM binary package, as described in Installing Solarflare Drivers and Utilities on Linux.

> **NOTE:** The location of the generated RPM is dependent on the distribution and often the version of the distribution and the RPM build tools.
>
> The RPM build process should print out the location of the RPM towards the end of the build process, but it can be hard to find amongst the other output.
>
> Typically the RPM will be placed in `/usr/src/<dir>/RPMS/<arch>/`, where `<dir>` is distribution specific. Possible folders include Red Hat, **packages** or **extra**. The RPM file will be named using the same convention as the Solarflare provided pre-built binary RPMs.
>
> The command: `find /usr/src -name "*sfc*.rpm”` will list the locations of all Solarflare RPMs.

3.4 Installing Solarflare Drivers and Utilities on Linux

Linux drivers for Solarflare are available in DKMS and source RPM packages. The source RPM can be used to build binary RPMs for a wide selection of distributions and kernel variants. This section details how to install the resultant binary RPM.

Solarflare recommend using DKMS RPMs if the DKMS framework is available. See DKMS RPM on page 42 for more details.

NOTE: The Solarflare adapter should be physically installed in the host computer before installing the driver. The user must have root permissions to install the adapter drivers.

3.5 Red Hat Enterprise Linux Distributions

These instructions cover installation and configuration of the Solarflare network adapter drivers on Red Hat Enterprise Linux Server. Refer to Software Driver Support on page 13 for details of supported Linux distributions.

Refer to Building the Source RPM on page 42 for directions on creating the binary RPM.

1 Install the RPMs:

```
[root@myhost1]# rpm -ivh kernel-module-sfc-RHEL6-2.6.32-
279.el6.x86_64-3.3.0.6262-1.x86_64.rpm
```

2 There are various tools that can be used for configuring the Solarflare Server Adapter:

a) The NetworkManager service and associated GUI tools. For more information about his refer to https://wiki.gnome.org/NetworkManager.

b) Solarflare recommend using the Network Administration Tool (**NEAT**) to configure the new network interface. **NEAT** is a GUI based application and therefore requires an X server to run.

c) Alternatively the command line program **Kudzu** can be used. However, you may find when kudzu is run that you are NOT presented with an option to configure the new network interface. If this occurs, carefully clear details of the Solarflare Server Adapter from the hardware database by removing all entries with “vendor id: 1924” in the `/etc/sysconfig/hwconf` file. Running kudzu again should now provide an option to configure the newly added network interface.

3 Apply the new network settings:

a) **NEAT** provides an option to **Activate** the new interface. The new network interface can then be used immediately (there is no need to reboot or restart the network service).

b) If you are not using **NEAT** you will need to reboot, or alternatively restart the networking service, by typing the following before the new Solarflare interface can be used:

```
[root@myhost1]# service network restart
```


3.6 SUSE Linux Enterprise Server Distributions

These instructions cover installation and configuration of the Solarflare Network Adapter drivers on SUSE Linux Enterprise Server. Refer to Software Driver Support...Page 13 for details of supported distributions.

Refer to Building the Source RPM on page 42 for directions on creating the binary RPM.

1 The Solarflare drivers are currently classified as 'unsupported' by SUSE Enterprise Linux 10 (SLES10). To allow unsupported drivers to load in SLES10, edit the following file:

```
/etc/sysconfig/hardware/config
```

find the line:

```
LOAD_UNSUPPORTED_MODULES_AUTOMATICALLY=no
```

and change no to `yes`.

For SLES 11, edit the last line in `/etc/modprobe.d/unsupported-modules` to:

```
allow_unsupported_modules 1
```

2 Install the RPMs:

```
[root@myhost1]# rpm -ivh kernel-module-sfc-2.6.5-7.244-smp-2.1.0111-
0.sf.1.SLES9.i586.rpm
```

3 Run **YaST** to configure the Solarflare Network Adapter. When you select the Ethernet Controller, the **Configuration Name** will take one of the following forms:

a) `eth-bus-pci-dddd:dd:dd.N` where N is either 0 or 1.

b) `eth-id-00:0F:53:XX:XX:XX`

Once configured, the **Configuration Name** for the correct Ethernet Controller will change to the second form, and an ethX interface will appear on the host. If the incorrect Ethernet Controller is chosen and configured, then the **Configuration Name** will remain as `eth-bus-pci-dddd:dd:dd.1` after configuration by YaST, and an ethX interface will not appear on the system. In this case, you should remove the configuration for this Ethernet Controller, and configure the other Ethernet Controller of the pair.

3.7 Unattended Installations

Building Drivers and RPMs for Unattended Installation

Linux unattended installation requires building two drivers:

- A minimal installation Solarflare driver that only provides networking support. This driver is used for network access during the installation process.
- An RPM that includes full driver support. This RPM is used to install drivers in the resultant Linux installation.

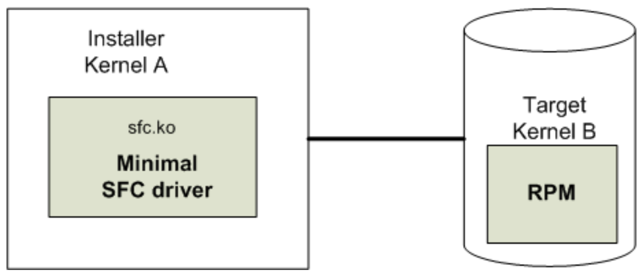


Figure 7: Unattended Installation RPM

Figure 7 shows how the unattended installation process works.

1 Build a minimal Solarflare driver needed for use in the installation kernel (Kernel A in the diagram above). This is achieved by defining “sfc_minimal” to rpmbuild. This macro disables hardware monitoring, MTD support (used for access to the adapters flash), I2C and `debugfs`. This results in a driver with no dependencies on other modules and allows networking support from the driver during installation.

```
# as normal user
$ mkdir -p /tmp/rpm/BUILD
$ rpm -i sfc-<ver>-1.src.rpm
$ rpmbuild -bc -D 'sfc_minimal=1' -D 'kernel=<installer kernel>' \
   /tmp/rpm/SPECS/sfc.spec
```

2 The Solarflare minimal driver `sfc.ko` can be found in `/tmp/rpm/BUILD/sfc-<ver>/linux_net/sfc.ko`. Integrate this minimal driver into your installer kernel, either by creating a driver disk incorporating this minimal driver or by integrating this minimal driver into initrd.

3 Build a full binary RPM for your Target kernel and integrate this RPM into your Target (Kernel B).

Driver Disks for Unattended Installations

Solarflare are preparing binary driver disks to help avoid the need to build the minimal drivers required in unattended installations. Please contact Solarflare support to obtain these driver disks

Table 12 shows the various stages of an unattended installation process:

Table 12: Installation Stages

In Control	Stages of Boot	Setup needed
BIOS	PXE code on the adapter runs.	Adapter must be in PXE boot mode. See PXE Support on page 361.
SF Boot ROM (PXE)	DHCP request from PXE (SF Boot ROM).	DHCP server filename and next-server options.
SF Boot ROM (PXE)	TFTP request for filename to next-server, e.g. pxelinux.0	TFTP server.
pxelinux	TFTP retrieval of pxelinux configuration.	pxelinux configuration on TFTP server.
pxelinux	TFTP menu retrieval of Linux kernel image initrd.	pxelinux configuration Kernel, kernel command, initrd
Linux kernel/installer	Installer retrieves kickstart configuration, e.g. via HTTP.	Kickstart/AutoYaST configuration.
Target Linux kernel	kernel reconfigures network adapters.	DHCP server.

3.8 Unattended Installation - Red Hat Enterprise Linux

Documentation for preparing for a Red Hat Enterprise Linux network installation can be found at:

http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/5/html/Installation_Guide/s1-begininstall-perform-nfs-x86.html

http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Installation_Guide/index.html

The prerequisites for a Network Kickstart installation are:

- Red Hat Enterprise Linux installation media.
- A Web server and/or FTP Server for delivery of the RPMs that are to be installed.
- A DHCP server for IP address assignments and to launch PXE Boot.
- A TFTP server for download of PXE Boot components to the machines being kickstarted.
- The BIOS on the computers to be Kickstarted must be configured to allow a network boot.
- A Boot CD-ROM or flash memory that contains the kickstart file or a network location where the kickstart file can be accessed.
- A Solarflare driver disk.

Unattended Red Hat Enterprise Linux installations are configured with Kickstart. The documentation for Kickstart can be found at:

http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/5/html/Installation_Guide/ch-redhat-config-kickstart.html

http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Installation_Guide/ch-kickstart2.html

To install Red Hat Enterprise you need the following:

1 A modified `initrd.img` file with amended `modules.alias` and `modules.dep` which incorporates the Solarflare minimal driver for the installation kernel.

   To `modules.alias`, add the following entries:

```
alias:          pci:v00001924d00000813sv*sd*bc*sc*i*
alias:          pci:v00001924d00000803sv*sd*bc*sc*i*
alias:          pci:v00001924d00000710sv*sd*bc*sc*i*
alias:          pci:v00001924d00000703sv*sd*bc*sc*i*
```

2 Identify the driver dependencies using the modinfo command:

```
modinfo ./sfc.ko | grep depends
depends:    i2c-core,mii,hwmon,hwmon-vid,i2c-algo-bit mtdcore mtdpart
```

   All modules listed as depends must be present in the initrd file image. In addition the user should be aware of further dependencies which can be resolved by adding the following lines to the modules.dep file:


```
sfc: i2c-core mii  hwmon  hwmon-vid  i2c-algo-bit  mtdcore  mtdpart *
i2c-algo-bit:  i2c-core
mtdpart:  mtdcore
```

*For Red Hat Enterprise Linux from version 5.5 add `mdio` to this line.

3 A configured kickstart file with the Solarflare Driver RPM manually added to the `%Post` section. For example:

```
%post

/bin/mount -o ro <IP Address of Installation server>:/<path to
location directory containing Solarflare RPM> /mnt
/bin/rpm -Uvh /mnt/<filename of Solarflare RPM>
/bin/umount /mnt
```

3.9 Unattended Installation - SUSE Linux Enterprise Server

Unattended SUSE Linux Enterprise Server installations are configured with AutoYaST. The documentation for AutoYaST can be found at:

http://www.suse.com/~ug/autoyast_doc/index.html

The prerequisites for a Network AutoYaST installation are:

- SUSE Linux Enterprise installation media.
- A DHCP server for IP address assignments and to launch PXE Boot.
- A NFS or FTP server to provide the installation source.
- A TFTP server for the download of the kernel boot images needed to PXE Boot.
- A boot server on the same Ethernet segment.
- An install server with the SUSE Linux Enterprise Server OS.
- An AutoYaST configuration server that defines rules and profiles.
- A configured AutoYast Profile (control file).

Further Reading

- SUSE Linux Enterprise Server remote installation:

http://www.novell.com/documentation/sles10/sles_admin/?page=/documentation/sles10/sles_admin/data/cha_deployment_remoteinst.html

- SUSE install with PXE Boot:

http://en.opensuse.org/SuSE_install_with_PXE_boot

3.10 Hardware Timestamps

The Solarflare Flareon SFN7000 series adapters can support hardware timestamping for all received network packets.

The Linux kernel must support the SO_TIMESTAMPING socket option (2.6.30+) therefore hardware packet timestamping is not supported on RHEL 5.

For more information about using the kernel timestamping API, users should refer to the Linux documentation: http://lxr.linux.no/linux/Documentation/networking/timestamping.txt

3.11 Configuring the Solarflare Adapter

Ethtool is a standard Linux tool that you can use to query and change Ethernet adapter settings, including those for Solarflare adapters. Ethtool can be downloaded from http://sourceforge.net/projects/gkernel/files/ethtool/.

The general command for ethtool is as follows:

`ethtool <-option> <ethX>`

Where X is the identifier of the interface. Note that root access will be required to configure adapter settings. Refer to the Linux online manual (`man ethtool`) for details of the options that are available for ethtool.

Configuring Speed and Modes

Solarflare adapters by default automatically negotiate the connection speed to the maximum supported by the link partner. On the 10GBASE-T adapters “auto” instructs the adapter to negotiate the highest speed supported in common with it’s link partner. On SFP+ adapters, “auto” instructs the adapter to use the highest link speed supported by the inserted SFP+ module. On 10GBASE-T and SFP+ adapters, any other value specified will fix the link at that speed, regardless of the capabilities of the link partner, which may result in an inability to establish the link. Dual speed SFP+ modules operate at their maximum (10G) link speed unless explicitly configured to operate at a lower speed (1G).

The following commands demonstrate ethtool to configure the network adapter Ethernet settings.

Identify interface configuration settings:

`ethtool ethX`

Set link speed:

`ethtool -s ethX speed 1000|100`

To return the connection speed to the default auto-negotiate, enter:

`ethtool -s <ethX> autoneg on`

Configure auto negotiation:

`ethtool -s ethX autoneg [on|off]`

Set auto negotiation advertised speed 1G:


```
ethtool -s ethX advertise 0x20
```

Set autonegotiation advertised speed 10G:

```
ethtool -s ethX advertise 0x1000
```

Set autonegotiation advertised speeds 1G and 10G:

```
ethtool -s ethX advertise 0x1020
```

Identify interface auto negotiation pause frame setting:

```
ethtool -a ethX
```

Configure auto negotiation of pause frames:

```
ethtool -A ethX autoneg on [rx on|off] [tx on|off]
```

Configuring Task Offloading

Solarflare adapters support transmit (Tx) and receive (Rx) checksum offload, as well as TCP segmentation offload. To ensure maximum performance from the adapter, all task offloads should be enabled, which is the default setting on the adapter. For more information, see Performance Tuning on Linux on page 77.

To change offload settings for Tx and Rx, use the ethtool command:

```
ethtool --offload <ethX> [rx on|off] [tx on|off]
```

Configuring Receive/Transmit Ring Buffer Size

By default receive and transmit ring buffers on the Solarflare adapter support 1024 descriptors. The user can identify and reconfigure ring buffer sizes using the ethtool command.

To identify the current ring size:

```
ethtool -g ethX
```

To set the new transmit or receive ring size to value N

```
ethtool -G ethX [rx N| tx N]
```

The ring buffer size must be a value between 128 and 4096. Buffer size can also be set directly in the `modprobe.conf` file or add the options line to a file under the `/etc/modprobe.d` directory e.g.

```
options sfc  rx_ring=4096
```

Using the modprobe method sets the value for all Solarflare interfaces. Then reload the driver for the option to become effective:

```
modprobe -r sfc
modprobe sfc
```


Configuring Jumbo Frames

Solarflare adapters support frame sizes from 1500 bytes to 9216 bytes. For example, to set a new frame size (MTU) of 9000 bytes, enter the following command:

```
ifconfig <ethX> mtu 9000
```

To make the changes permanent, edit the network configuration file for `<ethX>`; for example, `/etc/sysconfig/network-scripts/ifcfg-eth1` and append the following configuration directive, which specifies the size of the frame in bytes:

```
MTU=9000
```

Standby and Power Management

Solarflare adapters support Wake on LAN and Wake on Magic Packet setting on Linux. You need to ensure that Wake on LAN has been enabled on the BIOS correctly and your adapter has auxiliary power via a separate cable before configuring Wake on LAN features.

In SUSE Linux Enterprise Server, you can use the YaST WOL module to configure Wake on LAN or you can use the `ethtool wol g` setting.

In Red Hat Enterprise Linux you can use the `ethtool wol g` setting.

3.12 Setting Up VLANs

VLANs offer a method of dividing one physical network into multiple broadcast domains. In enterprise networks, these broadcast domains usually match with IP subnet boundaries, so that each subnet has its own VLAN. The advantages of VLANs include:

- Performance
- Ease of management
- Security
- Trunks
- You don't have to configure any hardware device, when physically moving your server to another location.

To set up VLANs, consult the following documentation:

- To configure VLANs on SUSE Linux Enterprise Server, see:

http://www.novell.com/support/viewContent.do?externalId=3864609

- To configure tagged VLAN traffic only on Red Hat Enterprise Linux, see:

http://kbase.redhat.com/faq/docs/DOC-8062

- To configure mixed VLAN tagged and untagged traffic on Red Hat Enterprise Linux, see:

http://kbase.redhat.com/faq/docs/DOC-8064

3.13 Setting Up Teams

Teaming network adapters (network bonding) allows a number of physical adapters to act as one, virtual adapter. Teaming network interfaces, from the same adapter or from multiple adapters, creates a single virtual interface with a single MAC address.

The virtual adapter or virtual interface can assist in load balancing and providing failover in the event of physical adapter or port failure.

Teaming configuration support provided by the Linux bonding driver includes:

- 802.3ad Dynamic link aggregation
- Static link aggregation
- Fault Tolerant

To set up an adapter team, consult the following documentation:

General:

http://www.kernel.org/doc/Documentation/networking/bonding.txt

RHEL 5:

http://www.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/5.4/html/Deployment_Guide/s2-modules-bonding.html

RHEL6:

http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Deployment_Guide/s2-networkscripts-interfaces-chan.html

SLES:

http://www.novell.com/documentation/sles11/book_sle_admin/data/sec_basicnet_yast.html#sec_basicnet_yast_netcard_man

3.14 Running Adapter Diagnostics

You can use ethtool to run adapter diagnostic tests. Tests can be run offline (default) or online. Offline runs the full set of tests, which can interrupt normal operation during testing. Online performs a limited set of tests without affecting normal adapter operation.

As root user, enter the following command:

```
ethtool --test ethX offline|online
```

The tests run by the command are as follows:

Table 13: Adapter Diagnostic Tests

Diagnostic Test	Purpose
core.nvram	Verifies the flash memory 'board configuration' area by parsing and examining checksums.
core.registers	Verifies the adapter registers by attempting to modify the writable bits in a selection of registers.
core.interrupt	Examines the available hardware interrupts by forcing the controller to generate an interrupt and verifying that the interrupt has been processed by the network driver.
tx/rx.loopback	Verifies that the network driver is able to pass packets to and from the network adapter using the MAC and Phy loopback layers.
core.memory	Verifies SRAM memory by writing various data patterns (incrementing bytes, all bit on and off, alternating bits on and off) to each memory location, reading back the data and comparing it to the written value.
core.mdio	Verifies the MII registers by reading from PHY ID registers and checking the data is valid (not all zeros or all ones). Verifies the MMD response bits by checking each of the MMDs in the Phy is present and responding.
chanX eventq.poll	Verifies the adapter's event handling capabilities by posting a software event on each event queue created by the driver and checking it is delivered correctly. The driver utilizes multiple event queues to spread the load over multiple CPU cores (RSS).
phy.bist	Examines the PHY by initializing it and causing any available built-in self tests to run.

3.15 Running Cable Diagnostics

Cable diagnostic data can be gathered from the Solarflare 10GBASE-T adapters physical interface using the `ethtool -t` command which runs a comprehensive set of diagnostic tests on the controller, PHY, and attached cables. To run the cable tests enter the following command:

```
ethtool -t ethX [online | offline]
```

Online tests are non-intrusive and will not disturb live traffic.

The following is an extract from the output of the ethtool diagnostic offline tests:

```
phy    cable.pairA.length        9
phy    cable.pairB.length        9
phy    cable.pairC.length        9
phy    cable.pairD.length        9
phy    cable.pairA.status        1
phy    cable.pairB.status        1
phy    cable.pairC.status        1
phy    cable.pairD.status        1
```

Cable length is the estimated length in metres. A length value of 65535 indicates length not estimated due to pair busy or cable diagnostic routine not completed successfully.

The cable status can be one of the following values:

0 - invalid, or cable diagnostic routine did not complete successfully
1 - pair ok, no fault detected
2 - pair open or Rt > 115 ohms
3 - intra pair short or Rt < 85 ohms
4 - inter pair short or Rt < 85 ohms
9 - pair busy or link partner forces 100Base-Tx or 1000Base-T test mode.

3.16 Linux Utilities RPM

The Solarflare Utilities RPM for Linux contains:

- A boot ROM utility. Configuring the Boot ROM with sfboot...Page 56
- A flash firmware update utility. Upgrading Adapter Firmware with Sfupdate...Page 70
- A license key install utility. License Install with sfkey...Page 75

The RPM package, is supplied as 64bit and 32bit binaries compiled to be compatible with GLIBC versions for all supported distributions.

The Solarflare utilities RPM file can be downloaded from the following location:

https://support.solarflare.com/

- SF-104451-LS is a 32bit binary RPM package.
- SF-107601-LS is a 64bit binary RPM package.

Download and copy the zipped binary RPM package to the required directory. Unzip and install (64bit package example):

1 Unzip the package:

unzip SF-107601-LS-20_Solarflare_Linux_Utilities_RPM_64bit.zip

2 Install the binary RPM:

rpm -Uvh sfutils-4.0.1.6605-1.x86_64.rpm

```
Preparing...                ########################################### [100%]
1:sfutils                   ########################################### [100%]
```

3 Check that the RPM installed correctly:

```
# rpm -q sfutils
sfutils-4.0.1.6605-1.x86_64
```

Directions for the use of the utility programs are explained in the following sections:

3.17 Configuring the Boot ROM with sfboot

Sfboot is a command line utility for configuring the Solarflare adapter Boot ROM for PXE and iSCSI booting. Using sfboot is an alternative to using **Ctrl + B** to access the Boot Rom agent during server startup.

See Configuring the Solarflare Boot ROM Agent on page 360 for more information on the Boot Rom agent.

PXE and iSCSI network boot is not supported for Solarflare adapters on IBM System p servers.

Sfboot: SLES 11 Limitation

Due to limitations in SLES 11 using kernel versions prior to 2.6.27.54 it is necessary to reboot the server after running the sfboot utility.

Sfboot: Command Usage

The general usage for sfboot is as follows (as root):

```
sfboot [--adapter=eth<N>] [options] [configurable parameters]
```

Note that without `--adapter`, the `sfboot` command applies to all adapters that are present in the target host.

The format for the parameters are:

```
<parameters>=<value>
```

Sfboot: Command Line Options

Table 14 lists the options for `sfboot` and Table 15 lists the available options.

Table 14: Sfboot Options

Option	Description
`-?-h, --help`	Displays command line syntax and provides a description of each sfboot option.
`-V, --version`	Shows detailed version information and exits.
`-v, --verbose`	Shows extended output information for the command entered.

Table 14: Sfboot Options

Option	Description
`-s, --quiet` `Aliases: --silent`	Suppresses all output, except errors; no user interaction. You should query the completion code to determine the outcome of commands when operating silently (see Performance Tuning on Windows on page 236).
`-l --list`	Lists all available Solarflare adapters. This option shows the ifname and MAC address. Note: this option may not be used in conjunction with the any other option. If this option is used with configuration parameters, those parameters will be silently ignored.
`-i, --adapter =<ethX>`	Performs the action on the identified Solarflare network adapter. The adapter identifier `ethX` can be the ifname or MAC address, as output by the --`list` option. If `--adapter` is not included, the action will apply to all installed Solarflare adapters.
`-c --clear`	Resets all adapter options except `boot-image` to their default values. Note that `--clear` can also be used with parameters, allowing you to reset to default values, and then apply the parameters specified.

The following parameters in Table 15 are used to control the configurable parameters for the Boot ROM driver when running prior to the operating system booting.

Table 15: Sfboot Parameters

Parameter	Description
`boot-image=<all|optionrom|uefi|disabled>`	Specifies which boot firmware images are served-up to the BIOS during start-up. This parameter can not be used if the `--adapter` option has been specified. This option is not reset if `--clear` is used.

Table 15: Sfboot Parameters

Parameter	Description
`link-speed=<auto|10g|1g|100m>`	Specifies the network link speed of the adapter used by the Boot ROM - the default is `auto`. On the 10GBASE-T adapters "auto" instructs the adapter to negotiate the highest speed supported in common with it's link partner. On SFP+ adapters, "auto" instructs the adapter to use the highest link speed supported by the inserted SFP+ module. On 10GBASE-T and SFP+ adapters, any other value specified will fix the link at that speed, regardless of the capabilities of the link partner, which may result in an inability to establish the link. `auto` Auto-negotiate link speed (default) `10G` 10G bit/sec `1G` 1G bit/sec `100M` 100M bit/sec
`linkup-delay=<seconds>`	Specifies the delay (in seconds) the adapter defers its first connection attempt after booting, allowing time for the network to come up following a power failure or other restart. This can be used to wait for spanning tree protocol on a connected switch to unblock the switch port after the physical network link is established. The default is 5 seconds.
`banner-delay=<seconds>`	Specifies the wait period for **Ctrl-B** to be pressed to enter adapter configuration tool. `seconds` = 0-256
`bootskip-delay=<seconds>`	Specifies the time allowed for **Esc** to be pressed to skip adapter booting. `seconds` = 0-256
`boot-type=<pxe|iscsi|disabled>`	Sets the adapter boot type. `pxe` – PXE (Preboot eXecution Environment) booting `iscsi` – iSCSI (Internet Small Computer System Interface) booting `disabled` – Disable adapter booting

Table 15: Sfboot Parameters

Parameter	Description

`initiator-dhcp=<enabled|disabled>`	Enables or disables DHCP address discovery for the adapter by the Boot ROM except for the Initiator IQN (see `initiator-iqn-dhcp`). This option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).
	If initiator-DHCP is set to disabled, the following options will need to be specified:
	`initiator-ip=<ip_address>`
	`netmask=<subnet>`
	The following options may also be needed:
	`gateway=<ip_address>`
	`primary-dns=<ip_address>`

`initiator-ip=<ipv4 address>`	Specifies the IPv4 address (in standard "." notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled initiator-ip=<192.168.1.3>`
`netmask=<ipv4 subnet>`	Specifies the IPv4 subnet mask (in standard "." notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled netmask=255.255.255.0`
`gateway=<ipv4 address>`	Specifies the IPv4 subnet mask (in standard "." notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled gateway=192.168.0.10`

Table 15: Sfboot Parameters

Parameter	Description
`primary-dns=<ipv4 address>`	Specifies the IPv4 address (in standard "." notation form) of the Primary DNS to be used by the adapter when `initiator-dhcp` is disabled. This option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled primary-dns=192.168.0.3`
`initiator-iqn-dhcp=<enabled|disabled>`	Enables or disables use of DHCP for the initiator IQN only.
`initiator-iqn=<IQN>`	Specifies the IQN (iSCSI Qualified Name) to be used by the adapter when `initiator-iqn-dhcp` is disabled. The IQN is a symbolic name in the "." notation form; for example: iqn.2009.01.com.solarflare, and is a maximum of 223 characters long. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot initiator-iqn-dhcp=disabled initiator-iqn=iqn.2009.01.com.solarflare adapter=2`
`lun-retry-count=<count>`	Specifies the number of times the adapter attempts to access and login to the Logical Unit Number (LUN) on the iSCSI Target before failing. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot lun-retry-count=3`

Table 15: Sfboot Parameters

Parameter	Description

`target-dhcp=<enabled|disabled>`	Enables or disables the use of DHCP to discover iSCSI target parameters on the adapter.
	If `target-dhcp` is disabled, you must specify the following options:
	`target-server=<address>`
	`target-iqn=<iqn>`
	`target-port=<port>`
	`target-lun=<LUN>`
	Example - Enable the use of DHCP to configure iSCSI Target settings:
	`sfboot boot-type=iscsi target-dhcp=enabled`

`target-server=<DNS name or ipv4 address>`	Specifies the iSCSI target's DNS name or IPv4 address to be used by the adapter when `target-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi target-dhcp=disabled target-server=192.168.2.2`
`target-port=<port_number>`	Specifies the Port number to be used by the iSCSI target when `target-dhcp` is disabled. The default Port number is Port 3260. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi target-dhcp=disabled target-port=3262` This option should only be used if your target is using a non-standard TCP Port.
`target-lun=<LUN>`	Specifies the Logical Unit Number (LUN) to be used by the iSCSI target when `target-dhcp` is disabled. The default LUN is 0. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).

Table 15: Sfboot Parameters

Parameter	Description
`target-iqn=<IQN>`	Specifies the IQN of the iSCSI target when `target-dhcp` is disabled. Maximum of 223 characters. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Note that if there are spaces contained in `<IQN>`, then the IQN must be wrapped in double quotes (“”). Example: `sfboot target-dhcp=disabled target-iqn=iqn.2009.01.com.solarflare adapter=2`
`vendor-id=<dhcp_id>`	Specifies the device vendor ID to be advertised to the DHCP server. This must match the vendor id configured at the DHCP server when using DHCP option 43 to obtain the iSCSI target.

`chap=<enabled|disabled>`	Enables or disables the use of Challenge Handshake Protocol (CHAP) to authenticate the iSCSI connection.
	Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).
	To be valid, this option also requires the following sub-options to be specified:
	`username=<initiator username>`
	`secret=<initiator password>`
	Example:
	`sfboot boot-type=iscsi chap=enabled username=initiatorusername secret=initiatorsecret`

Table 15: Sfboot Parameters

Parameter	Description
`username=<username>`	Specifies the CHAP initiator username (maximum 64 characters). Note that this option is required if either CHAP or Mutual CHAP is enabled (`chap=enabled`, `mutual-chap=enabled`). Note that if there are spaces contained in `<username>`, then it must be wrapped in double quotes (“”). Example: `sfboot boot-type=iscsi chap=enabled username=username`
`secret=<secret>`	Specifies the CHAP initiator secret (minimum 12 characters, maximum 20 characters). Note that this option is valid if either CHAP or Mutual CHAP is enabled (chap=enabled, `mutual-chap=enabled`). Note that if there are spaces contained in `<secret>`, then it must be wrapped in double quotes (“”). Example: `sfboot boot-type=iscsi chap=enabled username=username secret=veryverysecret`

`mutual-chap=<enabled|disabled>`	Enables/disables Mutual CHAP authentication when iSCSI booting is enabled.
	
	This option also requires the following sub-options to be specified:
	
	`target-username=<username>`
	
	`target-secret=<password>`
	
	`username=<username>`
	
	`secret=<password>`
	
	Example:
	
	`sfboot boot-type=iscsi mutual-chap=enabled username=username secret=veryverysecret target-username=targetusername target-secret=anothersecret`

Table 15: Sfboot Parameters

Parameter	Description
`target-username=<username>`	Specifies the username that has been configured on the iSCSI target (maximum 64 characters). Note that this option is necessary if Mutual CHAP is enabled on the adapter (`mutual-chap=enabled`). Note that if there are spaces contained in `<username>`, then it must be wrapped in double quotes (“”).
`target-secret=<secret>`	Specifies the secret that has been configured on the iSCSi target (minimum 12 characters; maximum 20 characters). Note: This option is necessary if Mutual CHAP is enabled on the adapter (`mutual-chap=enabled`). Note that if there are spaces contained in `<secret>`, then it must be wrapped in double quotes (“”).
`mpio-priority=<MPIO priority>`	Specifies the Multipath I/O (MPIO) priority for the adapter. This option is only valid for iSCSI booting over multi-port adapters, where it can be used to establish adapter port priority. The range is 1- 255, with 1 being the highest priority.
`mpio-attempts=<attempt count>`	Specifies the number of times MPIO will try and use each port in turn to login to the iSCSI target before failing.
`msix-limit=` <8|16|32|64|128|256|512|1024>	Specifies the maximum number of MSI-X interrupts the specified adapter will use. The default is 32. Note: Using the incorrect setting can impact the performance of the adapter. Contact Solarflare technical support before changing this setting.
`sriov=<enabled|disabled>`	Enable SR-IOV support for operating systems that support this.

Table 15: Sfboot Parameters

Parameter	**Description**
`vf-count=<vf count>`	The number of virtual functions (VF) advertised to the operating system. The Solarflare SFC9000 family of controllers support a total limit of 127 virtual functions per port and a total 1024 interrupts. Depending on the values of msix-limit and vf-msix-limit, some of these virtual functions may not be configured. Enabling all 127 VFs per port with more than one MSI-X interrupt per VF may not be supported by the host BIOS - in which case you may get 127 VFs on one port and none on others. Contact your BIOS vendor or reduce the VF count. The sriov parameter is implied if vf-count is greater than zero.
`vf-msix-limit=<1|2|4|8>`	The maximum number of interrupts a virtual function may use.
`firmware-variant=<full-feature|ultra-low-latency|auto>`	For SFN7000 series adapters only. The ultra-low-latency variant produces best latency without support for TX VLAN insertion or RX VLAN stripping (not currently used features). It is recommended that Onload customers use the ultra-low-latency variant. Default value = auto - means the driver will select ultra-low-latency by default.

Sfboot: Examples

- Show the current boot configuration for all adapters:

sfboot

```
Solarflare boot configuration utility [v3.0.3]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

eth1:
  Boot image                       Option ROM and UEFI
    Link speed                     Negotiated automatically
    Link-up delay time             5 seconds
    Banner delay time              2 seconds
    Boot skip delay time           5 seconds
    Boot type                      PXE
  MSI-X interrupt limit            32

eth2:
  Boot image                       Option ROM and UEFI
    Link speed                     Negotiated automatically
    Link-up delay time             5 seconds
    Banner delay time              2 seconds
    Boot skip delay time           5 seconds
    Boot type                      PXE
  MSI-X interrupt limit            32
```

- List all Solarflare adapters installed on the localhost:

sfboot --list

```
Solarflare boot configuration utility [v3.0.2]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

eth4 - 00-0F-53-01-3C-AC, eth5 - 00-0F-53-01-3C-AD, eth6 - 00-0F-53-01-
3C-A4, eth7 - 00-0F-53-01-3C-A5
```


- Enable iSCSI booting on adapter eth4. Implement default iSCSI settings:

```
sfboot --adapter=eth4 boot-type=iscsi
```

```
Solarflare boot configuration utility [v3.0.2]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

eth4:
 Boot image                     Option ROM and UEFI
   Link speed                   Negotiated automatically
   Link-up delay time           5 seconds
   Banner delay time            2 seconds
   Boot skip delay time         5 seconds
   Boot type                    iSCSI
    Use DHCP for Initiator      Enabled
    Use DHCP for Initiator IQN Enabled
    LUN busy retries            2
    Use DHCP for Target         Enabled
    DHCP Vendor Class ID        SFCgPXE
    CHAP authentication         Disabled
    Mutual CHAP authentication Disabled
    MPIO priority               0
    MPIO boot attempts          3
  MSI-X interrupt limit         32
```


- iSCSI enable adapter eth2. Disable DHCP. Specify adapter IP address and netmask:

```
sfboot boot-type=iscsi --adapter=eth2 initiator-dhcp=disabled initiator-
ip=192.168.0.1 netmask=255.255.255.0
```

```
Solarflare boot configuration utility [v3.0.2]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

 eth2:
  Boot image                        Option ROM and UEFI
    Link speed                        Negotiated automatically
    Link-up delay time                5 seconds
    Banner delay time                 2 seconds
    Boot skip delay time              5 seconds
    Boot type                         iSCSI
     Use DHCP for Initiator           Disabled
      Initiator IP address            192.168.0.1
      Initiator netmask               255.255.255.0
      Initiator default gateway       0.0.0.0
      Initiator primary DNS           0.0.0.0
     Use DHCP for Initiator IQN       Enabled
     LUN busy retries                 2
     Use DHCP for Target              Enabled
   DHCP Vendor Class ID               SFCgPXE
   CHAP authentication                Disabled
   Mutual CHAP authentication         Disabled
   MPIO priority                      0
   MPIO boot attempts                 3
 MSI-X interrupt limit                32
```

- Enable PXE boot

```
sfboot boot-image=option rom boot-type=pxe
```

- Enable SR-IOV

```
sfboot sriov=enabled vf-count=16 vf-msix-limit=1
```

- SFN7000 Series - Firmware Variant

sfboot firmware-variant=full-feature

```
Solarflare boot configuration utility [v4.0.0]
Copyright Solarflare Communications 2006-2013, Level 5 Networks 2002-2005

eth4:
  Boot image                                Option ROM only
    Link speed                              Negotiated automatically
    Link-up delay time                      7 seconds
    Banner delay time                       3 seconds
    Boot skip delay time                    6 seconds
    Boot type                               PXE
  MSI-X interrupt limit                     32
    Number of Virtual Functions             0
    VF MSI-X interrupt limit                1
  Firmware variant                          full feature / virtualization
```

3.18 Upgrading Adapter Firmware with Sfupdate

Sfupdate is a command line utility to manage and upgrade the Solarflare adapter Boot ROM, Phy and adapter firmware. Embedded within the sfupdate executable are firmware images for various Solarflare adapters - the exact updates available via sfupdate depend on the adapter.

See Configuring the Solarflare Boot ROM Agent on page 360 for more information on the Boot Rom agent.

NOTE: All Applications accelerated with OpenOnload should be terminated before updating the firmware with sfupdate.

Sfupdate: Command Usage

The general usage for sfupdate is as follows (as root):

```
sfupdate [--adapter=eth<N>] [options]
```

where:

`ethN` is the interface name (ifname) of the Solarflare adapter to be upgraded.

`option` is one of the command options listed in Table 16.

The format for the options are:

`<option>=<parameter>`

Running the command `sfupdate` with no additional parameters will show the current firmware version for all Solarflare adapters and identifies whether the firmware within sfupdate is more up to date. To update the firmware for all Solarflare adapters run the command `sfupdate --write`

Solarflare recommend the following procedure:

1. Run `sfupdate` to check that the firmware on all adapters is up to date.
2. Run `sfupdate --write` to update the firmware on all adapters.

Sfupdate: Linux MTD Limitations

The driver supplied "inbox" within RedHat and Novell distributions has a limitation on the number of adapters that sfupdate can support. This limitation is removed from RHEL 6.5 onwards. The Solarflare supplied driver is no longer subject to this limitation on any distro/kernel.

Linux kernel versions prior to 2.6.20 support up to 16 MTD (flash) devices. Solarflare adapters are equipped with 6 flash partitions. If more than two adapters are deployed within a system a number of flash partitions will be inaccessible during upgrade.

The limit was raised to 32 in Linux kernel version 2.6.20 and removed altogether in 2.6.35.

If issues are encountered during sfupdate, the user should consider one of the following options when upgrading firmware on systems equipped with more than two Solarflare adapters:

- Upgrade two adapters at a time with the other adapters removed.
- Upgrade the kernel.
- Rebuild the kernel, raising the value of `MAX_MTD_DEVICES` in include`/linux/mtd/mtd.h`.
- Request bootable utilities from support@solarflare.com.

Overcome Linux MTD Limitations

An alternative method is available to upgrade the firmware without removing the adapters.

1 Unbind all interfaces from the drivers:

```
# for bdf in $(lspci -D -d 1924: | awk '{ print $1 }'); do echo -n ${bdf}\
     > /sys/bus/pci/devices/${bdf}/driver/unbind; done
```

2 `ifconfig -a` will not discover any Solarflare interfaces.

3 Identify the bus/device/function for all Solarflare interfaces:

```
# lspci -D -d 1924:
```

4 Output similar to the following will be produced (5 NICs installed in this example):

```
# lspci -D -d 1924:
0000:02:00.0 Ethernet controller: Solarflare Communications SFC9020
     [Solarstorm]
0000:02:00.1 Ethernet controller: Solarflare Communications SFC9020
     [Solarstorm]
0000:03:00.0 Ethernet controller: Solarflare Communications SFC9020
     [Solarstorm]
0000:03:00.1 Ethernet controller: Solarflare Communications SFC9020
     [Solarstorm]
0000:04:00.0 Ethernet controller: Solarflare Communications SFL9021
     [Solarstorm]
0000:04:00.1 Ethernet controller: Solarflare Communications SFL9021
     [Solarstorm]
0000:83:00.0 Ethernet controller: Solarflare Communications SFC9020
     [Solarstorm]
0000:83:00.1 Ethernet controller: Solarflare Communications SFC9020
     [Solarstorm]
0000:84:00.0 Ethernet controller: Solarflare Communications SFC9020
     [Solarstorm]
0000:84:00.1 Ethernet controller: Solarflare Communications SFC9020
     [Solarstorm]
```


5 There are enough resources to upgrade two NICs at a time, so re-bind interfaces in groups of four (2x2NICs):

```
# echo -n "0000:02:00.0" > /sys/bus/pci/drivers/sfc/bind
# echo -n "0000:02:00.1" > /sys/bus/pci/drivers/sfc/bind
# echo -n "0000:03:00.0" > /sys/bus/pci/drivers/sfc/bind
# echo -n "0000:03:00.1" > /sys/bus/pci/drivers/sfc/bind
```

6 Run sfupdate to update these NICs (command options may vary):

```
# sfupdate --write --yes --force
```

7 Run the command to unbind the interfaces again, there will be failures reported because some of the interfaces aren't bound:

```
# for bdf in $(lspci -D -d 1924: | awk '{ print $1 }'); do echo -n ${bdf}\
     > /sys/bus/pci/devices/${bdf}/driver/unbind; done
```

8 Repeat the process for the other interfaces (0000:04:00.x; 0000:83:00.x and 0000:84:00.x) doing so in pairs until all the NICs have been upgraded.

9 Rebind all interfaces, doing so en-mass and ignoring errors from those already bound:

```
# for bdf in $(lspci -D -d 1924: | awk '{ print $1 }'); do echo -n ${bdf}\
     > /sys/bus/pci/drivers/sfc/bind; done
```

10 Alternatively reload the sfc driver:

```
# onload_tool reload
```

or:

```
# modprobe -r sfc
# modprobe sfc
```

11 Run `ifconfig -a` again to find that all the interfaces are reported and all have been firmware upgraded without having to physically touch the server or change the kernel.

Sfupdate: SLES 11 Limitation

Due to limitations in SLES 11 using kernel versions prior to 2.6.27.54 it is necessary to reboot the server after running the sfupdate utility to upgrade server firmware.

Sfupdate: Command Line Options

Table 16 lists the options for `sfupdate`.

Table 16: Sfupdate Options

Option	Description
`-h, --help`	Shows help for the available options and command line syntax.
`-i, --adapter=ethX`	Specifies the target adapter when more than one adapter is installed in the localhost. `ethX` = Adapter ifname or MAC address (as obtained with `--list`).
`--list`	Shows the adapter ID, adapter name and MAC address of each adapter installed in the localhost.
`--write`	Re-writes the firmware from the images embedded in the `sfupdate` tool. To re-write using an external image, specify `--image=<filename>` in the command. `--write` fails if the embedded image is the same or a previous version. To force a write in this case, specify `--force` in the command.
`--force`	Force the update of all firmware, even if the installed firmware version is the same as, or more recent then, the firmware embedded in `sfupdate`.
`--image=(filename)`	Update the firmware using the binary image from the given file rather than from those embedded in the utility.
`-y, --yes`	Prompts for user confirmation before writing the firmware to the adapter.
`-v, --verbose`	Verbose mode.
`-s, --silent`	Suppress output while the utility is running; useful when the utility is used in a script.
`-V --version`	Display version information and exit.

Sfupdate: Examples

- Display firmware versions for all adapters:

`sfupdate`

```
Solarstorm firmware update utility [v3.0.3]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

eth1 - MAC: 00-0F-53-01-39-70
    Firmware version:   v3.0.3
    PHY type:           QT2025C
    PHY version:        v2.0.2.5
    Controller type:    Solarflare SFC4000
    Controller version: v3.0.3.2127
    BootROM version:    v3.0.3.2127

The PHY firmware is up to date
The BootROM firmware is up to date
The controller firmware is up to date

eth2 - MAC: 00-0F-53-01-39-71
    Firmware version:   v3.0.2
    PHY type:           QT2025C
    PHY version:        v2.0.2.5

The PHY firmware is up to date
```

3.19 License Install with sfkey

The sfkey utility is distributed with the Linux Utilities RM package. This utility is used to install Solarflare AppFlex™ licenses and enable selected on-board services for Solarflare adapters. For more information about license requirements see Solarflare AppFlex™ Technology Licensing. on page 13.

sfkey: Command Usage

sfkey [--adapter=eth<N>] [options]

If the adapter option is not specified, operations will be applied to all installed adapters.

- To view all sfkey options:

```
# sfkey --help
```

- To list (by serial number) all adapters that support licensing:

```
# sfkey --inventory
```

- To display an adapter serial number and installed license keys:

```
# sfkey --adapter=eth2 --report
```

```
Adapter:            eth2
Product name:       Solarflare SFN7122F SFP+ Server Adapter
Part number:        SFN7122F
Serial number:      712200205071133867100591
MAC address:        00-0F-53-21-9B-B0
Installed keys:     2
Active keys:        2
Blacklisted keys:   0
Invalid keys:       0
Unverifiable keys:  0
Inapplicable keys:  0
```

The installed keys field identifies the number of license keys installed. The active keys field identifies the number of licenses activated on the adapter.

- To install a license:

Copy the license key data to a .txt file on the target server. All keys can be in the same key file and the file applied on multiple servers. The following example uses a license key file called key.txt created on the local server.

```
# sfkey --adapter=eth<N> --install key.txt

sfkey firmware update utility: v3.3.3.6330
Copyright Solarflare Communications 2006-2013, Level 5 Networks 2002-2005
Reading keys...
Writing keys to eth1...
```

```
Adapter: eth1
Product name: Solarflare SFN7122F SFP+ Adapter
Part number: SFN7122F
Serial number: 712200205071133867100591
MAC address: 00-0F-53-21-9B-B0
Installed keys: 2
Active keys: 2
Blacklisted keys: 0
Invalid keys: 0
```

Table 17 describes all sfkey options.

Table 17: sfkey options

Option	Description
`--inventory`	List by serial number all adapters that support licensing.
`--noevaluationupdate`	Do not update evaluation keys.
`-a --all`	Apply sfkey operation to all adapters that support licensing.
`-c --clear`	Delete all existing license keys from an adapter.
`-h, --help`	Display all sfkey options.
`-i --adapter`	identify specific adapter to apply sfkey operation to.
`-r --report`	Display an adapter serial number and current license status (see example above).
`-s --silent`	Silent mode, output errors only.
`-v --verbose`	Verbose mode.
`-V --version`	Display sfkey version and exit.
`-x --xml`	Report format as XML.

3.20 Performance Tuning on Linux

Introduction

The Solarflare family of network adapters are designed for high-performance network applications. The adapter driver is pre-configured with default performance settings that have been chosen to give good performance across a broad class of applications. In many cases, application performance can be improved by tuning these settings to best suit the application.

There are three metrics that should be considered when tuning an adapter:

- Throughput
- Latency
- CPU utilization

Different applications may be more or less affected by improvements in these three metrics. For example, transactional (request-response) network applications can be very sensitive to latency whereas bulk data transfer applications are likely to be more dependent on throughput.

The purpose of this guide is to highlight adapter driver settings that affect the performance metrics described. This guide covers the tuning of all Solarflare adapters.

In addition to this guide, the user should consider other issues influencing performance such as application settings, server motherboard chipset, additional software installed on the system, such as a firewall, and the specification and configuration of the LAN. Consideration of such issues is not within the scope of this guide.

Tuning settings

Adapter MTU (Maximum Transmission Unit)

The default MTU of 1500 bytes ensures that the adapter is compatible with legacy 10/100Mbps Ethernet endpoints. However if a larger MTU is used, adapter throughput and CPU utilization can be improved. CPU utilization is improved because it takes fewer packets to send and receive the same amount of data. Solarflare adapters support frame sizes up to 9216 bytes (this does not include the Ethernet preamble or frame-CRC).

Since the MTU should ideally be matched across all endpoints in the same LAN (VLAN), and since the LAN switch infrastructure must be able to forward such packets, the decision to deploy a larger than default MTU requires careful consideration. It is recommended that experimentation with MTU be done in a controlled test environment.

The MTU is changed dynamically using ifconfig, where `ethX` is the interface name and size is the MTU size in bytes:

```
# /sbin/ifconfig <ethX> mtu <size>
```

Verification of the MTU setting may be performed by running `ifconfig` with no options and checking the MTU value associated with the interface. The change in MTU size can be made to persist across reboots by editing the file `/etc/sysconfig/network-scripts/ifcfg-ethX` and adding `MTU=<mtu>` on a new line.

Interrupt Moderation (Interrupt Coalescing)

Interrupt moderation controls the number of interrupts generated by the adapter by adjusting the extent to which receive packet processing events are coalesced. Interrupt moderation may coalesce more than one packet-reception or transmit-completion event into a single interrupt.

By default, adaptive moderation is enabled. Adaptive moderation means that the network driver software adapts the interrupt moderation setting according to the traffic and workload conditions. Before adjusting the interrupt interval, it is recommended to disable adaptive moderation:

```
ethtool -C <ethX> adaptive-rx off
```

Interrupt moderation can be changed using ethtool, where `ethX` is the interface name and `interval` is the moderation setting in microseconds (µs). An interval value of zero (0) will turn interrupt moderation off.

To set RX interrupt moderation:

```
ethtool –C <ethX> rx-usecs <interval> rx-frames 0
or
ethtool –C <ethX> rx-usecs 0 rx-frames 1
```

The above example also sets the transmit interrupt moderation interval unless the driver module parameter `separate_tx_channels` is enabled. Normally packet RX and TX completions will share interrupts so RX and TX interrupt moderation intervals must be equal, then the adapter driver automatically adjusts tx-usecs to match rx-usecs. Refer to Table 22: Driver Module Parameters.

To set TX interrupt moderation, if `separate_tx_channels` is enabled:

```
ethtool -C <ethX> tx-usecs 0 tx-frames 0
```
or
```
ethtool -C <ethX> tx-usecs 0 tx-frames 1
```

Interrupt moderation settings can be checked using `ethtool -c` .

The interrupt moderation interval is critical for tuning adapter latency:

- Increasing the moderation value will increase latency, but reduce CPU utilization and improve peak throughput, if the CPU is fully utilized.
- Decreasing the moderation value or turning it off will decrease latency at the expense of CPU utilization and peak throughput.

For many transaction request-response type network applications, the benefit of reduced latency to overall application performance can be considerable. Such benefits may outweigh the cost of increased CPU utilization.

NOTE: The interrupt moderation interval dictates the minimum gap between two consecutive interrupts. It does not mandate a delay on the triggering of an interrupt on the reception of every packet. For example, an interrupt moderation setting of 30µs will not delay the reception of the first packet received, but the interrupt for any following packets will be delayed until 30µs after the reception of that first packet.

TCP/IP Checksum Offload

Checksum offload moves calculation and verification of IP Header, TCP and UDP packet checksums to the adapter. The driver by default has all checksum offload features enabled. Therefore, there is no opportunity to improve performance from the default.

Checksum offload is controlled using ethtool:

Receive Checksum:

```
# /sbin/ethtool -K <ethX> rx <on|off>
```

Transmit Checksum:

```
# /sbin/ethtool -K <ethX> tx <on|off>
```

Verification of the checksum settings may be performed by running ethtool with the –k option. Solarflare recommend you do not disable checksum offload.

TCP Segmentation Offload (TSO)

TCP Segmentation offload (TSO) offloads the splitting of outgoing TCP data into packets to the adapter. TCP segmentation offload benefits applications using TCP. Non TCP protocol applications will not benefit (but will not suffer) from TSO.

Enabling TCP segmentation offload will reduce CPU utilization on the transmit side of a TCP connection, and so improve peak throughput, if the CPU is fully utilized. Since TSO has no effect on latency, it can be enabled at all times. The driver has TSO enabled by default. Therefore, there is no opportunity to improve performance from the default.

TSO is controlled using ethtool:

```
# /sbin/ethtool –K <ethX> tso <on|off>
```

Verification of the TSO settings may be performed by running `ethtool` with the `–k` option. Solarflare recommend you do not disable TSO.

TCP Large Receive Offload (LRO)

TCP Large Receive Offload (LRO) is a feature whereby the adapter coalesces multiple packets received on a TCP connection into a single call to the operating system TCP Stack. This reduces CPU utilization, and so improves peak throughput when the CPU is fully utilized.

LRO should not be enabled if you are using the host to forward packets from one interface to another; for example if the host is performing IP routing or acting as a layer2 bridge. The driver has LRO enabled by default.

.

NOTE: It has been observed that as RHEL6 boots the libvirtd daemon changes the default forwarding setting such that LRO is disabled on all network interfaces. This behaviour is undesirable as it will potentially lower bandwidth and increase CPU utilization - especially for high bandwidth streaming applications.

To determine if LRO is enabled on an interface:

```
ethtool -k ethX
```

If IP forwarding is not required on the server, Solarflare recommends either:

Disabling the libvirtd service (if this is not being used),

Or, as root before loading the Solarflare driver:

```
sysctl -w net.ipv4.conf.default.forwarding=0
```

(This command can be loaded into `/etc/rc.local`),

Or, after loading the Solarflare driver, turn off forwarding for only the Solarflare interfaces and re-enable LRO:

```
sysctl -w net.ipv4.conf.ethX.forwarding=0

ethtool -K ethX lro on
```

(where X is the id of the Solarflare interface).

Disabling the libvirtd service is a permanent solution, whereas the other recommendations are temporary and will not persist over reboot.

LRO should not be enabled if IP forwarding is being used on the same interface as this could result in incorrect IP and TCP operation.

LRO can be controlled using the module parameter `lro`. Add the following line to `/etc/modprobe.conf` or add the options line to a file under the `/etc/modprobe.d` directory to disable LRO:

```
options sfc lro=0
```

Then reload the driver so it picks up this option:

```
rmmod sfc
modprobe sfc
```

The current value of this parameter can be found by running:

```
cat /sys/module/sfc/parameters/lro
```


LRO can also be controlled on a per-adapter basis by writing to this file in `sysfs`:

```
/sys/class/net/ethX/device/lro
```

To disable LRO:

```
echo 0 > /sys/class/net/ethX/device/lro
```

To enable LRO:

```
echo 1 > /sys/class/net/ethX/device/lro
```

To show the current value of the per-adapter LRO state:

```
cat /sys/class/net/ethX/device/lro
```

Modifying this file instantly enables or disables LRO, no reboot or driver reload is required. This setting takes precedence over the `lro` module parameter

Current LRO settings can be identified with Linux ethtool .e.g.

```
ethtool -k ethX
```


TCP Protocol Tuning

TCP Performance can also be improved by tuning kernel TCP settings. Settings include adjusting send and receive buffer sizes, connection backlog, congestion control, etc.

For Linux kernel versions, including 2.6.16 and later, initial buffering settings should provide good performance. However for earlier kernel versions, and for certain applications even on later kernels, tuning buffer settings can significantly benefit throughput. To change buffer settings, adjust the `tcp_rmem` and `tcp_wmem` using the `sysctl` command:

Receive buffering:

```
sysctl net.ipv4.tcp_rmem="<min> <default> <max>"
```

Transmit buffering:

```
sysctl net.ipv4.tcp_wmem="<min> <default> <max>"
```

(`tcp_rmem` and `tcp_wmem` can also be adjusted for IPV6 and globally with the net.ipv6 and net.core variable prefixes respectively).

Typically it is sufficient to tune just the max buffer value. It defines the largest size the buffer can grow to. Suggested alternate values are max=500000 (1/2 Mbyte). Factors such as link latency, packet loss and CPU cache size all influence the affect of the max buffer size values. The minimum and default values can be left at their defaults minimum=4096 and default=87380.

Receive Side Scaling (RSS)

Solarflare adapters support Receive Side Scaling (RSS). RSS enables packet receive-processing to scale with the number of available CPU cores. RSS requires a platform that supports MSI-X interrupts. RSS is enabled by default.

When RSS is enabled the controller uses multiple receive queues into which to deliver incoming packets. The receive queue selected for an incoming packet is chosen in such a way as to ensure that packets within a TCP stream are all sent to the same receive queue – this ensures that packet-ordering within each stream is maintained. Each receive queue has its own dedicated MSI-X interrupt which ideally should be tied to a dedicated CPU core. This allows the receive side TCP processing to be distributed amongst the available CPU cores, providing a considerable performance advantage over a conventional adapter architecture in which all received packets for a given interface are processed by just one CPU core.

By default the drivers enables RSS and configures one RSS Receive queue per CPU core. The number of RSS Receive queues can be controlled via the driver module parameter `rss_cpus`. The following options are supported:

Table 18: rss_cpus Options

Option	Description	Interrupt Affinity (MSI-X)
<num_cpus>	Indicates the number of RSS queues to create.	A separate MSI-X interrupt for a receive queue is affinitized to each CPU.
packages	An RSS queue will be created for each multi-core CPU package. The first CPU in the package will be chosen.	A separate MSI-X interrupt for a receive queue, is affinitized to each of the designated package CPUs.
cores	An RSS queue will be created for each CPU. The first hyperthread instance (If CPU has hyperthreading) will be chosen. The default option.	A separate MSI-X interrupt for a receive queue, is affinitized to each of the CPUs.
hyperthreads	An RSS queue will be created for each CPU hyperthread (hyperthreading must be enabled).	A separate MSI-X interrupt for a receive queue, is affinitized to each of the hyperthreads.

Add the following line to `/etc/modprobe.conf` file or add the options line to a user created file under the /etc/modprobe.d directory. The file should have a .conf extension :

```
options sfc rss_cpus=<option>
```

To set `rss_cpus` equal to the number of CPU cores:

```
options sfc rss_cpus=cores
```

Sometimes, it can be desirable to disable RSS when running single stream applications, since all interface processing may benefit from taking place on a single CPU:

```
options sfc rss_cpus=1
```

NOTE: The association of RSS receive queues to a CPU is governed by the receive queue's MSI-X interrupt affinity. See Interrupt and Irqbalance Service on page 89 for more details.

The driver must be reloaded to enable option changes:

```
rmmod sfc
modprobe sfc
```


NOTE: The `rss_cpus` parameter controls the number of MSI-X interrupts used by each Solarflare port. Unfortunately, some older Linux version have a bug whereby the maximum number of MSI-X interrupts used by a PCI function is fixed at the first driver load. For instance, if the drivers are first loaded with `rss_cpus=1`, all subsequent driver loads will always use `rss_cpus=1`.

Red Hat Enterprise Linux 5 update 2 (and above), and SUSE Enterprise Linux 11 are not affected by this issue.

To workaround this issue, you must reboot the host after modifying `rss_cpus`.

NOTE: RSS also works for UDP packets. For UDP traffic the Solarflare adapter will select the Receive CPU based on IP source and destination addresses. Solarflare adapters support IPv4 and IPv6 RSS except the SFN4xxx adapters which only supports IPv4 RSS.

Receive Flow Steering (RFS)

RFS will attempt to steer packets to the core where a receiving application is running. This reduces the need to move data between processor caches and can significantly reduce latency and jitter. Modern NUMA systems, in particular, can benefit substantially from RFS where packets are delivered into memory local to the receiving thread.

Unlike RSS which selects a CPU from a CPU affinity mask set by an administrator or user, RFS will store the application's CPU core identifier when the application process calls `recvmsg()` or `sendmsg()`.

- A hash is calculated from a packet’s addresses or ports (2-tuple or 4-tuple) and serves as the consistent hash for the flow associated with the packet.
- Each receive queue has an associated list of CPUs to which RFS may enqueue the received packets for processing.
- For each received packet, an index into the CPU list is computed from the flow hash modulo the size of the CPU list.

There are two types of RFS implementation; Soft RFS and Hardware (or Accelerated) RFS.

Soft RFS is a software feature supported since Linux 2.6.35 that attempts to schedule protocol processing of incoming packets on the same processor as the user thread that will consume the packets.

Accelerated RFS requires Linux kernel version 2.6.39 or later, with the Linux sfc driver or Solarflare v3.2 network adapter driver.

RFS can dynamically change the allowed CPUs that can be assigned to a packet or packet stream and this introduces the possibility of out of order packets. To prevent out of order data, two tables are created that hold state information used in the CPU selection.

- **Global_flow_table:** Identifies the number of simultaneous flows that are managed by RFS.
- **Per_queue_table**: Identifies the number of flows that can be steered to a queue. This holds state as to when a packet was last received.

The tables support the steering of incoming packets from the network adapter to a receive queue affinitized to a CPU where the application is waiting to receive them. The Solarflare accelerated RFS implementation requires configuration through the two tables and the ethtool -K command.

The following sub-sections identify the RFS configuration procedures:

Kernel Configuration

Before using RFS the kernel must be compiled with the kconfig symbol `CONFIG_RPS` enabled.

Global Flow Count

Configure the number of simultaneous flows that will be managed by RFS. The suggested flow count will depend on the expected number of active connections at any given time and may be less than the number of open connections. The value is rounded up to the nearest power of two.

```
# echo 32768 > /proc/sys/net/core/rps_sock_flow_entries
```

Per Queue Flow Count

For each adapter interface there will exist a ’queue’ directory containing one ’rx’ or ’tx’ subdirectory for each queue associated with the interface. For RFS only the receive queues are relevant.

```
# cd /sys/class/net/eth3/queue
```

Within each ’rx’ subdirectory, the `rps_flow_cnt` file holds the number of entries in the per- queue flow table. If only a single queue is used then `rps_flow_cnt` will be the same as `rps_sock_flow_entries`. When multiple queues are configured the count will be equal to `rps_sock_flow_entries/N` where N is the number of queues, for example:

`rps_sock_flow_entries` = 32768 and there are 16 queues then `rps_flow_cnt` for each queue will be configured as 2048.

```
# echo 2048 > /sys/class/net/eth3/queues/rx-0/rps_flow_cnt
# echo 2048 > /sys/class/net/eth3/queues/rx-1/rps_flow_cnt
```

Disable RFS

To turn off RFS using the following command:

```
# ethtool -K <devname> ntuple off
```


Transmit Packet Steering

Transmit Packet Steering (XPS) is supported in Linux 2.6.38 and later. XPS is a mechanism for selecting which transmit queue to use when transmitting a packet on a multi-queue device.

XPS is configured on a per transmit queue basis where a bitmap of CPUs identifies the CPUs that may use the queue to transmit.

Kernel Configuration

Before using XPS the kernel must be compiled with the kconfig symbol `CONFIG_XPS` enabled.

Configure CPU/Hyperthreads

Within in each `/sys/class/net/eth3/queues/tx-N` directory there exists an `'xps_cpus'` file which contains a bitmap of CPUs that can use the queue to transmit. In the following example transmit queue 0 can be used by the first two CPUs and transmit queue 1 can be used by the following two CPUs:

```
# echo 3 > /sys/class/net/eth3/queues/tx-0/xps_cpus
# echo c > /sys/class/net/eth3/queues/tx-0/xps_cpus
```

If hyperthreading is enabled, each hyperthread is identified as a seperate CPU, for example if the system has 16 cores but 32 hyperthreads then the transmit queues should be paired with the hyperthreaded cores:

```
# echo 30003 > /sys/class/net/eth3/queues/tx-0/xps_cpus
# echo c000c > /sys/class/net/eth3/queues/tx-0/xps_cpus
```

XPS - Example Configuration

System Configuration:

- Single Solarflare adapter
- 2 x 8 core processors with hyperthreading enabled to give a total of 32 cores
- rss_cpus=8
- Only 1 interface on the adapter is configured
- The IRQ Balance service is disabled

Identify interrupts for the configured interface:

```
# cat /proc/interrupts | grep 'eth3\ | CPU'
```

```
> cat /proc/irq/132/smp_affinity
00000000,00000000,00000000,00000001
> cat /proc/irq/133/smp_affinity
00000000,00000000,00000000,00000100
> cat /proc/irq/134/smp_affinity
00000000,00000000,00000000,00000002
[...snip...]
> cat /proc/irq/139/smp_affinity
00000000,00000000,00000000,00000800
```

The output identifies that IRQ-132 is the first queue and is routed to CPU0. IRQ-133 is the second queue routed to CPU8, IRQ-134 to CPU2 and so on.

Map TX queue to CPU

Hyperthreaded cores are included with the associated physical core:

```
> echo   110011 > /sys/class/net/eth3/queues/tx-0/xps_cpus
> echo 11001100 > /sys/class/net/eth3/queues/tx-1/xps_cpus
> echo   220022 > /sys/class/net/eth3/queues/tx-2/xps_cpus
> echo 22002200 > /sys/class/net/eth3/queues/tx-3/xps_cpus
> echo   440044 > /sys/class/net/eth3/queues/tx-4/xps_cpus
> echo 44004400 > /sys/class/net/eth3/queues/tx-5/xps_cpus
> echo   880088 > /sys/class/net/eth3/queues/tx-6/xps_cpus
> echo 88008800 > /sys/class/net/eth3/queues/tx-7/xps_cpus
```

Configure Global and Per Queue Tables

- The flow count (number of active connections at any one time) = 32768
- Number of queues = 8 (rss_cpus)
- So the flow count for each queue will be 32768/8

```
> echo 32768 > /proc/sys/net/core/rps_sock_flow_entries
> echo 4096 > /sys/class/net/eth3/queues/rx-0/rps_flow_cnt
> echo 4096 > /sys/class/net/eth3/queues/rx-1/rps_flow_cnt
> echo 4096 > /sys/class/net/eth3/queues/rx-2/rps_flow_cnt
> echo 4096 > /sys/class/net/eth3/queues/rx-3/rps_flow_cnt
> echo 4096 > /sys/class/net/eth3/queues/rx-4/rps_flow_cnt
> echo 4096 > /sys/class/net/eth3/queues/rx-5/rps_flow_cnt
> echo 4096 > /sys/class/net/eth3/queues/rx-6/rps_flow_cnt
> echo 4096 > /sys/class/net/eth3/queues/rx-7/rps_flow_cnt
```


Interrupt and Irqbalance Service

Interrupt affinity describes the set of host cpus that may service a particular interrupt.

This affinity therefore dictates the CPU context where received packets will be processed and where transmit packets will be freed once sent. If the application can process the received packets in the same CPU context by being affinitized to the relevant CPU, then latency and CPU utilization can be improved. This improvement is achieved because well tuned affinities reduce inter-CPU communication.

Tuning interrupt affinity is most relevant when MSI-X interrupts and RSS are being used. The irqbalance service, which typically runs by default in most Linux distributions, is a service that automatically changes interrupt affinities based on CPU workload.

In many cases the irqbalance service hinders rather than enhances network performance. It is therefore necessary to disable it and then set interrupt affinities.

To disable irqbalance permanently, run:

```
/sbin/chkconfig -level 12345 irqbalance off
```

To see whether irqbalanace is currently running, run:

```
/sbin/service irqbalance status
```

To disable irqbalance temporarily, run:

```
/sbin/service irqbalance stop
```

Once the irqbalance service has been stopped, the Interrupt affinities can be configured manually.

> **NOTE:** The Solarflare driver will evenly distribute interrupts across the available host CPUs (based on the `rss_cpus` module parameter).
>
> To use the Solarflare driver default affinities (recommended), the irqbalance service must be disabled before the Solarflare driver is loaded (otherwise it will immediately overwrite the affinity configuration values set by the Solarflare driver).

Example 1:

How affinities should be manually set will depend on the application. For a single streamed application such as Netperf, one recommendation would be to affinitize all the Rx queues and the application on the same CPU. This can be achieved with the following steps:

1 Determine which interrupt line numbers the network interface uses. Assuming the interface is eth0, this can be done with:

```
# cat /proc/interrupts | grep eth0-

123:  13302      0      0      0    PCI-MSI-X  eth0-0
131:      0     24      0      0    PCI-MSI-X  eth0-1
139:      0      0     32      0    PCI-MSI-X  eth0-2
147:      0      0      0     21    PCI-MSI-X  eth0-3
```


This output shows that there are four channels (rows) set up between four cpus (columns).

2 Determine the CPUs to which these interrupts are assigned to:

```
# cat /proc/irq/123/smp_affinity
00000000,00000000,00000000,00000000,00000000,00000000,00000000,000000
01
#  cat /proc/irq/131/smp_affinity
00000000,00000000,00000000,00000000,00000000,00000000,00000000,000000
02
#  cat /proc/irq/139/smp_affinity
00000000,00000000,00000000,00000000,00000000,00000000,00000000,000000
04
#  cat /proc/irq/147/smp_affinity
00000000,00000000,00000000,00000000,00000000,00000000,00000000,000000
08
```

This shows that `RXQ[0]` is affinitized to `CPU[0]`, `RXQ[1]` is affinitized to `CPU[1]`, and so on. With this configuration, the latency and cpu utilization for a particular TCP flow will be dependant on that flow's RSS hash, and which CPU that hash resolves onto.

NOTE: Interrupt line numbers and their initial CPU affinity are not guaranteed to be the same across reboots and driver reloads. Typically, it is therefore necessary to write a script to query these values and apply the affinity accordingly.

3 Set all network interface interrupts to a single CPU (in this case `CPU[0]`):

```
# echo 1 >  /proc/irq/123/smp_affinity
# echo 1 >  /proc/irq/131/smp_affinity
# echo 1 >  /proc/irq/139/smp_affinity
# echo 1 >  /proc/irq/147/smp_affinity
```

NOTE: The read-back of `/proc/irq/N/smp_affinity` will return the old value until a new interrupt arrives.

Set the application to run on the same CPU (in this case `CPU[0]`) as the network interface's interrupts:

```
# taskset 1 netperf
# taskset 1 netperf  -H <host>
```


NOTE: The use of taskset is typically only suitable for affinity tuning single threaded, single traffic flow applications. For a multi threaded application, whose threads for example process a subset of receive traffic, taskset is not suitable. In such applications, it is desirable to use RSS and Interrupt affinity to spread receive traffic over more than one CPU and then have each receive thread bind to each of the respective CPUs. Thread affinities can be set inside the application with the `shed_setaffinity()` function (see Linux man pages). Use of this call and how a particular application can be tuned is beyond the scope of this guide.

If the settings have been correctly applied, all interrupts from `eth0` are being handled on `CPU[0]`. This can be checked:

```
# cat /proc/interrupts | grep eth0-

123:  13302      0   1278131      0    PCI-MSI-X  eth0-0
131:      0     24         0      0    PCI-MSI-X  eth0-1
139:      0      0        32      0    PCI-MSI-X  eth0-2
147:      0      0         0     21    PCI-MSI-X  eth0-3
```

Example 2:

An example of affinitizing each interface to a CPU on the same package:

First identify which interrupt lines are servicing which CPU and IO device:

```
# cat /proc/interrupts | grep eth0-
123:      13302        0    1278131          0       PCI-MSI-X  eth0-0
# cat /proc/interrupts | grep eth1-
131:          0       24          0          0       PCI-MSI-X  eth1-0
```

Find CPUs on same package (have same 'package-id'):

```
# more /sys/devices/system/cpu/cpu*/topology/physical_package_id
::::::::::::::
/sys/devices/system/cpu/cpu0/topology/physical_package_id
::::::::::::::
1
::::::::::::::
/sys/devices/system/cpu/cpu10/topology/physical_package_id
::::::::::::::
1
::::::::::::::
/sys/devices/system/cpu/cpu11/topology/physical_package_id
::::::::::::::
0
…
```

Having determined that cpu0 and cpu10 are on package 1, we can assign each ethX interface's MSI-X interrupt to its own CPU on the same package. In this case we choose package 1:


```
# echo 1 >  /proc/irq/123/smp_affinity        1hex is bit 0 = CPU0
# echo 400 >  /proc/irq/131/smp_affinity      400hex is bit 10 = CPU10
```

Buffer Allocation Method

The Solarflare driver has a single optimized buffer allocation strategy. This replaces the two different methods controlled with the `rx_alloc_method` driver module parameter which were available using 3.3 and previous drivers.

The net driver continues to expose the `rx_alloc_method` module option, but the value is ignored and it only exists to not break existing customer configurations.

TX PIO

PIO (programmed input/output) describes the process where data is directly transferred by the CPU to or from an I/O device. It's is an alternative technique to the I/O device using bus master DMA to transfer data without CPU involvement.

Solarflare 7000 series adapters support TX PIO, where packet s on the transmit path can be "pushed" to the adapter directly by the CPU. This improves the latency of transmitted packets but can cause a very small increase in CPU utilisation. TX PIO is therefore especially useful for smaller packets.

The TX PIO feature is enabled by default for packets up to 256 bytes. The maximum packet size that can use PIO can be configured with the driver module option `piobuf_size`.

Other Considerations

PCI Express Lane Configurations

The PCI Express (PCIe) interface used to connect the adapter to the server can function at different widths. This is independent of the physical slot size used to connect the adapter. The possible widths are multiples x1, x2, x4, x8 and x16 lanes of (2.5Gbps for PCIe Gen 1, 5.0 Gbps for PCIe Gen 2 and 8.0 Gbps for PCIe Gen 3) in each direction. Solarflare Adapters are designed for x8 lane operation.

On some server motherboards, choice of PCIe slot is important. This is because some slots (including slots that are physically x8 or x16 lanes) may only electrically support x4 lanes. In x4 lane slots, Solarflare PCIe adapters will continue to operate, but not at full speed. The Solarflare driver will warn if it detects the adapter is plugged into a PCIe slot which electrically has fewer than x8 lanes.

Adapters which require a PCIe Gen 2 or Gen 3 slot for optimal operation will issue a warning if they are installed in a PCIe Gen 1 slot. Warning messages can be viewed in `dmesg` from `/var/log/messages`.

The `lspci` command can be used to discover the currently negotiated PCIe lane width and speed:

```
lspci -d 1924: -vv
  02:00.1 Class 0200: Unknown device 1924:0710 (rev 01)
    ...
    Link: Supported Speed 2.5Gb/s, Width x8, ASPM L0s, Port 1
    Link: Speed 2.5Gb/s, Width x8
```

NOTE: The Supported speed may be returned as 'unknown', due to older `lspci` utilities not knowing how to determine that a slot supports PCIe Gen. 2.0/5.0 Gb/s or PCIe Gen 3.0/8,0 Gb/s.

CPU Speed Service

Most Linux distributions will have the `cpuspeed` service running by default. This service controls the CPU clock speed dynamically according to current processing demand. For latency sensitive applications, where the application switches between having packets to process and having periods of idle time waiting to receive a packet, dynamic clock speed control may increase packet latency. Solarflare recommend disabling the cpuspeed service if minimum latency is the main consideration.

The service can be disabled temporarily:

```
/sbin/service cpuspeed stop
```

The service can be disabled across reboots:

```
/sbin/chkconfig –level 12345 cpuspeed off
```

Memory bandwidth

Many chipsets use multiple channels to access main system memory. Maximum memory performance is only achieved when the chipset can make use of all channels simultaneously. This should be taken into account when selecting the number of DIMMs to populate in the server. Consult the motherboard documentation for details.

Intel® QuickData

Intel® QuickData Technology allows recent Linux distributions to data copy by the chipset instead of the CPU, to move data more efficiently through the server and provide fast, scalable, and reliable throughput.

Enabling QuickData

- On some systems the hardware associated with QuickData must first be enabled (once only) in the BIOS
- Load the QuickData drivers with `modprobe ioatdma`

Server Motherboard, Server BIOS, Chipset Drivers

Tuning or enabling other system capabilities may further enhance adapter performance. Readers should consult their server user guide. Possible opportunities include tuning PCIe memory controller (PCIe Latency Timer setting available in some BIOS versions).

Tuning Recommendations

The following tables provide recommendations for tuning settings for different applications.

Throughput - Table 19

Latency - Table 20

Forwarding - Table 21

Recommended Throughput Tuning

Table 19: Throughput Tuning Settings

Tuning Parameter	How?
MTU Size to maximum supported by network	`/sbin/ifconfig <ethX> mtu <size>`
Interrupt moderation	Leave at default
TCP/IP Checksum Offload	Leave at default
TCP Segmentation Offload	Leave at default
TCP Large Receive Offload	Leave at default

TCP Protocol Tuning	Leave at default for 2.6.16 and later kernels.
	For earlier kernels:
	`sysctl net.core.tcp_rmem 4096 87380 524288`
	`sysctl net.core.tcp_wmem 4096 87380 524288`

Receive Side Scaling (RSS)	Application dependent
Interrupt affinity & irqbalance service	Interrupt affinity application dependent Stop irq balance service: `/sbin/service irqbalance stop` Reload the drivers to use the driver default interrupt affinity.
Buffer Allocation Method	Leave at default. Some applications may benefit from specific setting. The Solarflare driver now supports a single optimized buffer allocation strategy and any value set by the rx_alloc_method parameter is ignored.
PCI Express Lane Configuration	Ensure current speed (not the supported speed) reads back as “x8 and 5Gb/s” Or “x8 and Unknown”
CPU Speed Service (cpuspeed)	Leave enabled

Table 19: Throughput Tuning Settings

Tuning Parameter	How?
Memory bandwidth	Ensure Memory utilizes all memory channels on system motherboard
Intel QuickData (Intel chipsets only)	Enable in BIOS and install driver: `modprobe ioatdma`

Recommended Latency Tuning

Table 20: Latency Tuning Settings

Tuning Parameter	How?
MTU Size to maximum supported by network	Leave at default
Interrupt moderation	Disable with: `ethtool -C <ethX> rx-usecs-irq 0`
TCP/IP Checksum Offload	Leave at default
TCP Segmentation Offload	Leave at default
TCP Large Receive Offload	Disable using sysfs: `echo 0 > /sys/class/net/ethX/device/lro`
TCP Protocol Tuning	Leave at default, but changing does not impact latency.
Receive Side Scaling	Application dependent
Interrupt affinity & irqbalance service	Stop irq balance service: `/sbin/service irqbalance stop` Interrupt affinity settings are application dependent
Buffer Allocation Method	The Solarflare driver now supports a single optimized buffer allocation strategy and any value set by the rx_alloc_method parameter is ignored.
PCI Express Lane Configuration	Ensure current speed (not the supported speed) reads back as “x8 and 5Gb/s” Or “x8 and Unknown”
CPU Speed Service (cpuspeed)	Disable with: `/sbin/service cpuspeed stop`
Memory bandwidth	Ensure Memory utilizes all memory channels on system motherboard

Table 20: Latency Tuning Settings

Tuning Parameter	How?
Intel QuickData (Intel chipsets only)	Enable in BIOS and install driver: `modprobe ioatdma`

Recommended Forwarding Tuning

Table 21: Forwarding Tuning Settings

Tuning Parameter	How?
TCP Large Receive Offload	Disable using sysfs: `echo 0 > /sys/class/net/ethX/device/lro`

TCP Protocol Tuning	Can leave at default for 2.6.16 and later.
	For earlier kernels:
	`sysctl net.core.tcp_rmem 4096 87380 524288`
	`sysctl net.core.tcp_wmem 4096 87380 524288`

Receive Side Scaling (RSS)	Set to 1 CPU by adding rss_cpus to following line to `/etc/modprobe.conf` file or add the options line to a file under the `/etc/modprobe.d` directory:
	`options sfc rss_cpus=1`
	Then reload drivers to use new configuration.
	`/sbin/modprobe -r sfc`
	`/sbin/modprobe sfc`

Interrupt affinity & irqbalance service	Stop irqbalance service: `/sbin/service irqbalance stop` Interrupt affinity. Affinitize each ethX interface to its own CPU (if possible select CPU's on the same Package). Refer to Interrupt and Irqbalance Service...Page 89
Buffer Allocation Method	The Solarflare driver now supports a single optimized buffer allocation strategy and any value set by the rx_alloc_method parameter is ignored.

3.21 Module Parameters

Table 22 lists the available parameters in the Solarflare Linux driver module (`modinfo sfc`):

Table 22: Driver Module Parameters

Parameter	Description	Possible Value	Default Value
piobuf_size	Identify the largest packet size that can use PIO. Setting this to zero effectively disables PIO	uint	256 bytes
rx_alloc_method	Allocation method used for RX buffers. The Solarflare driver now supports a single optimized buffer allocation strategy and any value set by the rx_alloc_method parameter is ignored. See "Buffer Allocation Method" on page 92.	uint	AVN(0) new kernels. PAGE(2) old kernels
rx_refill_threshold	RX descriptor ring fast/slow fill threshold (%).	uint	90
lro_table_size[1]	Size of the LRO hash table. Must be a power of 2.	uint	128
lro_chain_max[1]	Maximum length of chains in the LRO hash table.	uint	20
lro_idle_jiffies[1]	Time (in jiffies) after which an idle connection's LRO state is discarded.	uint	101
lro_slow_start_packets[1]	Number of packets that must pass in-order before starting LRO.	uint	20000
lro_loss_packets[1]	Number of packets that must pass in-order following loss before restarting LRO.	uint	20
rx_desc_cache_size	Set RX descriptor cache size.	int	64
tx_desc_cache_size	Set TX descriptor cache size.	int	16
rx_xoff_thresh_bytes	RX fifo XOFF threshold.	int	-1 (auto)
rx_xon_thresh_bytes	RX fifo XON threshold.	int	-1 (auto)
lro	Large receive offload acceleration	int	1
separate_tx_channels	Use separate channels for TX and RX	uint	0

Table 22: Driver Module Parameters

Parameter	Description	Possible Value	Default Value
rss_cpus	Number of CPUs to use for Receive-Side Scaling, or 'packages', 'cores' or 'hyperthreads'	uint or string	<empty>
irq_adapt_enable	Enable adaptive interrupt moderation	uint	1
irq_adapt_low_thresh	Threshold score for reducing IRQ moderation	uint	10000
irq_adapt_high_thresh	Threshold score for increasing IRQ moderation	uint	20000
irq_adapt_irqs	Number of IRQs per IRQ moderation adaptation	uint	1000
napi_weight	NAPI weighting	uint	64
rx_irq_mod_usec	Receive interrupt moderation (microseconds)	uint	60
tx_irq_mod_usec	Transmit interrupt moderation (microseconds)	uint	150
allow_load_on_failure	If set then allow driver load when online self-tests fail	uint	0
onload_offline_selftest	Perform offline self-test on load	uint	1
interrupt_mode	Interrupt mode (0=MSIX, 1=MSI, 2=legacy)	uint	0
falcon_force_internal_sram	Force internal SRAM to be used	int	0

1. Check OS documentation for availability on SUSE and RHEL versions.

3.22 Linux ethtool Statistics

The Linux command ethtool will display an extensive range of statistics originated from the MAC on the Solarflare network adapter. To display statistics use the following command:

```
ethtool -S ethX
```

(where X is the ID of the Solarflare interface)

Table 23 lists the complete output from the ethtool -S command. **Note ethtool -S output depends on the features supported by the adapter type**.

Table 23: Ethtool -S Output

Field	Description
`tx_bytes`	Number of bytes transmitted.
`tx_good_bytes`	Number of bytes transmitted with correct FCS. Does not include bytes from flow control packets. Does not include bytes from packets exceeding the maximum frame length.
`tx_bad_bytes`	Number of bytes transmitted with incorrect FCS.
`tx_packets`	Number of packets transmitted.
`tx_bad`	Number of packets transmitted with incorrect FCS.
`tx_pause`	Number of pause frames transmitted with valid pause op_code.
`tx_control`	Number of control frames transmitted. Does not include pause frames.
`tx_unicast`	Number of unicast packets transmitted. Includes packets that exceed that maximum length.
`tx_multicast`	Number of multicast packets transmitted. Includes flow control packets.
`tx_broadcast`	Number of broadcast packets transmitted.
`tx_lt64`	Number of frames transmitted where the length is less than 64 bytes.
`tx_64`	Number of frames transmitted where the length is exactly 64 bytes.
`tx_65_to_127`	Number of frames transmitted where the length is between 65 and 127 bytes
`tx_128_to_255`	Number of frames transmitted where the length is between 128 and 255 bytes

Table 23: Ethtool -S Output

Field	Description
`tx_256_to_511`	Number of frames transmitted where the length is between 256 and 511 bytes
`tx_512_to_1023`	Number of frames transmitted where length is between 512 and 1023 bytes
`tx_1024_to_15xx`	Number of frames transmitted where the length is between 1024 and 1518 bytes (1522 with VLAN tag).
`tx_15xx_to_jumbo`	Number of frames transmitted where length is between 1518 bytes (1522 with VLAN tag) and 9000 bytes.
`tx_gtjumbo`	Number of frames transmitted where the length is greater than 9000 bytes.
`tx_collision`	Number of collisions incurred during transmission attempts. This should always be zero as Solarflare adapters operate in full duplex mode.
`tx_single_collision`	Number of occurrences when a single collision delayed immediate transmission of a packet.
`tx_multiple_collision`	Number of packets successfully transmitted after being subject to multiple collisions.
`tx_excessive_collision`	Number of packets not transmitted due to excessive collisions. Excessive collisions occur on network under heavy load or when too many devices contend for the collision domain. After 15 retransmission attempts + the original transmission attempt the counter is incremented and the frame is discarded.
`tx_deferred`	The number of packets successfully transmitted after the network adapter defers transmission at least once when the medium is busy.
`tx_late_collision`	A sending device may detect a collision as it attempts to transmit a frame or before it completes sending the entire frame. If a collision is detected after the device has completed sending the entire frame, the device will assume that the collision occurred because of a different frame. Late collisions can occur if the length of the network segment is greater than the standard allowed length. Collision occurred beyond the collision window (512 bit times). This should always be zero as Solarflare adapters operate in full duplex mode.

Table 23: Ethtool -S Output

Field	Description
`tx_excessive_deferred`	Number of frames for which transmission is deferred for an excessive period of time.
`tx_non_tcpudp`	Number of packets, being neither TCP or UDP, dropped by the adapter when non_TCP/UDP drop is enabled.
`tx_mac_src_error`	Number of packets discarded by the adapter because the source address field does not match the MAC address of the port. Counts only those packets dropped when MAC address filtering is enabled.
`tx_ip_src_error`	Number of packets discarded by the adapter because the source IP address does not match any IP address in the filter table. Counts only those packets dropped when IP address filtering is enabled.
`tx_pushes`	Number of times a packet descriptor is 'pushed' to the adapter from the network adapter driver.
`tx_pio_packets`	Number of packets sent using PIO.
`tx_tso_bursts`	Number of times when outgoing TCP data is split into packets by the adapter driver. Refer to TCP Segmentation Offload (TSO) on page 79.
`tx_tso_long_headers`	Number of times TSO is applied to packets with long headers.
`tx_tso_packets`	Number of physical packets produced by TSO.
`rx_bytes`	Number of bytes received. Not include collided bytes.
`rx_good_bytes`	Number of bytes received without errors. Excludes bytes from flow control packets.
`rx_bad_bytes`	Number of bytes with invalid FCS. Includes bytes from packets that exceed the maximum frame length.
`rx_packets`	Number of packets received.
`rx_good`	Number of packets received with correct CRC value and no error codes.
`rx_bad`	Number of packets received with incorrect CRC value.
`rx_pause`	Number of pause frames received with valid pause op_code.
`rx_control`	Number of control frames received. Does not include pause frames.

Table 23: Ethtool -S Output

Field	Description
`rx_unicast`	Number of unicast packets received.
`rx_multicast`	Number of multicast packets received.
`rx_broadcast`	Number of broadcasted packets received.
`rx_lt64`	Number of packets received where the length is less than 64 bytes.
`rx_64`	Number of packets received where the length is exactly 64 bytes.
`rx_65_to_127`	Number of packets received where the length is between 65 and 127 bytes.
`rx_128_to_255`	Number of packets received where the length is between 128 and 255 bytes.
`rx_256_to_511`	Number of packets received where the length is between 256 and 511 bytes.
`rx_512_to_1023`	Number of packets received where the length is between 512 and 1023 bytes.
`rx_1024_to_15xx`	Number of packets received where the length is between 1024 and 1518 bytes (1522 with VLAN tag).
`rx_15xx_to_jumbo`	Number of packets received where the length is between 1518 bytes (1522 with VLAN tag) and 9000 bytes.
`rx_gtjumbo`	Number of packets received where the length is greater than 9000 bytes.
`rx_bad_lt64`	Number of packets received with incorrect CRC value and where the length is less than 64 bytes.
`rx_bad_64_to_15xx`	Number of packets received with incorrect CRC value and where the length is between 64 bytes and 1518 bytes (1522 with VLAN tag).
`rx_bad_15xx_to_jumbo`	Number of frames received with incorrect CRC value and where the length is between 1518 bytes (1522 with VLAN tag) and 9000 bytes.
`rx_bad_gtjumbo`	Number of frames received with incorrect CRC value and where the length is greater than 9000 bytes.
`rx_overflow`	Number of packets dropped by receiver because of FIFO overrun.

Table 23: Ethtool -S Output

Field	Description
rx_missed	Number of packets missed (not received) by the receiver. Normally due to internal error condition such as FIFO overflow.
rx_false_carrier	Count of the instances of false carrier detected. False carrier is activity on the receive channel that does not result in a packet receive attempt being made.
rx_symbol_error	Count of the number of times the receiving media is non-idle (the time between the Start of Packet Delimiter and the End of Packet Delimiter) for a period of time equal to or greater than minimum frame size, and during which there was at least one occurrence of an event that causes the PHY to indicate Receive Error on the MII.
rx_align_error	Number of occurrences of frame alignment error.
rx_length_error	Number of packets received of length 64-1518 bytes (1522 with VLAN tag) bytes not matching the number of actual received bytes.
rx_internal_error	Number of frames that could not be received due to a MAC internal error condition. e.g. frames not received by the MAC due to FIFO overflow condition.
rx_nodesc_drop_cnt rx_nodesc_drops	Number of packets dropped by the network adapter because of a lack of RX descriptors in the RX queue. Packets can be dropped by the NIC when there are insufficient RX descriptors in the RX queue to allocate to the packet. This problem occurs if the receive rate is very high and the network adapter receive cycle process has insufficient time between processing to refill the queue with new descriptors. A number of different steps can be tried to resolve this issue: 1. Disable the irqbalance daemon in the OS 2. Distribute the traffic load across the available CPU/cores by setting rss_cpus=cores. Refer to Receive Side Scaling section 3. Increase receive queue size using ethtool.
rx_pm_trunc_bb_overflow	Overflow of the packet memory burst buffer - should not occur.

Table 23: Ethtool -S Output

Field	Description
`rx_pm_trunc_vfifo_full`	Number of packets truncated or discarded because there was not enough packet memory available to receive them. Happens when packets cannot be delivered as quickly as they arrive due to: - packet rate exceeds maximum supported by the adapter. - adapter is inserted into a low speed or low width PCI slot – so the PCIe bus cannot support the required bandwidth. - packets are being replicated by the adapter and the resulting bandwidth cannot be handled by the PCIe bus. - host memory bandwidth is being used by other devices resulting in poor performance for the adapter.
`rx_pm_discard_vfifo_full`	Count of the number of packets dropped because of a lack of main packet memory on the adapter to receive the packet into.
`rx_pm_trunc_qbb`	Not currently supported.
`rx_pm_discard_qbb`	Not currently supported.
`rx_pm_discard_mapping`	Number of packets dropped because they have an 802.1p priority level configured to be dropped
`rx_dp_q_disabled_packets`	Increments when the filter indicates the packet should be delivered to a specific rx queue which is currently disabled due to configuration error or error condition.
`rx_dp_di_dropped_packets`	Number of packets dropped because the filters indicate the packet should be dropped. Can happen because: - the packet does not match any filter. - the matched filter indicates the packet should be dropped.
`rx_dp_streaming_packets`	Number of packets directed to RXDP streaming bus which is used if the packet matches a filter which directs it to the MCPU. Not currently used.
`rx_dp_emerg_fetch`	Count the number of times the adapter descriptor cache is empty when a new packet arrives, for which the adapter must do an emergency fetch to replenish the cache with more descriptors.

Table 23: Ethtool -S Output

Field	Description
rx_dp_emerg_wait	Increments each time the adapter has done an emergency fetch which has not yet completed.
tx_merge_events	The number of TX completion events where more than one TX descriptor was completed.
tx_tso_bursts	The number of times a block of data (up to 64Kb) was accepted to be sent via TSO.
tx_tso_long_headers	Number of times the header in the TSO packet was >tx_copybreak limit.
tx_tso_packets	The number of packets formed and sent by TSO.
tx_pushes	Number of transmit packet descriptors 'pushed' to the adapter - rather than the adapter having to fetch the descriptor before transmitting the packet.
tx_pio_packets	Number of packets sent using Programmed Input/Output (PIO).
rx_reset	0
rx_tobe_disc	Number of packets marked by the adapter to be discarded because of one of the following: • Mismatch unicast address and unicast promiscuous mode is not enabled. • Packet is a pause frame. • Packet has length discrepancy. • Due to internal FIFO overflow condition. • Length < 60 bytes.
rx_ip_hdr_chksum_err	Number of packets received with IP header Checksum error.
rx_tcp_udp_chksum_err	Number of packets received with TCP/UDP checksum error.
rx_eth_crc_err	Number of packets received whose CRC did not match the internally generated CRC value.
rx_mcast_mismatch	Number of unsolicited multicast packets received. Unwanted multicast packets can be received because a connected switch simply broadcasts all packets to all endpoints or because the connected switch is not able or not configured for IGMP snooping - a process from which it learns which endpoints are interested in which multicast streams.

Table 23: Ethtool -S Output

Field	Description
rx_frm_trunc	Number of frames truncated because an internal FIFO is full. As a packet is received it is fed by the MAC into a 128K FIFO. If for any reason the PCI interface cannot keep pace and is unable to empty the FIFO at a sufficient rate, the MAC will be unable to feed more of the packet to the FIFO. In this event the MAC will truncate the frame - marking it as such and discard the remainder. The driver on seeing a 'partial' packet which has been truncated will discard it.
rx_char_error_lane0	0
rx_char_error_lane1	0
rx_char_error_lane2	0
rx_char_error_lane3	0
rx_disp_error_lane0	0
rx_disp_error_lane1	0
rx_disp_error_lane2	0
rx_disp_error_lane3	0
rx_match_fault	0

Chapter 4: Solarflare Adapters on Windows

This chapter covers the following topics on the Microsoft Windows® platform:

4.1 System Requirements

- Refer to Software Driver Support on page 13 for details of supported Windows versions.
- Microsoft.NET Framework 2.0 is required if installing Solarflare Adapter Manager on any platform. Microsoft.NET Framework 2.0 is an optional component on Windows Server 2012 and Windows 8 where .NET 4.5 is the default, but does not have 2.0 backward compatibility.
- Windows WOW64 support must be enabled before installing Solarflare drivers. WOW64 is an optional component on Windows 8 and Windows Server 2012.

Install Required Components from the Windows PowerShell prompt

- On a 32bit system use the following command:

```
Install-WindowsFeature NET-Framework-Core
```

- On a 64bit system use the following command:

```
Install-WindowsFeature NET-Framework-Core,WoW64-Support
```

4.2 Windows Feature Set

Table 24 lists the features supported by Solarflare adapters on Windows.

Users should refer to Microsoft documentation to check feature availability and support on specific Windows OS versions.

Table 24: Solarflare Windows Features

Jumbo frames	Solarflare adapters support MTUs (Maximum Transmission Units) from 1500 bytes to 9216 bytes. • See Ethernet Frame Length on page 154 • See Configuring Network Adapter Properties in Windows on page 180
Task offloads	Solarflare adapters support Large Segmentation Offload (LSO), Large Receive Offload (LRO), and TCP/UDP/IP checksum offload for improved adapter performance and reduced CPU processing requirements. • See Segmentation Offload on page 153 • See Configuring Network Adapter Properties in Windows on page 180
Receive Side Scaling (RSS)	Solarflare adapters support RSS multi-core load distribution technology. • See Using SAM to View Statistics and State Information on page 167 • See Configuring Network Adapter Properties in Windows on page 180
Interrupt Moderation	Solarflare adapters support Interrupt Moderation to reduce the number of interrupts on the host processor from packet events. • See RSS and Interrupts on page 150 • See Configuring Network Adapter Properties in Windows on page 180

Table 24: Solarflare Windows Features

Teaming and or Link Aggregation	Improve server reliability and bandwidth by bonding physical ports, from one or more Solarflare adapters, into a team, having a single MAC address and which function as a single port providing redundancy against a single point of failure. • See Using SAM to Configure Teams and VLANs on page 158 • See Sfteam: Adapter Teaming and VLAN Tool on page 206 • See Teaming and VLANs on page 223
Standby and Power Management	Solarflare adapters support the following Wake On LAN standards on Windows platforms: • ARP Offload (IPv4) • NS Offload (IPv6) • Wake On Magic Packet • Wake On Packet Match • Device Sleep On Disconnect
Virtual LANs (VLANs)	Support for multiple VLANs per adapter: • See Using SAM to Configure Teams and VLANs on page 158 • See Sfteam: Adapter Teaming and VLAN Tool on page 206 • See Teaming and VLANs on page 223
PXE and iSCSI booting	Solarflare adapters support PXE and iSCSI booting, enabling diskless systems to boot from a remote target operating system. • See Using SAM for Boot ROM Configuration on page 173 • See Sfboot: Boot ROM Configuration Tool on page 188 • See Solarflare Boot ROM Agent on page 360
Fault diagnostics	Solarflare adapters provide comprehensive adapter and cable fault diagnostics and system reports. • See Using SAM to Run Adapter and Cable Diagnostics on page 168 • See Sfcable: Cable Diagnostics Tool on page 213
Firmware updates	Solarflare adapters support adapter firmware upgrades. • See Sfupdate: Firmware Update Tool on page 202

Table 24: Solarflare Windows Features

State and statistics analysis	Solarflare adapters provide comprehensive state and statistics information for data transfer, device, MAC, PHY and other adapter features. • See Using SAM to View Statistics and State Information • See Sfteam: Adapter Teaming and VLAN Tool for teaming statistics. • See Sfnet for per interface statistics.
VMQ	Solarflare drivers support static VMQ for Windows Server 2008 R2 and Dynamic VMQ on Windows Server 2012 See Virtual Machine Queue on page 156.

4.3 Installing the Solarflare Driver Package on Windows

> **NOTE:** The Solarflare adapter should be physically inserted before installing the drivers. See Installation on page 19.
>
> The user must have administrative rights to install adapter drivers and may be prompted to enter an administrator user name and password.
>
> If Windows attempts to install the drivers automatically, cancel the Windows New Hardware Found wizard and follow the instructions below.
>
> Solarflare does not recommend installing drivers via Remote Desktop Protocol (RDP). For example via Terminal Services.

The drivers install package is named after the Solarflare document part number e.g.

SF-107784-LS-2_Solarflare_Windows_x86_32-bit_Driver_Package.exe

This can be renamed e.g. setup.exe before use.

4.4 Adapter Drivers Only Installation

The steps below describe how to install only the Solarflare adapter drivers in Windows. To install the drivers from the command line, see Install Drivers and Options From a Windows Command Prompt on page 121.

1 Double-click the supplied `Setup.exe`. to start the Solarflare Driver Package Setup wizard. If prompted, confirm your administrator privileges to continue installing the drivers.

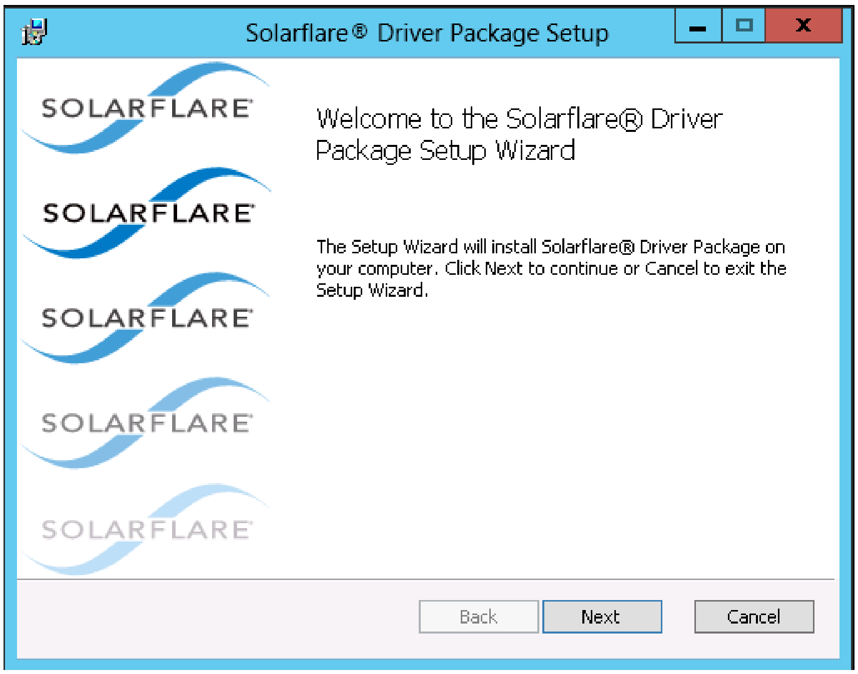


Figure 8: Solarflare Driver Package Setup

2 From the Custom Setup screen, select the **Install Solarflare® device drivers** option only.

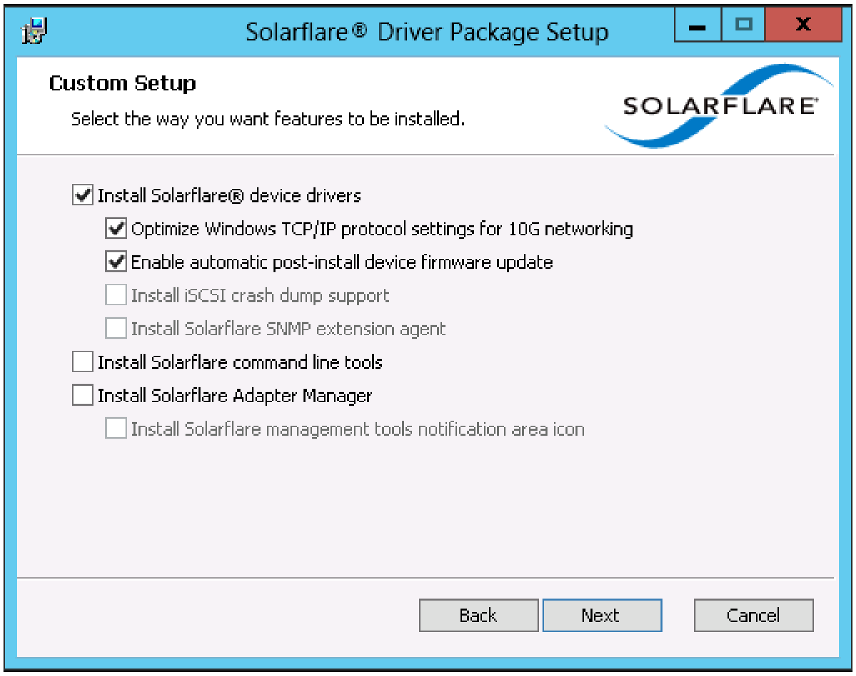


Figure 9: Solarflare Custom Setup

3 A firmware update will be performed following installation if the **Enable automatic post-install device firmware update** option is selected and if the firmware version in the installation package is a more recent version than firmware on the adapter.

4 Click **Finish** to close the wizard. Restart Windows if prompted to do so.

4.5 Full Solarflare Package Installation

This section cover the following topics:

Prerequisites

- Microsoft .NET Framework 2.0 (or later) is required before installing the Solarflare Adapter Manager Utility (SAM).
- When booting the operating system from an iSCSI target over a Solarflare adapter you may want to install iSCSI crash dump support. It is necessary to install and configure the Microsoft iSCSI Initiator first. See Install iSCSI Initiator on page 113 for more details. For more details on iSCSI booting see Solarflare Boot ROM Agent on page 360.
- If installing the Solarflare SNMP extension agent, it is necessary to install and configure the Microsoft SNMP Service agent first. See Install Microsoft SNMP For Windows Server 2008, 2008 R2 and Windows 7 on page 114 for more details.

Install iSCSI Initiator

The Microsoft iSCSI Initiator must be running on your server before installing the Solarflare iSCSI crash dump option. This process is different on different Windows OS versions.

The iSCSI Initiator is installed by default on Windows Server 2008, 2008 R2, Windows 7 and Windows Server 2012.

Refer to the article 'Using Microsoft iSCSI Initiator in Windows Server 2008 and Windows 7' - http://technet.microsoft.com/en-us/library/ee338477%28v=ws.10%29.aspx.

For Windows Server 2012 refer to http://blogs.technet.com/b/filecab/archive/2012/05/21/introduction-of-iscsi-target-in-windows-server-2012.aspx

For Windows Server 2003 and Windows XP

1. The iSCSI Initiator is not installed by default on Windows Server 2003 and Windows XP. The latest version can be downloaded from the Microsoft site at:

http://www.microsoft.com/en-us/download/details.aspx?id=18986

2. The installation wizard will display the following options to be selected during installation:
   - ***c)*** iSCSI Port Driver (cannot be cleared)
   - ***d)*** Initiator Service
   - ***e)*** Software Initiator
   - ***f)*** Microsoft MPIO Multipathing Support for iSCSI

Solarflare recommends that you select all of these options.

3 After the installation has finished, the iSCSI Initiator will be available from the **Control Panel**, or via a link from your desktop.

4 Check that the **iSCSI Initiator service** is running.

5 Check that the iSCSI Initiator is listed under **SCSI and RAID controllers** in the **Device Manager**.

For Windows Server 2008, 2008 R2 and Windows 7

The iSCSI Initiator is part of the operating system installation and can be accessed either via the **Control Panel** or from **Start > All Programs > Administrative Tools**:

1 The first time you run the Initiator, you will see a dialog box stating that the iSCSI service is not running. Click **Yes** to automatically run the service.

2 If you are running the Windows Firewall, you will also see a dialog box asking you to allow the iSCSI service to access an Internet storage name service through the Windows Firewall. Click **Yes** to unblock access.

3 That **Microsoft iSCSI Initiator** is listed under **Storage controllers** in the **Device Manager**.

Install Microsoft SNMP For Windows Server 2008, 2008 R2 and Windows 7

To use the Solarflare SNMP Agent, you need to install and configure Microsoft Simple Network Management Protocol (SNMP) agent before installing the Solarflare Driver package:

1 From the **Control Panel > Programs > Turn Windows features on or off** .

2 From **Server Manager > Features > Add Features**, find and install **SNMP Services**.

3 From the **Server Manager > Configuration > Services**, stop the **SNMP Service**, then double click the entry to access the SNMP Service Properties dialog.

4 Select the **Security** tab. (if the Security tab is not shown, it means you are not logged in as an administrator).

5 With **Send authentication trap** selected, click **Add**.

6 Select **READ ONLY** from the **Community rights** drop-down list box.

7 Enter a Community name. For security reasons, do not use Public.

8 Click **OK**, then **Restart** the Service.

Solarflare comes supplied with two **MIB** files, **SFC-CONFIG** and **SFC-STATISTICS**. By default these are located in your **Program Files > Solarflare Communications > Solarflare Driver Package** directory. These are read-only with no traps.

For further information on the SNMP service click the **Learn more about SNMP** link from the **Security** tab on the **SNMP Service Properties** sheet, or visit www.net-snmp.org for details about SNMP tools.For Windows Server 2003 and Windows XP

To use the Solarflare SNMP Agent, you need to install and configure Microsoft Simple Network Management Protocol (SNMP) agent before installing the Solarflare Driver package:

1 From the **Control Panel > Add or Remove Programs > Add/Remove Windows Components**.

2 Select (but do not tick the check box) for **Management and Monitoring Tools**.

3 Select the **Details** button to reveal the **Management and Monitoring Tools** Dialog.

4 Tick the **SNMP** check box and select the **OK** button.

5 For further configuration details see http://www.microsoft.com/resources/documentation/windows/xp/all/proddocs/en-us/snmp_install.mspx?mfr=true

Solarflare comes supplied with two **MIB** files, **SFC-CONFIG** and **SFC-STATISTICS**. By default these are located in your **Program Files > Solarflare Communications > Solarflare Driver Package** directory. These are read-only with no traps.

For further information on the SNMP service click the **Learn more about SNMP** link from the **Security** tab on the **SNMP Service Properties** sheet, or visit www.net-snmp.org for details about SNMP tools.

Solarflare Package Installation Procedure

The steps below describe how to install the complete Solarflare installation package. To install this from the command line, see Install Drivers and Options From a Windows Command Prompt on page 121.

1 Double-click the supplied `Setup.exe`. The Solarflare Driver Package Setup wizard starts.

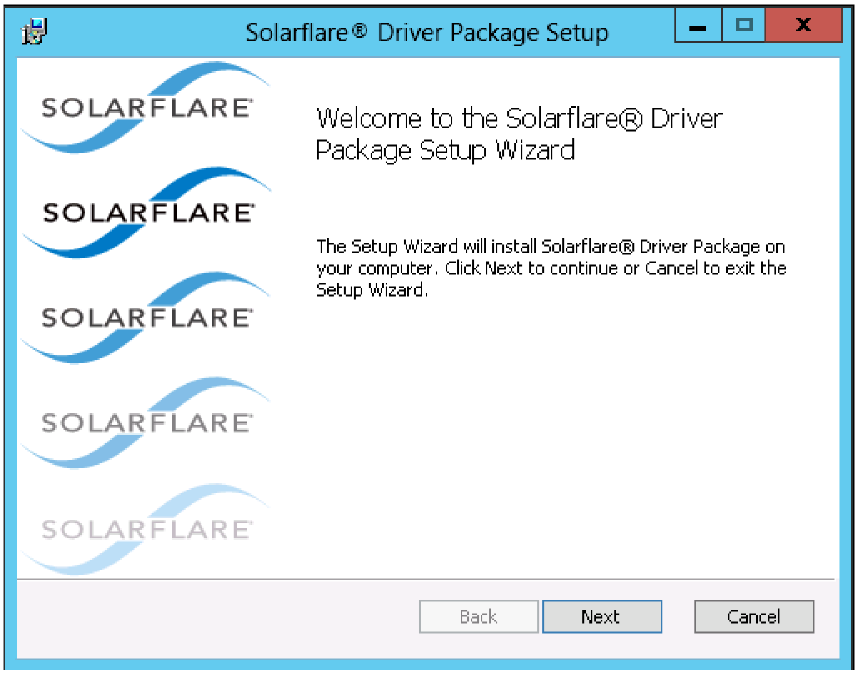


Figure 10: Solarflare Driver Package Setup

If prompted, confirm your administrator privileges to continue installing the drivers.

2 Follow the setup instructions in the wizard to complete the driver installation procedure. See Figure 11 and Table 25 for a list of setup options.

3 A firmware update will be performed following installation if the **Enable automatic post-install device firmware update** option is selected and if the firmware version in the installation package is a more recent version than firmware on the adapter.

4 Click **Finish** to close the wizard. Restart Windows if prompted to do so.

To confirm the drivers installed correctly, do either of the following:

- Open the Windows Device Manager and check the Solarflare adapter is present under Network Adapters.
- Start Solarflare Adapter Manager (**Start > All Programs > Solarflare Drivers > Solarflare Adapter Manager**). If the Solarflare adapter is installed and working correctly, it will be shown in the SAM main screen, along with any other adapters, as in Table 14 on page 140.

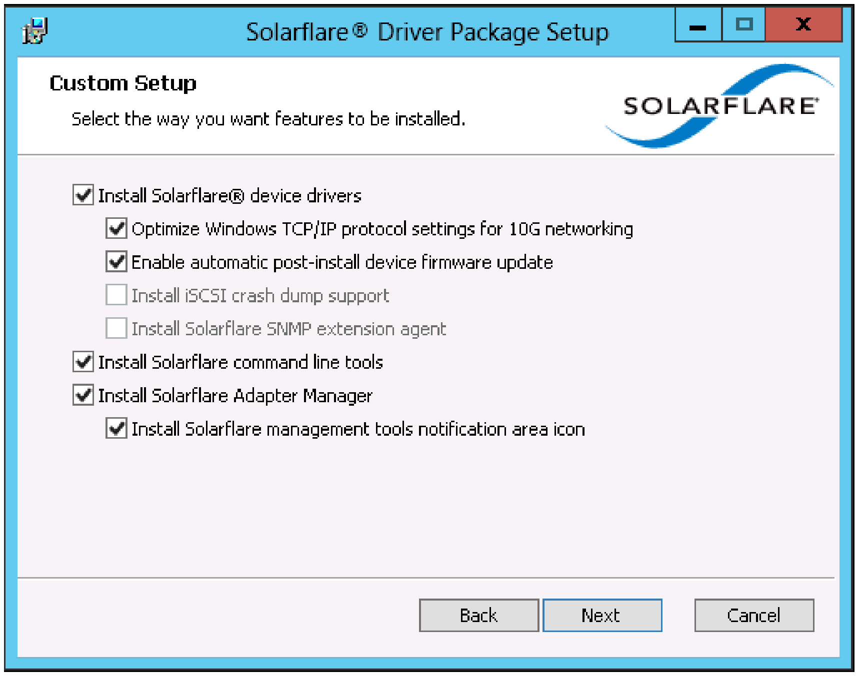


Figure 11: Solarflare Driver Package Custom Setup

Table 25: Solarflare Custom Setup

Option	Description
Install Solarflare device drivers	Installs Solarflare NDIS drivers for Windows. The Solarflare drivers are installed by default.
Optimize Windows TCP/IP protocol settings for 10G networking	Reconfigures the TCP/IP system settings to provide better performance over 10G networks. Selecting this option will increase the RSS receive queue count to 8 on all Windows versions from Windows Server 2003. For Windows Server 2003 and Windows XP this will increase the TCP windows size, enable Windows scaling, TCP SACK and increases the TCP receive window size. These options are enabled by default on Windows Server 2008 and later versions. TCP/IP protocol optimization is installed by default. See note below reference power settings.

Table 25: Solarflare Custom Setup

Option	Description
Enable automatic post-install device firmware update	A firmware update will be performed following installation if this option is selected and if the firmware version in the installation package is a more recent version than firmware on the adapter.
Install iSCSI crash dump support	Enables iSCSI crash dump file generation. This is only applicable if you are booting from an iSCSI target over a Solarflare adapter. See iSCSI Boot on page 364 for more details. iSCSI crash dump support is not installed by default. Note: The iSCSI initiator must be configured on your server before installing the Solarflare driver package. See Install iSCSI Initiator on page 113 for more details.
Install Solarflare SNMP extension agent	Enables the SNMP extension agent. This is not installed by default. Note: you must install and be running the SNMP service on your server before installing the Solarflare driver package if you want to use SNMP. See Install Microsoft SNMP For Windows Server 2008, 2008 R2 and Windows 7 on page 114 for more details on configuring SNMP.
Install Solarflare command line tools	Installs the following Solarflare Windows command line tools: `sfboot.exe` – Boot ROM configuration tool `sfupdate.exe` – Firmware update tool `sfteam.exe` – Adapter teaming tool `sfcable.exe` – Cable diagnostics tool `sfnet.exe` – Adapter configuration tool See Windows Command Line Tools on page 186. These tools are installed by default.

Table 25: Solarflare Custom Setup

Option	Description
Install Solarflare Adapter Manager	Installs Solarflare Adapter Manager (SAM) for easy access to adapter configuration options, wizards for teaming and VLAN setup, adapter statistics, and diagnostic tools. See Managing Adapters with SAM on page 139 for more details. SAM is installed by default. Note: If this option is grayed out, you need to exit the Solarflare installer and then install Microsoft .NET Framework 2.0 before re-running the Solarflare installer.
Install Solarflare management tools notification area icon	Installs a Solarflare notification area icon for launching Solarflare Adapter Manager (SAM) locally or for a remote computer. The icon is not installed by default.

NOTE: Selecting the **Optimize Windows TCP/IP protocol settings for 10G networking** option from the Solarflare Driver Package Setup window, during driver installation, will create and enable a "Optimum Performance" power profile. This prevents processors from being managed into lower power states and can improve performance and reduce latency.

NOTE: On Windows Server 2012 this setting can cause the CPU to report 100% usage when viewed in Task Manger performance tab although a closer inspection using the Resource Monitor utility will show that actual CPU usage has not increased.

Repair, Remove and Change Drivers and Utilities

For Windows Server 2003 and Windows XP

To change, repair, or remove the Solarflare drivers and/or tools, run the **setup.exe** again (or from the **Control Panel > Add or Remove Programs** and select the appropriate option from the Solarflare Driver Package Setup wizard.

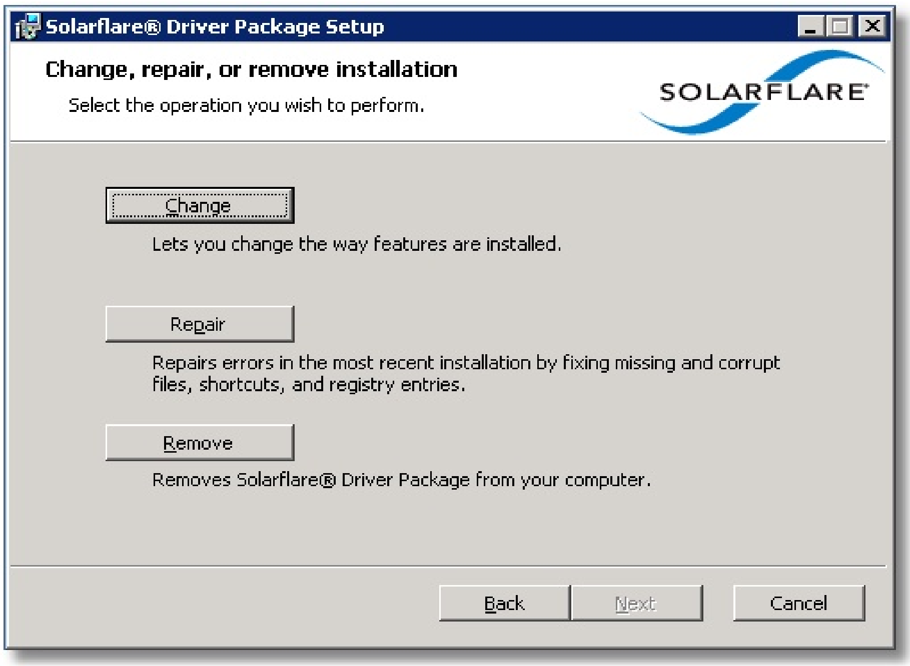


Figure 12: Change, Repair or Remove Installation

The wizard will guide you through the procedure and prompt you to restart Windows if necessary.

For Windows Server 2008, 2008 R2, Windows 7 and Windows Server 2012

From the **Control Panel > Programs > Programs and Features**, select the **Solarflare Driver Package** then select **Uninstall**, **Change** or **Repair** from the menu bar above the program list.

4.6 Install Drivers and Options From a Windows Command Prompt

This section covers the following subjects:

Command Line Usage

To view command line options available, run the setup-<release>.exe /? command to display the following dialog window.

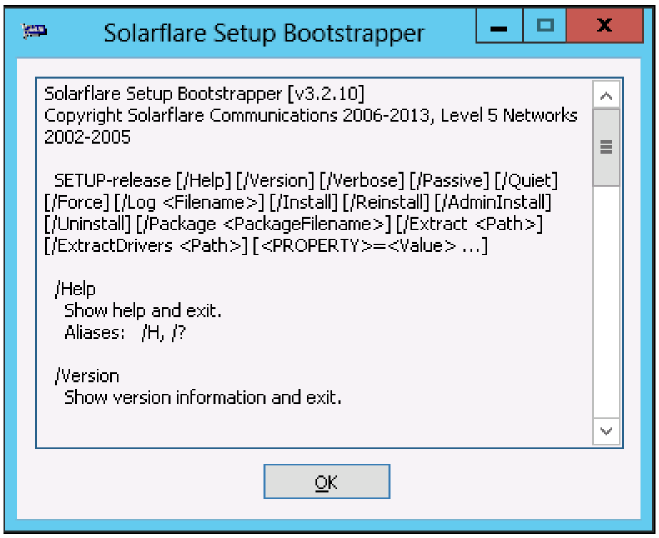


Figure 13: Command Line Install - Windows Server 2012 options.

Installing from the Windows command line allows scripted, silent and unattended installation of the core Solarflare drivers and package utilities. The drivers install package is named after the Solarflare document part number e.g.

```
SF-107784-LS-2_Solarflare_Windows_x86_32-bit_Driver_Package.exe
```

This can be renamed e.g setup.exe before invoking from the command line.

The command line usage for installing the driver package from the command line is:

```
setup.exe [/Help | /?] [/Version] [/Verbose] [/Passive] [/Quiet] [/Force]
[/Log <filename>] [/Install] [/Reinstall] [/Admininstall] [/Uninstall] [/
Package <packagefilename>] [/Extract <path>] [ExtractDrivers <path>]
```

For example, to install default package options silently (no message output), enter the following command:

```
setup.exe /Quiet /Install
```

Table 26 lists other command line examples. Note that command line options are case insensitive, so `/install` and `/INSTALL` are the same.

Table 26: Solarflare Installation Options

Example	Action
`setup.exe /Admininstall <path>`	Allows an administrator to unpack and install the package to a network share and to specify which features of the package can be installed by users.
`setup.exe /Extract <path>`	Extracts the contents of `setup.exe` to the specified path.
`setup.exe /ExtractDrivers <path>`	Extract the adapter driver to the specified path.
`setup.exe /Filename <filename>`	Log all output to the specified file.
`setup.exe /Force`	Allow passive or quiet mode to replace an existing installation with an earlier version.
`setup.exe /Help`	Shows a help screen and exits.
`setup.exe /Install`	Installs or configures the package.
`setup.exe /Install /Log <filename>`	Install the drivers and logs messages to the specified file.
`setup.exe /Install /Package <packagefilename>`	Installs the drivers and utilities specified in `packagefilename`.
`setup.exe /Install /Passive`	Performs an unattended installation of the drivers and utilities, rebooting the host to complete the installation as required.
`setup.exe /Install /Quiet`	Performs a silent installation of the drivers and utilities.
`setup.exe /Reinstall`	Reinstalls the drivers and utilities.
`setup.exe /Uninstall`	Removes the drivers and utilities from the host operating system.
`setup.exe /Install /Verbose`	Performs a verbose installation of the drivers and utilities, outputting details for each stage of the installation procedure.
`setup.exe /Package <PackageFilename>`	Identify the package file to use for the operation.
`setup.exe /Version`	Shows version information for the drivers.

Table 26: Solarflare Installation Options

Example	Action
`setup.exe /Quiet /Install ADDLOCAL=NetworkAdapterManager`	Silently installs the drivers and Solarflare Adapter Manager only (other utilities will not be installed). See, Using ADDLOCAL on page 123.
`<PROPERTY>=<Value>`	Specify one or more install properties.

Using ADDLOCAL

ADDLOCAL is a standard Windows Installer property that controls which features are installed via the command line. For Solarflare adapters, the following features can be installed from the command line:

- **CoreDrivers** – Installs the core adapter drivers
  - **OptimizeTCP** – Optimizes TCP/IP for 10G Ethernet
  - **Enable automatic post-install device firmware update** - update firmware following installation if the install package firmware is newer then the already installed version
  - **SNMP** – Installs the SNMP extension agent
  - **iSCSICrashDump** – Enables iSCSI crash dump file generation
- **NetworkAdapterManager** – Installs Solarflare Adapter Manager (SAM)
- **CommandLineTools** – Installs Solarflare command line tools: sfboot.exe, sfupdate.exe, sfcable.exe, sfteam.exe, sfnet.exe.
- **Launcher** – Installs the Solarflare system tray icon, providing easy access to the Solarflare Adapter Manager (SAM).

The nested indentation of the feature list above indicates their parent/child relationship, so that if you ask for **OptimizeTCP** to be installed, **CoreDrivers** will also be installed. Multiple features may be installed by separating each feature with a comma (spaces are not allowed).

ADDLOCAL cannot prevent **Launcher** from being installed if either **NetworkAdapterManager** or **CommandLineTools** are not installed or are still being installed.

ADDLOCAL Examples:

Install the package interactively with the default installation options selected (equivalent to `Setup.exe` or `Setup.exe /Install`).

```
Setup.exe /Install ADDLOCAL=CoreDrivers,
NetworkAdapterManager,CommandLineTools,Launcher
```

Install the package without any management tools. Displays a limited user interface with status and progress only.

```
Setup.exe /Quiet /Install ADDLOCAL=CoreDrivers
```

Install Solarflare Adapter Manager (SAM) only. This command shows no user interface during installation and will restart the host system if required.

```
Setup.exe /Quiet /Install ADDLOCAL=NetworkAdapterManager
```

Install Solarflare Adapter Manager (SAM) only but suppress the auto-restart.

```
Setup.exe /Quiet /Install ADDLOCAL=NetworkAdapterManager REBOOT=Suppress
```

Extract Solarflare Drivers

To extract the Solarflare drivers from the installation package:

1 From the Command prompt, navigate to the directory where the installation package is located.

2 Enter the following command:

```
Setup.exe /Extract <DestinationDirectory>
```

The Destination Directory will list the following sub-directory structure - The actual folders/files displayed will depend on the Solarflare driver package installed:

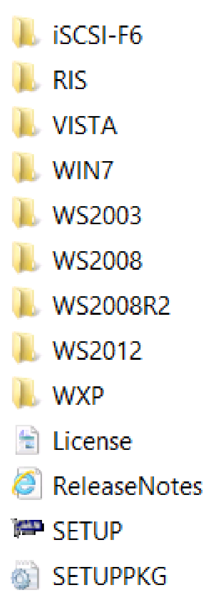


Table 27 lists the drivers supplied with the Solarflare Driver installation package:

Table 27: Solarflare Drivers

Folder	Where Used
iSCSI-F6	Driver to install Windows Server 2003 64 bit directly to an iSCSI target.
iSCSI-F6	Driver to install Windows Server 2003 32 bit directly to an iSCSI target.
RIS\AMD64	RIS driver to allow initial network connectivity during the installation copy process for 64 bit Windows Server 2003 images.
RIS\x86	RIS driver to initial network connectivity during the installation copy process for 32 bit Windows Server 2003 images.
VISTA\AMD64\DRIVERS	Driver to install Windows Vista 64bit directly to an iSCSI target.
WIN7\AMD64\DRIVERS	Driver to install Windows 7 32 bit directly to an iSCSI target.
WS2003	Driver to install Windows 8 32 bit directly to an iSCSI target.
WLH\AMD64\DRIVERS	Driver to install Windows 2008 64 bit directly to an iSCSI target.
WLH\x86\DRIVERS	Driver to install Windows 2008 32 bit directly to an iSCSI target.
WNET\AMD64\DRIVERS	Driver to install Windows XP and Windows Server 2003 64 bit directly to an iSCSI target.
WNET\x86\DRIVERS	Driver to install Windows Server 2003 32 bit directly to an iSCSI target.
WS2012	Driver to install Windows Server 2012 64bit directly to an iSCSI target.
WXP\x86\DRIVERS	Driver to install Windows XP 32 bit directly to an iSCSI target.

4.7 Unattended Installation - Windows Server 2008, 2008 R2, Windows 7 and Windows Server 2012

This section covers the following subjects:

Windows Driver Locations

The following steps use drivers extracted from the Solarflare installation package. Refer to Table 27 for driver folder locations.

Unattended Installation using WDS

Windows Deployment Services (WDS) enables you to deploy Windows Server 2008, 2008 R2, Windows 7 and Windows Server 2012 over your network (from a WDS server), avoiding the need to install each operating system directly from a CD or DVD.

- This guide assumes you have installed and are familiar with WDS. For more information on WDS, see Further Reading on page 130.
- You should also be familiar with PXE booting over Solarflare adapters. See PXE Support on page 361 for more information.

The following steps are an example of how to set up an unattended installation using the WDS interface:

Add a Boot Image

1. From the left hand pane of the WDS MMC snap in, right-click the **Boot Images** node and select **Add Boot** Image.
2. Specify a name for the image group and click **Add Boot Image**.
3. Select the `boot.wim` file from the **Windows installation DVD** (in the `\Sources` folder). The `Boot.wim` file contains the **Windows PE** and the **Windows Deployment Services** client.
4. Click **Open**, then click **Next**.
5. Follow the instructions in the wizard to add the boot image.

Add an Install Image

1. From the left hand pane of the WDS MMC snap in, right-click the **Install Images** node and select **Add Install** Image.
2. Specify a name for the image group and click **Add Install Image**.
3. Select the `install.wim` file from your installation DVD (in the `\Sources` folder), or create your own install image. Consult the WDS documentation for details on creating custom install images.
4. Click **Open**, then click **Next**.
5. Follow the instructions in the wizard to add the image.

Adding Solarflare Drivers to the WDS Boot Image

These steps describe how to add the Solarflare drivers into the Boot Image.

Modifying the Boot Image

You next need to modify the boot image to include the Solarflare Drivers extracted from the setup package. Table 27 identifies drivers required for the target operating system. To modify the boot image Solarflare recommends using the **ImageX** tool supplied with the **Windows Automated Installation Kit (AIK)**.

1. Within WDS, expand the server where the boot image is located and select the boot image you want to modify. From the right-click menu, select **Disable**.
2. Create a Windows PE customization working directory (in this example `c:\windowspe-x86`). Within a command prompt, from:

   ```
   C:\program files\windows aik\tools\petools\
   ```

   and enter the following command:

   ```
   copype.cmd x86 c:\windowspe-x86
   ```

3. Enter the following ImageX commands from the PE customization working directory:

   ```
   imagex /info <Drive>:\remoteinstall\boot\x86\images\<boot.wim>
   ```

> **NOTE:** `<Drive>` is the path where the `remoteinstall` folder is located. `<boot.wim>` is the name of your boot image.

4. Mount the boot image with the following command from your PE customization working directory:

```
imagex /mountrw <Drive>:\remoteinstall\boot\x86\images\<boot.wim> 2 mount
```

5. Copy the contents of the appropriate Solarflare driver folder (see Table 27) to a subdirectory within your PE customization working directory (in this example `c:\windowspe-x86\drivers`).

6 Add the Solarflare VBD driver to the image by entering the following command from your PE customization working directory:

```
peimg /inf=c:\windowspe-x86\drivers\netSFB*.inf mount\windows
```

7 Add the Solarflare NDIS driver to the image by entering the following command from your PE customization working directory:

```
peimg /inf=c:\windowspe-x86\drivers\netSFN6*.inf mount\windows
```

8 Unmount the image, using the following command from your PE customization working directory:

```
imagex /unmount /commit mount
```

9 From WDS, expand the server where the boot image is located and select the boot image you have modified. From the right-click menu, select **Enable**.

Create Custom Install Image

These steps describe how to add the Solarflare drivers into the Custom Install Image. These are the same Solarflare drivers added to the boot image.

Preparing the Custom Install Image

1 From WDS, locate the install image from the **Install Images** folder on your server.

2 Right-click the image and select **Export Image** from the menu.

3 Export the image to a location where it can be mounted. Solarflare recommend using the Windows PE customization working directory as this saves creating a second directory. In this example: `c:\windowspe-x86`.

Modifying the Install Image

1 Mount the install image with the following command from your PE customization working directory:

```
imagex /mountrw <Drive>:\<path>\<install.wim> 1 mount
```

NOTE: <Drive> is the path where the remoteinstall folder is located. <boot.wim> is the name of your boot image.

2 Copy the contents of the appropriate Solarflare driver folder in Table 27 to a sub-directory in your PE customization working directory (in this example `c:\windowspe-x86\drivers`). If you are using the same directory as for the boot image, this directory should already be present.

3 Add the Solarflare VBD driver to the image by entering the following command from your PE customization working directory:

```
peimg /inf=c:\windowspe-x86\drivers\netSFB*.inf mount\windows
```

4 Add the Solarflare NDIS driver to the image by entering the following command from your PE customization working directory:

```
peimg /inf=c:\windowspe-x86\drivers\netSFN6*.inf mount\windows
```

5 Unmount the image, using the following command from your PE customization working directory:

```
imagex /unmount /commit mount
```

Import the Custom Image to WDS

1 From WDS, select the **Image** group you want to add the image to. Right-click and select **Import Image**.

2 Browse to the location of the custom image, and click **Next**.

3 Follow the instructions in the wizard to import the image.

Create the WDSClientUnattend.xml File

The WDSClientUnattend.xml file is used by the Windows PE boot environment to configure settings including the language, credentials for connecting to the WDS server, the partitioning of the disk and which image to deploy.

> **NOTE:** You can use the Windows System Image Manager (Part of the Windows Automated Installation Kit) to create the `WDSClientUnattend.xml` file.

To associate your WDSClientUnattend.xml file with your modified boot image:

1 Copy the `WDSClientUnattend.xml` file to the following folder in the `RemoteInstall` folder: `RemoteInstall\WDSClientUnattend`.

2 Open the Windows Deployment Services MMC snap-in, right-click the **server** that contains the Windows Server 2008, 2008 R2 or Windows 7 boot image with which you want to associate the file, and then select **Properties**.

3 On the **Client** tab, select **Enable unattended installation**, browse to the `WDSClientUnattend.xml` file, then click **Open**.

4 Click **OK** to close the Properties page.

Create the AutoUnattend.xml File

The AutoUnattend.xml file is used during the installation of Windows Server 2008, 2008 R2 and Windows 7 to automatically populate the various configuration settings.

> **NOTE:** You can use the Windows System Image Manager (Part of the Windows Automated Installation Kit) to create the `AutoUnattend.xml` file.

To associate your AutoUnattend.xml file with your custom install image:

1 Copy the `AutoUnattend.xml` file to the following folder in the `RemoteInstall` folder: `RemoteInstall\WDSClientUnattend`.

2 Open the Windows Deployment Services MMC snap-in, select the custom install image with which you want to associate the file, right-click and then select **Properties**.

3 Select the **Allow image to install in unattend mode** option.

4 Click **Select File** and browse to your `AutoUnattend.xml` file.

Further Reading

- Installing and configuring Windows Deployment Services (WDS) on Windows Server 2008, 2008 R2 and Windows 7:

http://technet.microsoft.com/en-us/library/cc771670%28WS.10%29.aspx

- Windows PE Customization:

http://technet.microsoft.com/en-us/library/cc721985%28WS.10%29.aspx

- Getting Started with the Windows AIK:

http://technet.microsoft.com/en-us/library/cc749082%28WS.10%29.aspx

- Performing Unattended Installations:

http://technet.microsoft.com/en-us/library/cc771830%28WS.10%29.aspx

- How to add network driver to WDS boot image:

http://support.microsoft.com/kb/923834

- Windows Deployment Services Getting Started Guide for Windows Server 2012

http://technet.microsoft.com/en-us/library/jj648426.aspx

4.8 Unattended Installation - Windows Server 2003

This section covers the following subjects:

Windows Server 2003 Driver Locations

The following procedure requires drivers extracted from the Solarflare installation package. Table 27 identifies the location of Solarflare drivers.

Unattended install on Windows Server 2003 often needs the use of a special "RIS" driver for the Solarflare adapters during the early stages of OS install. The following sections make it clear when to install the RIS driver and when to install the VBD and NDIS drivers. Take care to use the correct driver.

Local Unattended Installations

This section details creating a Windows Server 2003 installation CD that incorporates the Solarflare drivers.

- Use `Setupmgr.exe` (Located in the `Support\Tools` folder of the Windows Server 2003 CD-ROM) to create the `Unattend.txt` file.
- Create a `$oem$\$1\Drivers\Nic` folder within the `i386` (32 bit versions) or `AMD64` (64 bit versions) folder.
- Add the Solarflare VBD and NDIS drivers under the `Nic` folder.
- Add the `OemPnPDriversPath = Driver_Paths` entry in the `Unattended` section of the `Setup answer` file.

Using Remote Installation Service (RIS)

- Remote Installation Services (RIS) enables you to deploy Windows Server 2003 over your network (from a RIS server running on Windows 2003), avoiding the need to install each operating system directly from a CD or DVD.
- This guide assumes you have installed and are familiar with RIS. For more information on RIS, see Further Reading on page 138.

- You should also be familiar with PXE booting over Solarflare adapters. See PXE Support on page 361 for more information.

The following steps are an example of how to setup an unattended installation using RIS

Adding drivers

The following steps assume a RIS server has been configured with a Windows Server 2003 installation. They describe how to add the Solarflare drivers to the Windows installation.

1. Add a `$OEM$` folder at the same level as `\i386` folder in the Windows image.
2. Add a `$1` folder within the `$OEM$` folder.
3. Add a `Drivers` folder within the `$1` folder.
4. Add a folder (in this example, called `NIC`) within the `Drivers` folder.
5. Copy all the files from the Solarflare VBD and NDIS directory into the `NIC` folder.
6. Copy all the files from the Solarflare RIS folder into the `\i386` folder.
7. In the file `\i386\templates\ristndrd.sif`, locate the `Unattended` section. Change the line `OemPreinstall = No` to `Yes`.
8. Add the line `OemPnPDriversPath = \Drivers\NIC` for the Solarflare drivers.
9. From the Command Prompt, Stop, then Start the RIS service with the following command:

   ```
   net Stop binlsvc <enter>
   net Start binlsvc <enter>
   ```

   This creates the PNF file (precompiled setup information file).

Installation

From the computer you want to install Windows Server 2003 on:

1. Start the computer in **PXE boot** mode.
2. When prompted, press **F12** to continue with the installation.
3. Follow the prompts, entering a valid **User name**, **Password** and **Domain Name** when required.
4. The installation will then continue as normal, using the details you have entered in the `ristndrd.sif` file.

Using Windows Deployment Services (WDS)

- Windows Deployment Services (WDS) enables you to deploy Windows Server 2003 over your network (from a WDS server running on Windows 2008), avoiding the need to install each operating system directly from a CD or DVD.
- This guide assumes you have installed and are familiar with WDS. For more information on WDS, see Further Reading on page 130.
- You should also be familiar with PXE booting over Solarflare adapters. See PXE Support on page 361 for more information.

The following steps are an example of how to set up an unattended installation using the WDS interface:

Add a Boot Image

1. From the left hand pane of the WDS MMC snap in, right-click the **Boot Images** node and select **Add Boot** Image.
2. Specify a name for the image group and click **Add Boot Image**.
3. Select the `boot.wim` file from the **Windows Server 2003 installation DVD** (in the `\Sources` folder). The `Boot.wim` file contains the **Windows PE** and the **Windows Deployment Services** client.
4. Click **Open**, then click **Next**.
5. Follow the instructions in the wizard to add the boot image.

Add an Install Image

1. From the left hand pane of the WDS MMC snap in, right-click the **Install Images** node and select **Add Install** Image.
2. Specify a name for the image group and click **Add Install Image**.
3. Select the `install.wim` file from your installation DVD (in the `\Sources` folder), or create your own install image. Consult the WDS documentation for details on creating custom install images.
4. Click **Open**, then click **Next**.
5. Follow the instructions in the wizard to add the image.

Modifying the Boot Image

You next need to modify the boot image to include the Solarflare RIS Drivers extracted from the setup package. Table 27 details which drivers are needed for the target operating system. To modify the boot image Solarflare recommends using the **ImageX** tool supplied with the **Windows Automated Installation Kit (AIK)**.

1. Within WDS, expand the server where the boot image is located and select the boot image you want to modify. From the right-click menu, select **Disable**.
2. Create a Windows PE customization working directory (in this example `c:\windowspe-x86`). Within a command prompt, from the `C:\program files\windows aik\tools\petools\` directory enter the following command:

   ```
   copype.cmd x86 c:\windowspe-x86
   ```
3. Enter the following ImageX commands from the PE customization working directory:

   ```
   imagex /info <Drive>:\remoteinstall\boot\x86\images\<boot.wim>
   ```

NOTE: `<Drive>` is the path where the `remoteinstall` folder is located. `<boot.wim>` is the name of your boot image.

4. Mount the boot image with the following command from your PE customization working directory:

   ```
   imagex /mountrw <Drive>:\remoteinstall\boot\x86\images\<boot.wim> 2
   mount
   ```
5. Copy the contents of the appropriate Solarflare RIS driver folder (see Table 27) to a subdirectory within your PE customization working directory (in this example `c:\windowspe-x86\boot`).
6. Add the Solarflare RIS driver to the image by entering the following command from your PE customization working directory:

   ```
   peimg /inf=c:\windowspe-x86\boot\netSFNR*.inf mount\windows
   ```
7. Unmount the image, using the following command from your PE customization working directory:

   ```
   imagex /unmount /commit mount
   ```
8. From WDS, expand the server where the boot image is located and select the boot image you have modified. From the right-click menu, select **Enable**.

Modifying the Install Image

1. Mount the install image with the following command from your PE customization working directory:

```
imagex /mountrw <Drive>:\<path>\<install.wim> 1 mount
```

2. Copy the contents of the appropriate Solarflare VBD and NDIS driver folder (see Table 27) to a subdirectory within your PE customization working directory (for this example `c:\windowspe-x86\drivers`).

3. Add the Solarflare VBD driver to the image by entering the following command from your PE customization working directory:

```
peimg /inf=c:\windowspe-x86\drivers\netSFB*.inf mount\windows
```

4. Add the Solarflare NDIS driver to the image by entering the following command from your PE customization working directory:

```
peimg /inf=c:\windowspe-x86\drivers\netSFN5*.inf mount\windows
```

5. Unmount the image, using the following command from your PE customization working directory:

```
imagex /unmount /commit mount
```

Import Custom Image to WDS

1. From WDS, select the Image group you want to add the image to. Right-click and select **Import Image**.
2. Browse to the location of the custom image, and click **Next**.
3. Follow the instructions in the wizard to import the image.

Create the WDSClientUnattend.xml File

The WDSClientUnattend.xml file is used by the Windows PE boot environment to configure settings including the language, credentials for connecting to the WDS server, the partitioning of the disk and which image to deploy.

> **NOTE:** You can use the Windows System Image Manager (Part of the Windows Automated Installation Kit) to create the `WDSClientUnattend.xml` file.

To associate your WDSClientUnattend.xml file with your modified boot image:

1. Copy the `WDSClientUnattend.xml` file to the following folder in the `RemoteInstall` folder: `RemoteInstall\WDSClientUnattend`.
2. Open the Windows Deployment Services MMC snap-in, right-click the **server** that contains the Windows Server 2003 boot image with which you want to associate the file, and then select **Properties**.
3. On the **Client** tab, select **Enable unattended installation**, browse to the `WDSClientUnattend.xml` file, then click **Open**.

4 Click **OK** to close the Properties page.

Create the AutoUnattend.xml File

The AutoUnattend.xml file is used during the installation of Windows Server 2003 to automatically populate the various configuration settings.

> **NOTE:** You can use the Windows System Image Manager (Part of the Windows Automated Installation Kit) to create the `AutoUnattend.xml` file.

To associate your AutoUnattend.xml file with your custom install image:

1 Copy the `AutoUnattend.xml` file to the following folder in the `RemoteInstall` folder: `RemoteInstall\WDSClientUnattend`.

2 Open the Windows Deployment Services MMC snap-in, select the custom install image with which you want to associate the file, right-click and then select **Properties**.

3 Select the **Allow image to install in unattend mode** option.

Click **Select File** and browse to your `AutoUnattend.xml` file.

Using Automated Deployment Services (ADS)

Automated Deployment Services (ADS), enables you to deploy Windows server 2003 and Windows XP onto bare-metal servers across large, scaled-out installations.

The steps for including the Solarflare drivers for Windows Server 2003 and Windows XP assume that you have the following:

- A fully configured ADS Controller server.
- A master destination device, running Windows Server 2003, added as a device on the ADS controller. The reference server must be connected to the ADS Controller via a Solarflare adapter with the drivers/management software installed. The reference server must also have the adsroot certificate copied to it from the ASDS Controller. Consult your ADS documentation for details on how to copy the adsroot certificate.
- A destination device that will have Windows Server 2003 or Windows XP installed on it. This computer must be connected to the ADS Controller via a Solarflare adapter.

Capture the Windows Sever 2003 Image

1 Ensure your master destination device has the ADS Administration Agent installed.

2 Add the following folders to the root of your hard drive:

```
\sysprep
\sysprep\i386
```

3 From the `\Support\Tools` folder on your Windows server 2003 CD-ROM, extract the `Deploy.cab` file.

4 Copy `sysprep.exe` and `setupcl.exe` from the extracted cab file to the `\sysprep\i386` folder.

5 From the ADS Controller, copy the relevant Windows Server 2003 sample file from the `\Program Files\Microsoft ADS\samples\Sysprep` folder.

You can select either:
`sysprep-wg-w2003.inf` if you want the new client to join a workgroup.
`sysprep-domain-w2003.inf` if you want the new client to join a domain.

6 Copy the above `inf` file to the `\sysprep` folder on your master destination device and rename it `sysprep.inf.`

7 From the ADS Controller, open the ADS sequence editor from **Programs > Microsoft ADS > Sequence Editor**.

8 From the Sequence Editor, select Open from the File menu and browse to **Program Files\Microsoft ADS\samples\Sequences**. Select the `capture-image.xml` file.

9 Select **Capture image** from the Sequence Editor.

10 From the Properties tab displayed, enter a **Description**, **Image Name** and relevant **Disk** and **Partition** information.

11 Select **Save** from the **File** menu to save your sequence.

12 From the ADS Controller open ADS Management from **Programs > Microsoft ADS**.

13 Open the **Job Templates** folder and select **capture-image**. From the right-click menu, select **Run job**. The **Run Job Wizard** starts.

14 Click **Next** from the **Welcome** screen.

15 From the **Destination Device Selection** screen, select either your **single device** (as in this example) or a s**et of devices**. Select your device and click **Next**.

16 Click **Finish** to complete the wizard.

17 Your job will now be visible in the **Running jobs** folder.

Install the Windows Server 2003 Image to the Destination Device

1 Add the device record for the destination device to the ADS Controller. This is either by MAC Address or SMBIOS GRUID

2 Use `Setupmgr.exe` (Extracted from the `deploy.cab` file from the `Support\Tools` folder of the Windows Server 2003 CD-ROM) to create the answer files needed for ADS deployment.

3 At the root of your OS drive (for example `C:\`), create a directory called `sysprep`.

4 In the sysprep folder create a `i386` folder:

5 Copy `sysprep.exe`, `setupcl.exe` and `sysprep.inf` into the `i386` folder.

6 Create a `c:\sysprep\drivers\nic` drivers directory and in this directory create a separate folder for the Solarflare network adapter driver. Copy the contents of the appropriate Solarflare VBD and NDIS Windows Server 2003 driver folder (see Table 29) to the `c:\sysprep\drivers\nic` drivers folder.

7 Modify your `sysprep.inf` file to include the location of these files.

Further Reading

- How to use setupmgr to create an answer file in Windows Server 2003:

http://support.microsoft.com/kb/323438

- Description of the Netset.exe tool:

http://support.microsoft.com/kb/268781/en-us

- Specifying Multiple Network Adapters in an Unattended Setup:

http://support.microsoft.com/kb/229762/en-us

- Specifying Adapters (Virtual Devices):

http://support.microsoft.com/kb/920293 (You cannot configure a network adapter that resides on a virtual bus to use a static IP address in an automated deployment of Windows Server 2003)

- How to use RIS to Install Windows Server 2003:

http://support.microsoft.com/kb/325862

- How to add third-party OEM Network Adapters to RIS installations:

http://support.microsoft.com/kb/246184/en-us

- How to add OEM Plug and Play Drivers to Windows installations:

http://support.microsoft.com/kb/254078/EN-US/

- Installing Windows Deployment Services (WDS) for Windows Server 2003:

http://technet.microsoft.com/en-us/library/cc766320%28WS.10%29.aspx

- Automated Deployment Services (ADS) for Windows Server 2003:

http://www.microsoft.com/windowsserver2003/techinfo/overview/adssysreq.mspx

- How to add network driver to WDS boot image:

http://support.microsoft.com/kb/923834

4.9 Managing Adapters with SAM

NOTE: The Windows dialog boxes displayed by SAM will appear differently on different Microsoft Windows OS versions.

Introduction

The Solarflare Adapter Manager (SAM) is a Microsoft Management Console (MMC) plug-in for managing Solarflare adapters, teams and VLANs. SAM identifies information for all adapters installed on the server, as well as the standard MMC plug-in Actions pane.

Using SAM, you can easily configure Ethernet and task offloading settings, set up teams and VLANs, configure the Boot ROM for PXE or iSCSI booting, and upgrade the adapter firmware.

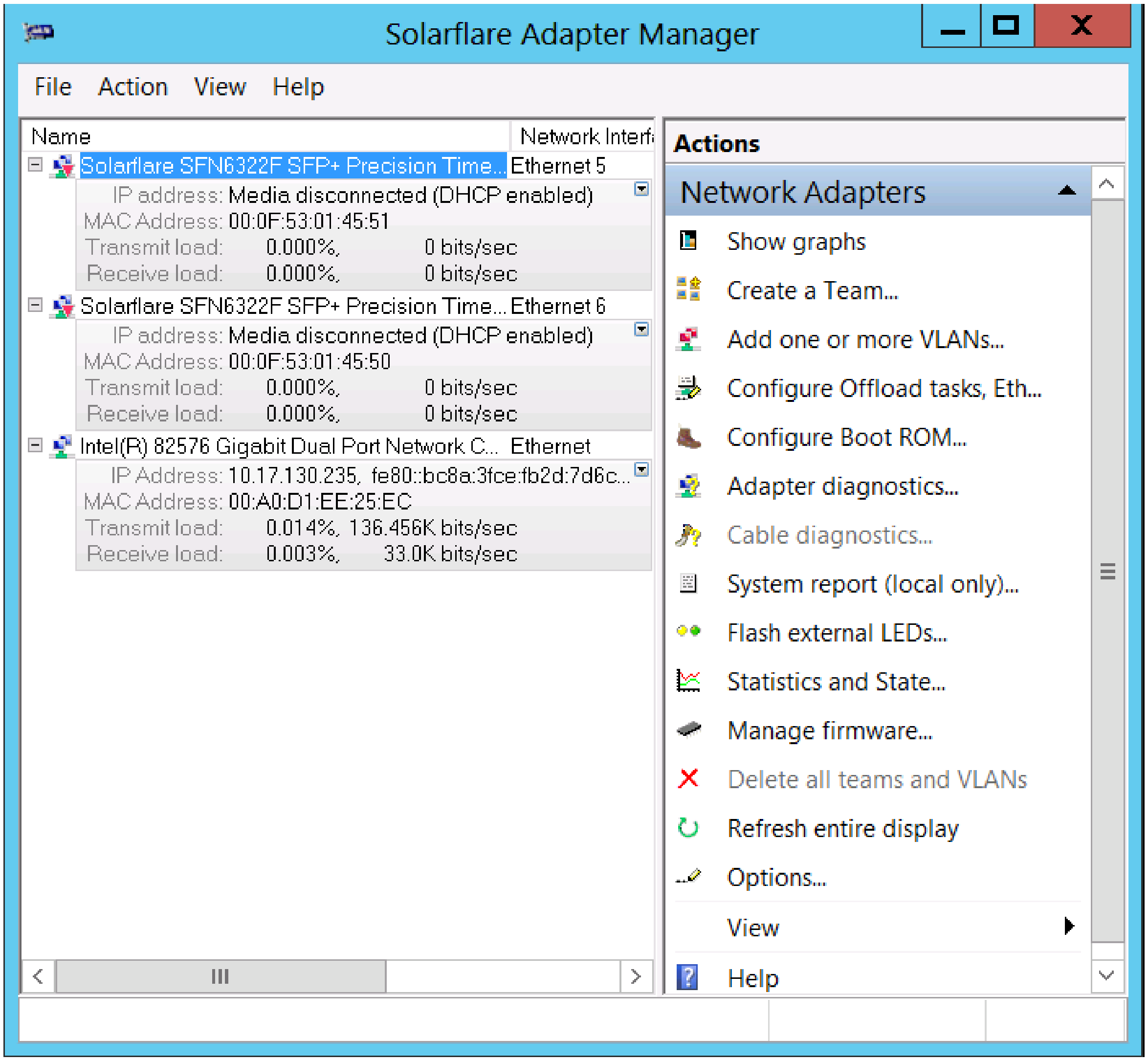


Figure 14: SAM Main Screen - Windows Server 2012

SAM's diagnostics utilities allow you to run tests on the adapter, and on 10GBASE-T adapters, on the cable to discover any potential issues which may be affecting adapter performance. Also, SAM's detailed statistics and state information can be used to view data transfer figures, sent and received packet types, as well as other traffic-related details.

SAM is included with the Solarflare drivers installation package.

4.10 Managing Adapters Remotely with SAM

SAM can be used to administer Solarflare adapters on your server from a remote computer. SAM can be used remotely to administer adapters on any supported Windows platform, including a Windows Server Core Installation. Remote Administration provides access to all SAM features.

To allow SAM to remotely administer your server, you need to add a Computer Management snap-in to the computer Microsoft Management Console (MMC).

4.11 Using SAM

Starting SAM

There are various ways of starting SAM.

To manage a local computer:

- If the Solarflare notification area icon is installed, right-click the icon and select **Manage network adapters on this computer**.

  OR

- Click **Start > All Programs > Solarflare Network Adapters > Manage network adapters on this computer**.

  OR

- Click **Start > Administrative Tools > Computer Management > System Tools >Network Adapters**.

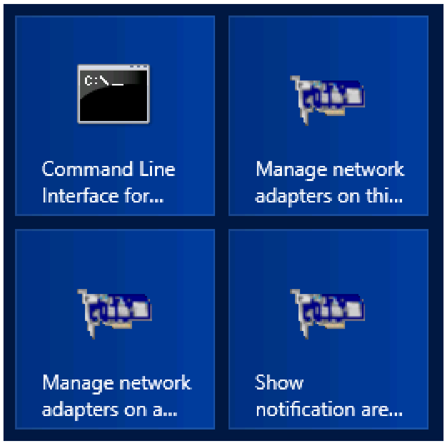


Figure 15: SAM Desktop Icons

> **NOTE:** You may be asked for permission to continue by the User Account Control when starting SAM. You must run SAM as an administrator to make any changes.

To manage a remote computer:

- Click **Start > All Programs > Solarflare Network Adapters > Manage network adapters on a remote computer**.
- If the Solarflare notification area icon is installed, you can right-click the icon and select **Manage network adapters on a remote computer**.

Viewing Adapter Details

SAM lists all available network adapters installed in the server, regardless of manufacturer or adapter type

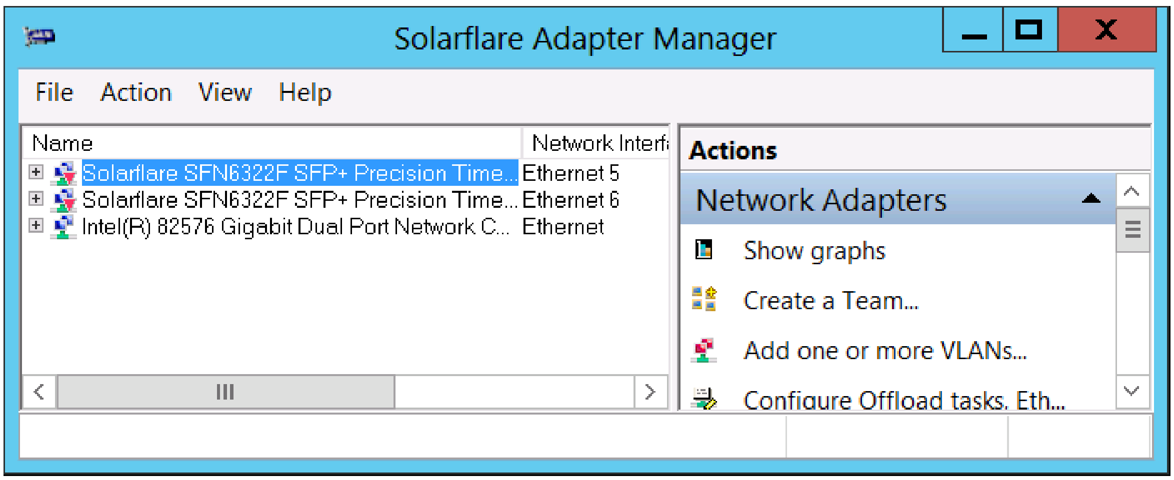


Figure 16: Solarflare Adapter Manager (SAM)

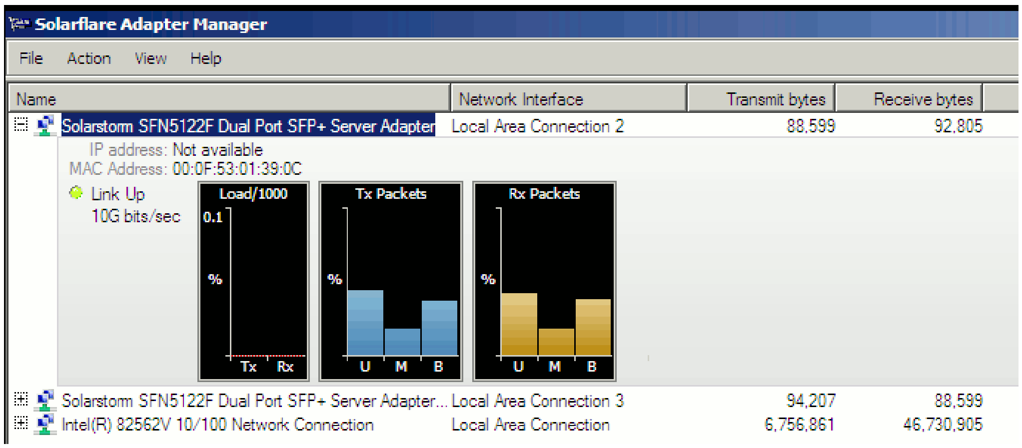
For each adapter, SAM provides the following details:

- Name and network interface
- IP address (IPv4 and IPv6, if available)
- MAC address
- Transmit load
- Receive load

For Solarflare adapters only, SAM also lists any teams or VLANs that have been configured, along with details that allow you to quickly check performance and status.

Viewing Performance Graphs

To view Solarflare performance graphs, Right-click on an adapter and select **Show graphs** from the menu. By default, SAM shows the load, transmitted packets and received packets graphs only. To view other available graphs, Select **Graphs** from the right-click menu, or from the Actions Pane/ Action menu. For non-Solarflare adapters only the load graph is displayed.



Configuring Options in SAM

SAM allows you to change the units used to display data, enable separators when displaying large numbers and disable/enable warning messages.

To configure SAM options:

1 Start SAM.

2 From the **Actions** pane, click **Options**, or choose **Action > Options**.

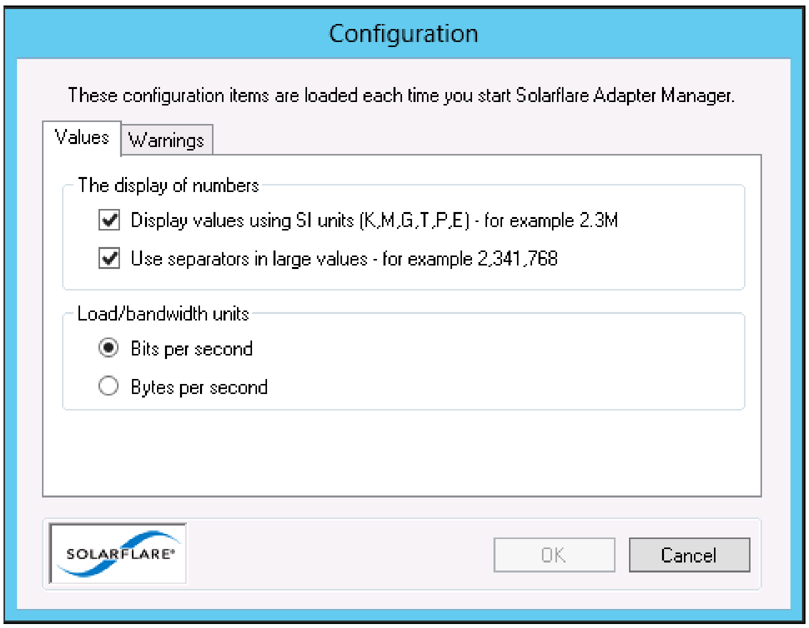


Figure 17: SAM - Actions > Options

3 In the Configuration window, select required options (seeTable 28).

4 Click **OK** to save your options or **Cancel** to retain the existing settings.

Table 28: SAM Configuration Options

Tab	Options	Description
Values	**Display values using SI units**	Displays values using international standard units (K, M, G, T, P, E), for example 2.3M. Enabled by default. This can be useful when dealing with the large Tx/Rx numbers that can accumulate with 10Gb networking. Note: The Transmit and Receive bytes columns ignore this setting.

Table 28: SAM Configuration Options

Tab	Options	Description
Values	**Use separators in large values**	Use separators with large numbers, for example 2,341,768. Enabled by default.
Values	**Load/bandwidth units**	Use bits per second (default setting), or bytes per second when displaying data transfer figures.
Warnings	**Warnings displayed before a major action takes place**	Warnings for the following actions can be enabled or disabled in SAM: • Deleting a VLAN or removing a network adapter from a team • Deleting a team

Working with Third-Party Adapters

Third-party adapters installed in the server are also listed in the SAM's Network Adapters list, along with the Solarflare adapters and any teams and VLANs which have been set up on the server.

SAM provides some options for working with third-party adapters. The available actions for third party adapters are shown in the **Action** pane.

4.12 Using SAM to Configure Adapter Features

SAM allows you to configure the following features on Solarflare adapters:

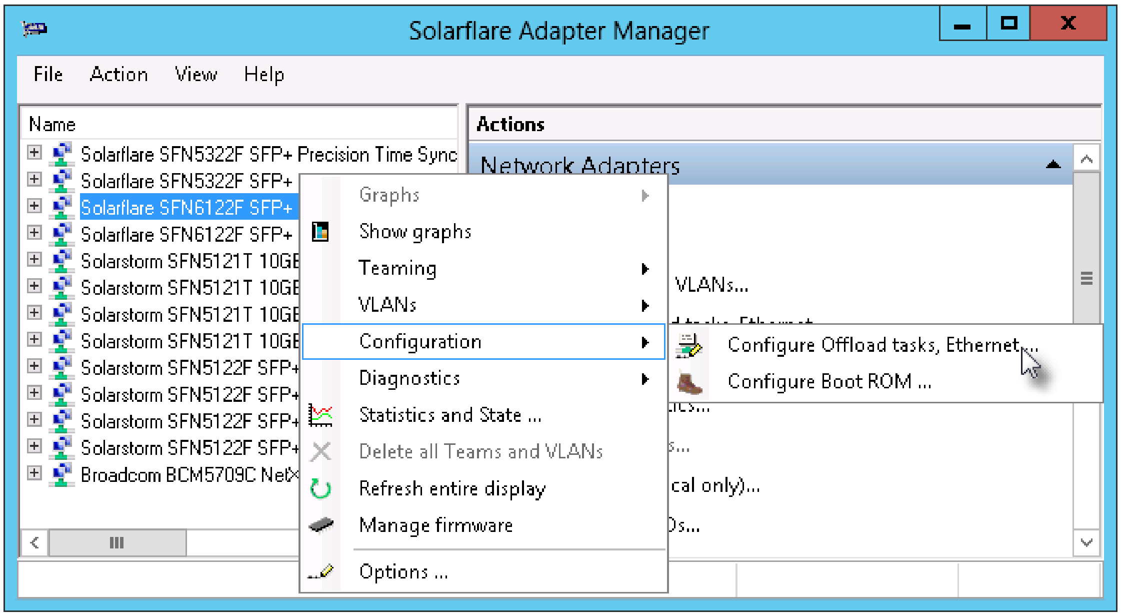
NOTE: Changing the value of an Adapter feature can negatively impact the performance of the adapter. You are strongly advised to leave them at their default values.

NOTE: Before making any changes to your Solarflare adapter features, read the Performance Tuning on Windows section on page 236 first.

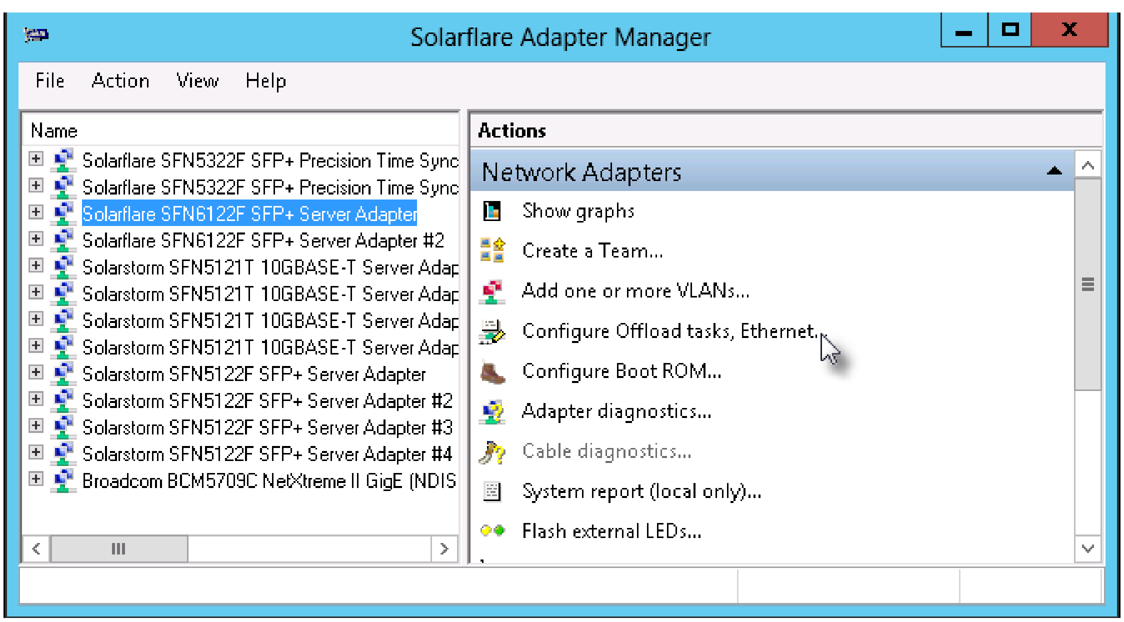
Accessing Adapter Feature Settings

Use **one** of the following methods to access the Adapter Features Dialog:

From SAM, right-click on an adapter and select **Configuration > Configure Offload tasks, Ethernet and other features**



From SAM, select an adapter and from the **Action** menu, select **Configure Offload tasks, Ethernet and other features.**



The **Adapter Features** dialog box will be displayed:

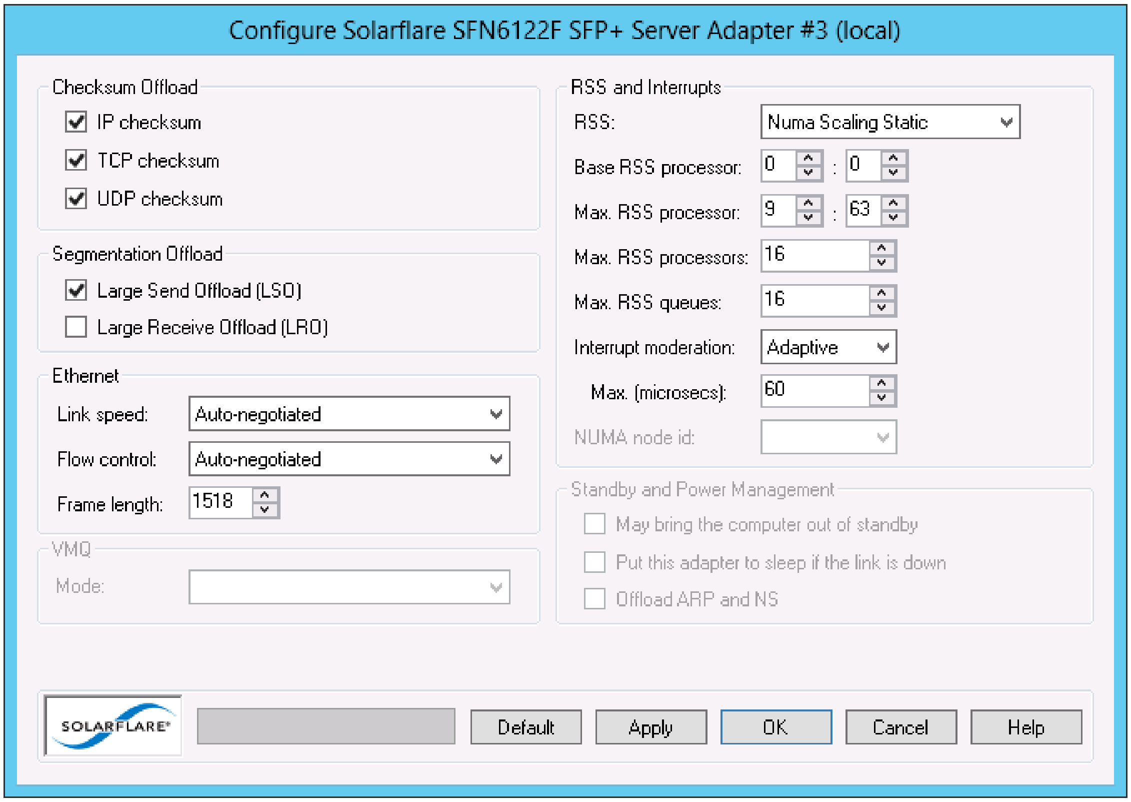


Figure 18: Solarflare Adapter Manager Adapter Features

Click **Apply** or **OK** when changes to Adapter Features are modified.

Checksum Offload

Windows XP, Windows Server 2003, Windows 7, Windows 8, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012.

Checksum offloading is supported on IP, TCP and UDP packets. Before transmitting a packet, a checksum is generated and appended to the packet. At the receiving end, the same checksum calculation is performed against the received packet. By offloading the checksum process to the network adapter, the load is decreased on the server CPU.

By default, Solarflare adapters are set up to offload both the calculation and verification of TCP, IP and UDP checksums. The following Checksum Offload options are supported:

Table 29: Checksum Offloads

Check box selected	**Transmit and Receive**	Transmit checksums are generated and received checksums are enabled. This is the default setting.
Check selected but selection greyed out	**Transmit Only or Receive Only**	For either transmit or received checksum only. **NOTE:** The Transmit or Receive Only states can only be set from the Advanced tab of the Driver Properties. See Configuring Network Adapter Properties in Windows on page 180 for more details.
Check box cleared	**Disabled**	Disabled. Data will be checksummed by the host processor for both transmitted and received data.

You can also configure Checksum offload settings from the network adapter properties. See Configuring Network Adapter Properties in Windows on page 180 for more details.

NOTE: Changing the checksum offload settings can impact the performance of the adapter. Solarflare recommend that these remain at the default values. Disabling checksum offload disables TCP segmentation offload.

RSS and Interrupts

Windows XP, Windows Server 2003, Windows 7, Windows 8, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012.

Solarflare network adapters support RSS (Receive Side Scaling) and interrupt moderation. Both are enabled by default and can significantly improve the performance of the host CPU when handling large amounts of network data.

RSS attempts to dynamically distribute data processing across the available host CPUs in order to spread the workload. Interrupt moderation is a technique used to reduce the number of interrupts sent to the CPU. With interrupt moderation, the adapter will not generate interrupts closer together than the interrupt moderation interval. An initial packet will generate an interrupt immediately, but if subsequent packets arrive before the interrupt moderation interval, interrupts are delayed.

You can also configure RSS and interrupts settings from the network adapter properties. See Configuring Network Adapter Properties in Windows on page 180 for more details.

NOTE: Changing the RSS and Interrupt Moderation settings can impact the performance of the adapter. You are strongly advised to leave them at their default values.

RSS and Interrupts Options

Table 30:

Displayed (supported) options will differ between Windows OS versions and different Solarflare drivers.	
RSS	Enabed|Disabled. See also RSS (Windows Server 2012).
RSS Algortihm	The RSS algorithm determines how RSS queues and interrupts are spread over the available processors. The Microsoft setting uses the algorithm supported by the Windows version. The Solarflare setting uses an optimized mode found to improve performance and reduce CPU utilization over a range of traffic patterns. The Solarflare setting is the default value. Solarflare|Microsoft
RSS queue count	Balanced means interrupts are balanced across all available CPU cores. Otherwise the user can direct RSS to create a specific number of receive queues (1-64). By default receive queue 1 will map to the first CPU, receive queue 2 will map to the second etc.
Max. RSS processors	Set the number of processors to be used by RSS. If this is greater than or equal to the number of logical processors in the system then all processors are used.
Interrupt moderation	Adaptive - adjusts the interrupt rates dynamically, depending on the traffic type and network usage. Disabled - interrupt moderation is disabled. Enabled - interrupt moderation is enabled.
Maximum (microseconds)	This setting controls the value for the interrupt moderation time. The default value is 60 microseconds and can be changed for deployments requiring minimal latency.

Table 30:

RSS (Windows Server 2012)	Disabled - RSS is disabled. (Enabled by default). Closest Processor - (default behaviour) Closest Processor Static - Network traffic is distributed across available CPUs, but there is no dynamic load balancing. NUMA Scaling - CPUs are assigned on a round-robin basis across every NUMA node. NUMA Scaling Static - As for NUMA Scaling but without dynamic load balancing. Conservative Scaling - RSS will use as few processors as possible to sustain the current network load. This helps to reduce the number of interrupts.
Base RSS processor	The base processor to be used by RSS. The value is specified as a group (range 0-15) and CPU number (range 0-63).
Max. RSS processor	The maximum processor available to RSS. The value is specified as a group (range 0-15) and CPU number (range 0-63).
Max. RSS processors	The maximum number of processors to be used by RSS. The value is in the range 0-256.
Max. RSS queues	The maximum number of receive queues created per interface. The value is in the range 0-64.
NUMA node id	The NUMA node id drop down list box is displayed on Windows platforms that support NUMA architectures. This contains the set of CPU cores used for RSS to the specified NUMA node. Solarflare recommend you leave this at the default setting of **All.** The adapter will attempt to use only processors from the specified NUMA node for RSS. If this is set to ALL or it is greater than or equal to the number of NUMA nodes in the system, all NUMA nodes are used.

Further Reading

For more information on Windows RSS profiles and options refer to http://msdn.microsoft.com/en-us/library/windows/hardware/ff570864%28v=vs.85%29.aspx

4.13 Segmentation Offload

Windows XP, Windows Server 2003, Windows 7, Windows 8, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012.

Solarflare adapters offload the tasks of packet segmentation and reassembly to the adapter hardware, reducing the CPU processing burden and improving performance.

LRO is a Solarflare proprietary implementation of the Windows Receive Side Coalescing feature. When enabled the adapter will coalesce multiple received TCP packets on a TCP connection into a single call to the TCP/IP stack. This reduces CPU use and improves peak performance. However LRO can increase latency and should not be used if a host is forwarding received packets from one interface to another. LRO is disabled by default.

You can also configure LSO and LRO settings from the NDIS properties. See Configuring Network Adapter Properties in Windows on page 180 for more details.

Ethernet Link Speed

Generally, it is neither necessary or desirable to configure the link speed of the adapter. The adapter by default will negotiate the link speed dynamically, connecting at the maximum, supported speed. However, if the adapter is unable to connect to the link partner, you may wish to try setting a fixed link speed. For further information see 'Link Speed' in Table 41 on page 181

Ethernet flow control

Ethernet flow control allows two communicating devices to inform each other when they are being overloaded by received data. This prevents one device from overwhelming the other device with network packets. For instance, when a switch is unable to keep up with forwarding packets between ports. Solarflare adapters allow flow control settings to be auto-negotiated with the link partner.

You can also configure ethernet flow control from the network adapter properties. See Table 41 on page 181 for more details.

Table 31: Ethernet Flow Control Options

Option	Description
Auto-negotiate	Flow control is auto-negotiated between the devices. This is the default setting.
Generate and respond	Adapter generates and responds to flow control messages.
Respond only	Adapter responds to flow control messages but is unable to generate messages if it becomes overwhelmed.
Generate only	Adapter generates flow control messages but is unable to respond to incoming messages and will keep sending data to the link partner.
None	Ethernet flow control is disabled on the adapter. Data will continue to flow even if the adapter or link partner is overwhelmed.

Ethernet Frame Length

The maximum Ethernet frame length used by the adapter to transmit data is (or should be) closely related to the MTU (maximum transmission unit) of your network. The network MTU determines the maximum frame size that your network is able to transmit across all devices in the network.

NOTE: For optimum performance set the Ethernet frame length to your network MTU.

If the network uses Jumbo frames, SAM supports frames up to a maximum of 9216 bytes.

Standby and Power Management

These settings are only available if the adapter has auxiliary power supplied by a separate cable. .

Table 32: Standby and Power Management

May bring the computer out of standby	Enables Wake on LAN capability for adapters supporting this feature.
Put this adapter to sleep if the link is down	This setting uses the **Device Sleep on Disconnect** setting from the **Advanced** tab of the adapter properties. **Device Sleep on Disconnect** is the ability of the network adapter to go to sleep when it is not in use. When Windows detects that media has been disconnected (for example, when a cable is unplugged), Windows will put the device into the low power state and disable the LAN. The computer will automatically detect when the cable is plugged in again and return the network adapter to full power.
Offload ARP and NS	Windows Server 2008 R2,Windows 7, Windows Server 2012.

You can also configure standby power management from the network adapter properties. See Configuring Network Adapter Properties in Windows on page 180 for more details.

Virtual Machine Queue

Windows XP, Windows Server 2003, Windows 7, Windows 8, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012.

Solarflare adapters (not SFN4122F) support VMQ to offload the classification and delivery of network traffic destined for **Hyper-V** virtual machines to the network adapter thereby reducing the CPU load on Hyper-V hosts.

Windows Server 2008R2 allows the administrator user to statically configure the number of CPUs available to process interrupts for VMQ. Interrupts are spread across the specified cores, however the static configuration does not provide best performance when the network load varies over time.

Dynamic VMQ, supported in Windows Server 2012, will dynamically distribute received network traffic across available CPUs while adjusting for network load by, if necessary, bringing in more processors or releasing processors under light load conditions.

Support for static VMQ is removed from Windows Server 2012, but the Solarflare driver which uses NDIS 6.3 is automatically granted Dynamic VMQ capabilities.

VMQ supports the following features:

- Classification of received network traffic in hardware by using the destination MAC address (and optionally also the VLAN identifier) to route packets to different receive queues dedicated to each virtual machine.
- Can use the network adapter to directly transfer received network traffic to a virtual machine's shared memory avoiding a potential software-based copy from the Hyper-V host to the virtual machine.
- Scaling to multiple processors by processing network traffic destined for different virtual machines on different processors.

Table 33: VMQ Mode Options

Enabled	VMQ is enabled by default.
Enabled (no lookahead split)	VMQ allows the network adapter to split packets into header and payload portions in hardware. The payload is delivered directly into the address space of the destination Hyper-V virtual machine by the adapter hardware. This feature is enabled by default. Disabling lookahead split will impact performance as the payload is delivered into the virtual machine using software. Not supported on Windows Server 2012.

Table 33: VMQ Mode Options

Enabled (no VLAN filtering)	VMQ uses the VLAN identifier from the Ethernet MAC header for filtering traffic to the intended Hyper-V virtual machine. VMQ VLAN filtering is enabled by default. When this option is disabled only the destination MAC address is used for filtering. Not supported on Windows Server 2012.
Enabled (MAC address filtering)	VMQ uses the Ethernet MAC header for filtering traffic to the intended Hyper-V virtual machine. VMQ VLAN filtering is enabled by default.
Disabled	VMQ is disabled.

4.14 Using SAM to Configure Teams and VLANs

About Teaming

NOTE: To set up teams and VLANS in Windows using the sfteam command line tool, see Sfteam: Adapter Teaming and VLAN Tool...Page 206

Solarflare adapters support the following teaming configurations:

- IEEE 802.3ad Dynamic link aggregation
- Static link aggregation
- Fault tolerant teams

Teaming allows the user to configure teams consisting of all Solarflare adapter ports on all installed Solarflare adapters or might consist of only selected adapter ports e.g. from a dual port Solarflare adapter, the first port could be a member of team A and the second port a member of team B or both ports members of the same team.

NOTE: Adapter teaming and VLANs are not supported in Windows for iSCSI remote boot enabled Solarflare adapters. To configure load balancing and failover support on iSCSI remote boot enabled adapters, use Microsoft MultiPath I/O (MPIO), which is supported on all Solarflare adapters.

This section is only relevant to teams of Solarflare adapters. Solarflare adapters can be used in multi-vendor teams when teamed using the other vendor's teaming driver.

NOTE: Windows Server 2012 has native support for Windows teaming. You should NOT mix native teaming and Solarflare teaming in the same server.

Setting Up Teams

SAM's **Create a Team** setup wizard will guide you through setting up an adapter team, automatically assigning the active adapter, key adapter and standby adapter.

To create a team:

1. Before creating a team, Solarflare strongly recommend taking the server offline to avoid disrupting existing services as the team is being configured.
2. Start SAM and select a Solarflare adapter in the Network Adapter list.
3. From the **Action** menu, select **Create a Team**. The Solarflare Create a team Wizard starts.

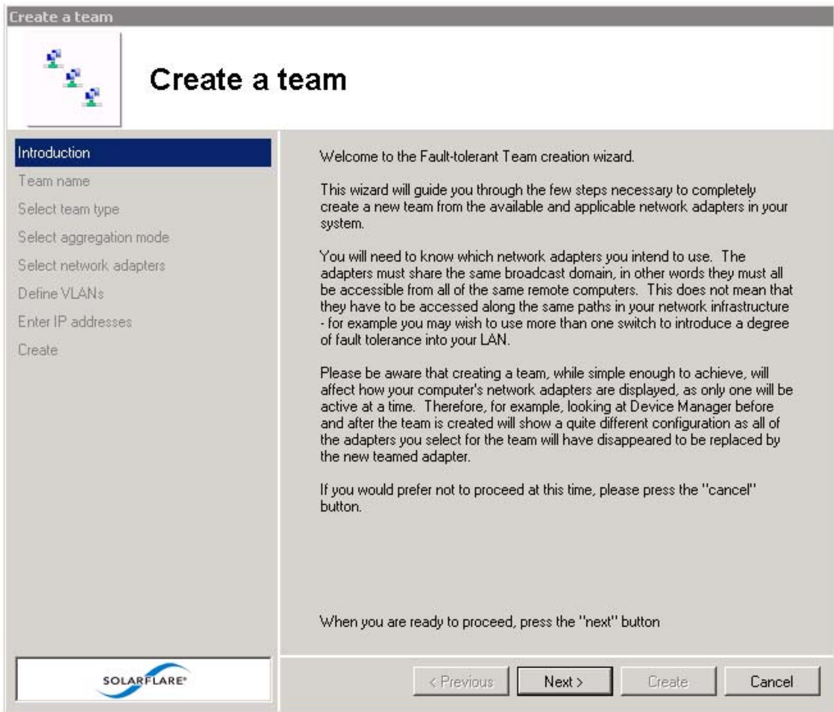


Figure 19: Team Create Wizard

4. The wizard will guide you through the process of creating a team and optionally adding VLANs to your team (see Table 35 on page 166 for help when selecting VLAN options).
5. Bring the server back online.
6. After creating a team, you can use the **Configure this Team** option from the **Actions** pane to change team settings, such as the Ethernet frame length, key adapter assignment, and adapter priorities within the team.

CAUTION: Before physically removing an adapter from a server, first check it is not the key adapter. You **must** reassign the key adapter if you want to remove it from the team to avoid duplicating the MAC address on your network. See Table 34 on page 161 for details on reassigning the key adapter.

Reconfiguring a Team

When setting up teams, SAM assigns the key, active and standby adapters, and specifies the Ethernet frame length for the team. To change any of these settings, use the **Configure this Team** option, as described below.

To change team settings:

NOTE: Changing team settings can disrupt network traffic flow to and from services running on the server. Solarflare recommend only changing network settings when disruption to the services can be tolerated.

1. Start SAM and, from the Network Adapter list, select the team you want to reconfigure.
2. From the **Action** menu, select **Configure this Team**. The **Configure a Team** dialog box displays.

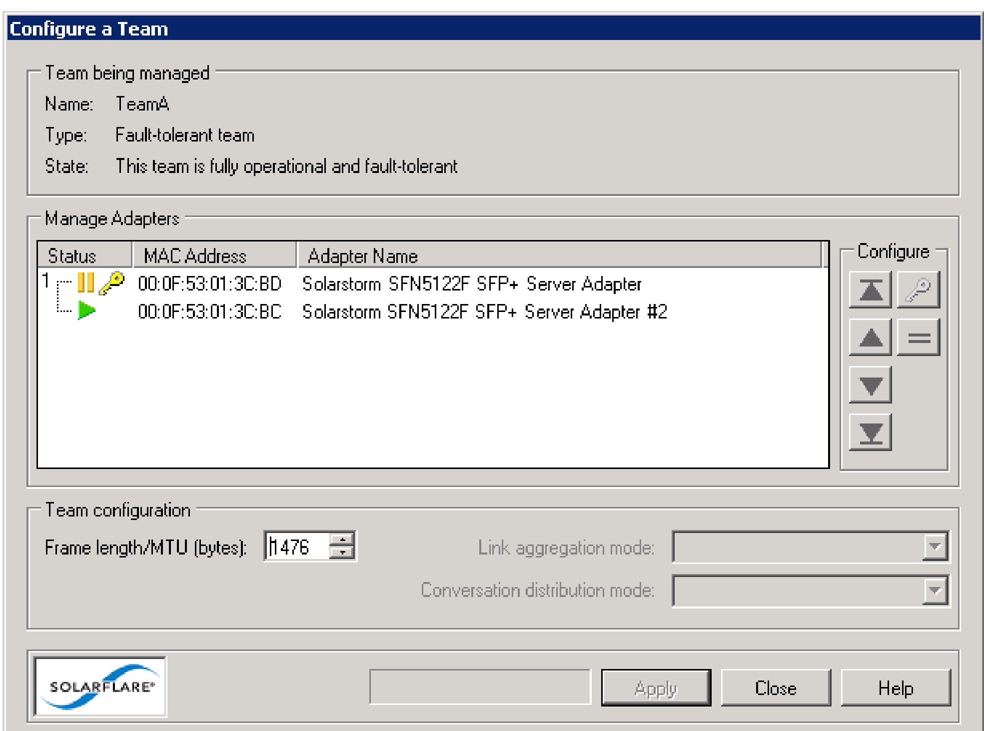


Figure 20: Configure aTeam

By default, all teamed adapters are given an equal priority (indicated by the grouped number 1). The current active adapter is indicated by the green active symbol. The key adapter is indicated with the key symbol. Adapters in standby are indicated by the yellow standby symbol. For link aggregated teams there may be more than one active adapter.

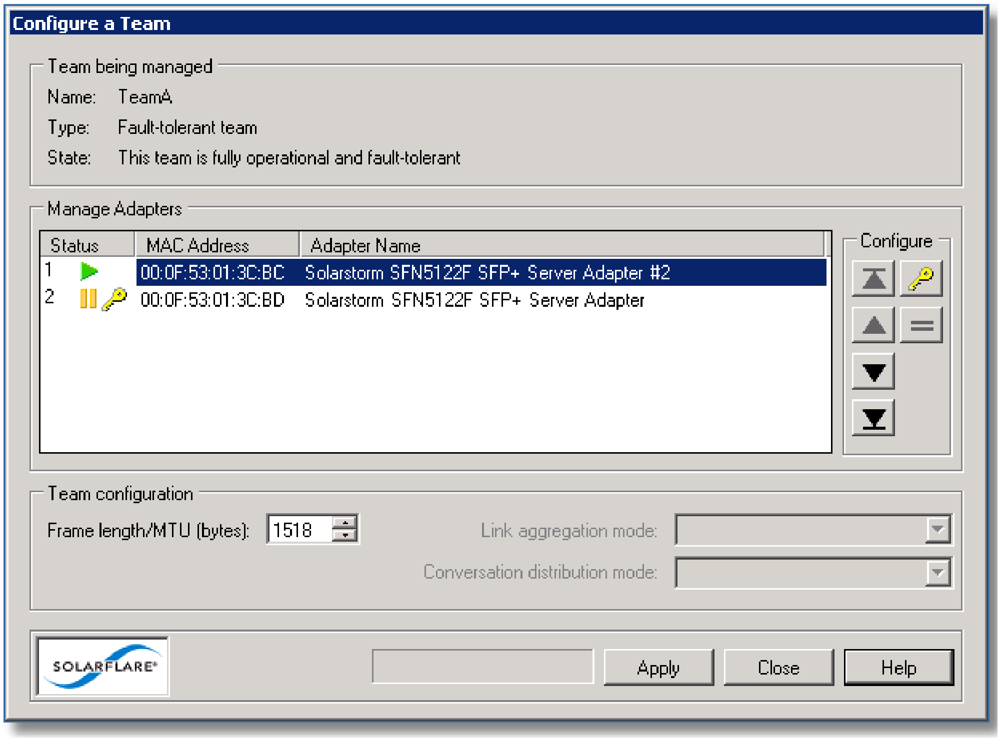


Figure 21: Prioritized Adapters

Figure 21 shows the active adapter with the highest priority, with the second adapter being second priority. :

Table 34: Configure a Team Options

To change the key adapter:	Select the new key adapter, then click the **key** button. **Note**: Before physically removing an adapter from a server, first check it is not the key adapter. You **must** reassign the key adapter if you want to remove it from the team to avoid duplicating the MAC address on your network.
To change adapter priority:	By default, all adapters have equal priority. Select an adapter and use the up or down buttons to promote or demote the adapter priority as required. **Note**: For Fault-Tolerant Teams, the highest priority adapter in a team becomes the active adapter, passing all network traffic for the team.

Table 34: Configure a Team Options

To specify a new active adapter:	For Fault -Tolerant Teams only. Set your preferred active adapter to the highest prioritized adapter in the team. The highest prioritized adapter becomes the active adapter in the team after you apply your changes. To change adapter priority, use the up and down buttons.
To specify the Ethernet frame length/MTU:	Specify a value between 1514 and 9216 bytes. Check your network supports the new frame length before setting the new value. **Note**: This setting affects all adapters in the team, and will override any individual adapter settings made from the **Configure Offload tasks, Ethernet and other features** window. See Using SAM to Configure Adapter Features on page 146 for more details.

3 After making your changes, click **Set** and then click **Close**.

Adding Adapters to a Team

If additional Solarflare adapters are installed in your server, you can add them to an existing team to increase the overall resilience or performance (aggregation) of the server connection.

To add adapters to a team:

> **NOTE:** Changing team settings can disrupt current services running on the server. Solarflare recommend only changing network settings when disruption to the services can be tolerated.

1 Start SAM and select a Solarflare adapter team from the Network Adapter list.

2 From the **Actions** list, click **Add one or more adapters**, or choose **Actions > Add one or more adapters**. The Available Network Adapters dialog box is displayed:

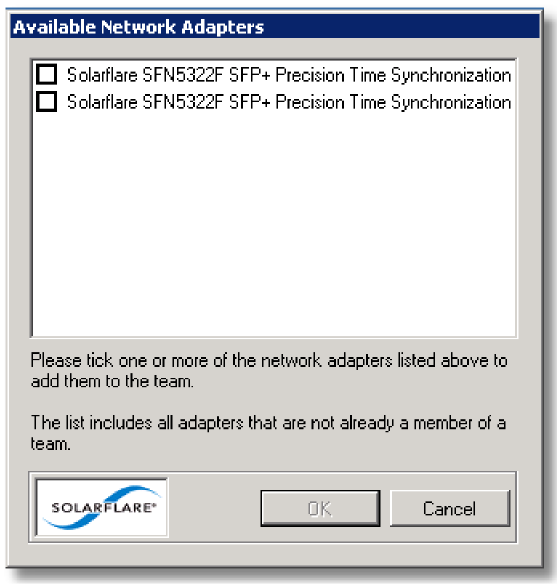


Figure 22: Available Adapters

3 Select the adapter(s) to add to the team. Click **OK** to add the selected adapters and close the dialog box.

Deleting Teams

You can delete a team by selecting **Delete this team** in SAM. Once a team has been deleted, all of its adapters are returned to their original configuration settings and become available on the server once again. Any VLANs set up for the team will be deleted when the team is deleted.

To delete a team:

NOTE: Changing team settings can disrupt current services running on the server. Solarflare recommend only changing network settings when disruption to network services can be tolerated.

1 Start SAM and select a Solarflare adapter team from the Network Adapter list.

2 From the **Action** menu, select **Delete this team**. Alternatively, to delete all teams and VLANs on the server, select **Delete all teams and VLANs**. The Confirm Action Dialog box is displayed.

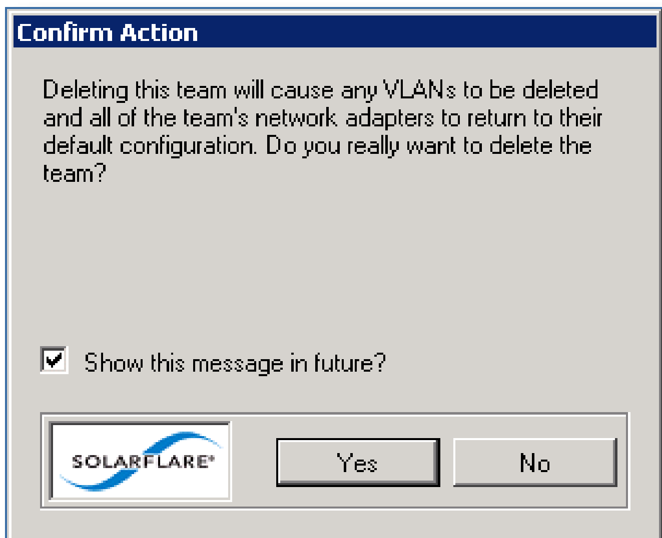


Figure 23: Confirm Action

3 Confirm the deletion when prompted.

NOTE: Delete all teams and VLANs will cause a display refresh which may take some time to complete, depending on the number of teams and VLANs being deleted.

Setting up Virtual LANs (VLANs)

SAM allows you to add up to 64 VLANs per team or adapter. Each VLAN is a virtual network adapter, visible in the Windows Device Manager, through which the operating system is able to receive data tagged with the correct VLAN ID (VID). You may assign one VLAN to accept VLAN 0 or untagged traffic, which allows the interface to communicate with devices that do not support VLAN tagging, or that are sending traffic on VLAN 0.

To create VLANs:

> **NOTE:** Creating VLANs can disrupt current services running on the server. Solarflare recommend only changing network settings when disruption to network services can be tolerated.

1 Start SAM and select the adapter or adapter team from the Network Adapter list.

2 From the **Actions** list, click **Add one or more VLANs**, or choose **Actions > Add one or more VLANs** to display the VLAN Setup Wizard.

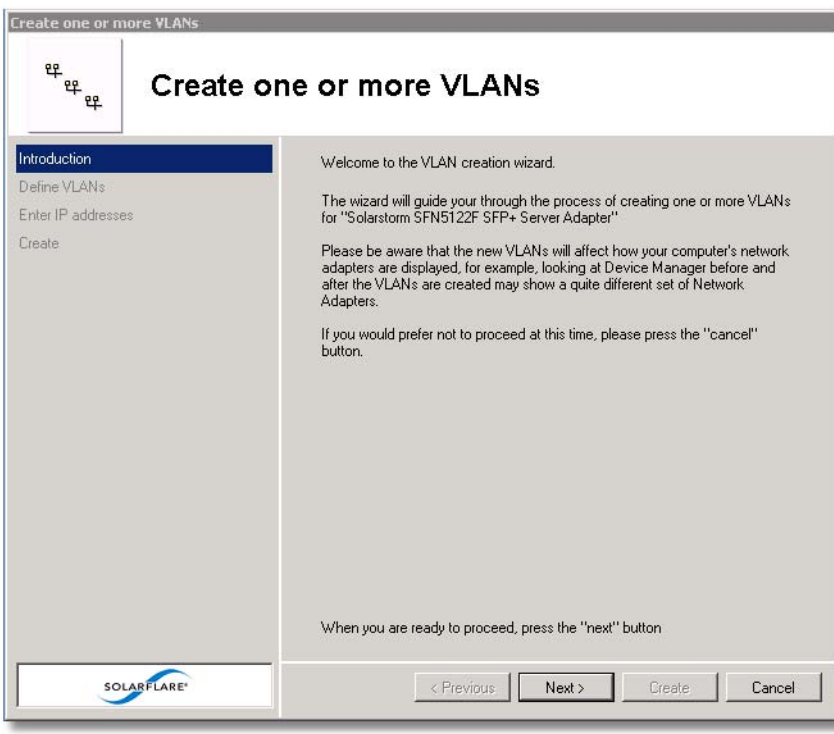


Figure 24: Create VLANs

Table 35: VLAN Options

Option	Description
Name	An optional name for the VLAN network adapter. This option will not be available when remotely administering the server.
Supports the handling of priority traffic	Enables the handling of traffic that is tagged as priority.
Supports untagged and VLAN 0 traffic	Restricts the VLAN to handling packets that are untagged or with VID 0. This option allows the interface to communicate with devices which don't support VLAN tagging.
Supports traffic solely on this VLAN	Restricts the network interface to traffic that is tagged with the specified VLAN.

Deleting VLANs

VLANs can be removed from a team or single adapter when no longer required.

To delete VLANs:

NOTE: Deleting VLANs can disrupt current processes and applications running on the server. Solarflare recommend only changing network settings when disruption to network services can be tolerated.

1. Start SAM.
2. In the Network adapter list, select the VLAN to delete. If necessary, expand the team if the VLAN is attached to a team then select the VLAN.
3. From the Actions list, click **Delete this VLAN**, or choose **Action > Delete this VLAN**.
4. Confirm the deletion in the Confirm Action Dialog box.

4.15 Using SAM to View Statistics and State Information

SAM’s Network Adapter list provides an overview of the adapters installed in the host computer. For a more detailed view of the adapter device settings, data transfer statistics, and other features, you can use the adapter Statistics and State.

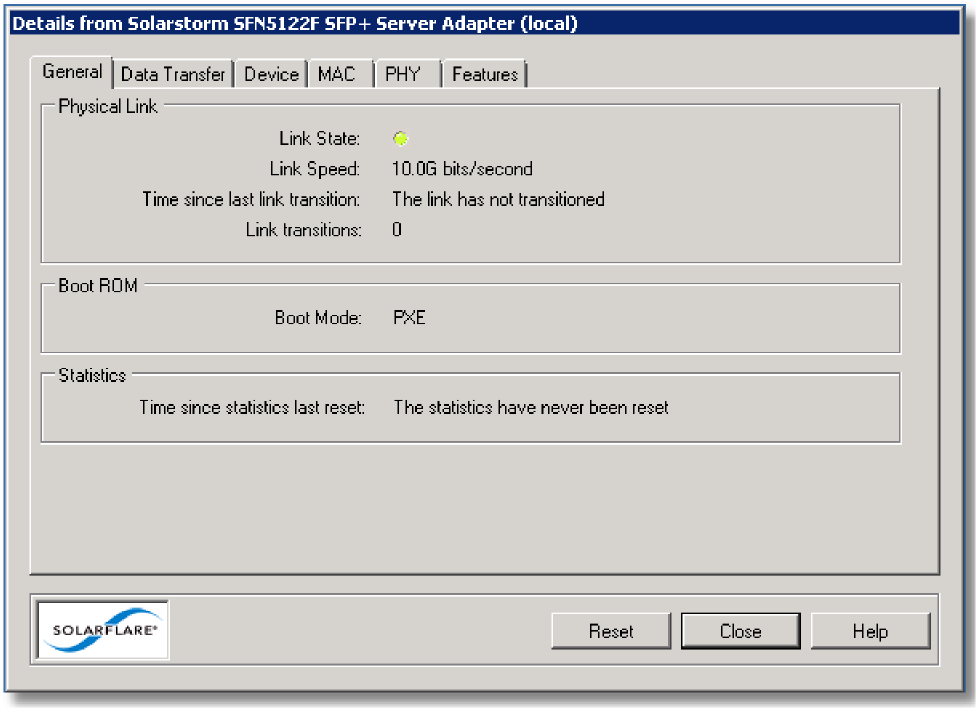


Figure 25: Solarflare Adapter Statistics and State

To view Solarflare statistics and state information:

1 Start SAM and select a Solarflare adapter from the Network Adapter list.

2 From the Actions list, click **Statistics and State**. The **Details from <adapter name>** dialog box is displayed.

> **NOTE:** The tabs displayed will differ, dependent on whether an adapter, VLAN or Team is selected.

3 Click each tab to see the various adapter statistics and state information that is available for the adapter. Note that statistics are collated from the start of the current session. To reset the statistics, see Resetting Adapter Statistics on page 168.

4 When you have finished viewing statistics, click **Close**.

Resetting Adapter Statistics

Statistics for data transfer and the MAC layer are reset, either following a system restart or installing of the adapter drivers. If necessary, you can reset the adapter statistics to restart the accumulated data values at any time.

1. Start SAM and select a Solarflare adapter from the Network Adapter list.
2. From the Actions list, click **Statistics and State**, or choose **Actions > Statistics and State**. The **Details from <adapter name>** dialog box is displayed.
3. In the **General** tab, click the **Reset** button to reset statistics.
4. Click **Close**.

4.16 Using SAM to Run Adapter and Cable Diagnostics

You can verify the Solarflare adapter, driver and cable by running SAM's built-in diagnostic tools (Solarflare 10GBASE-T adapter only).

The tools provide a simple way to verify that the adapter and driver are working correctly, and that the cable has the correct characteristics for high-speed data transfer.

The diagnostics tools also include an option to flash the LEDs (useful for identifying the adapter in a server room). Both options are available from **Actions > Adapter Diagnostics**.

NOTE: Running of these tests will cause traffic to be halted on the selected adapter, and all of its VLANs, unless part of a fault-tolerant team. Diagnostics tests are not available when the adapter is running in iSCSI boot mode.

NOTE: The full system report cannot be generated when remotely administering a server.

Running Driver and Adapter Diagnostics

SAM’s driver diagnostics enable you to test the adapter and driver are functioning correctly, returning a simple pass or fail for each test run.

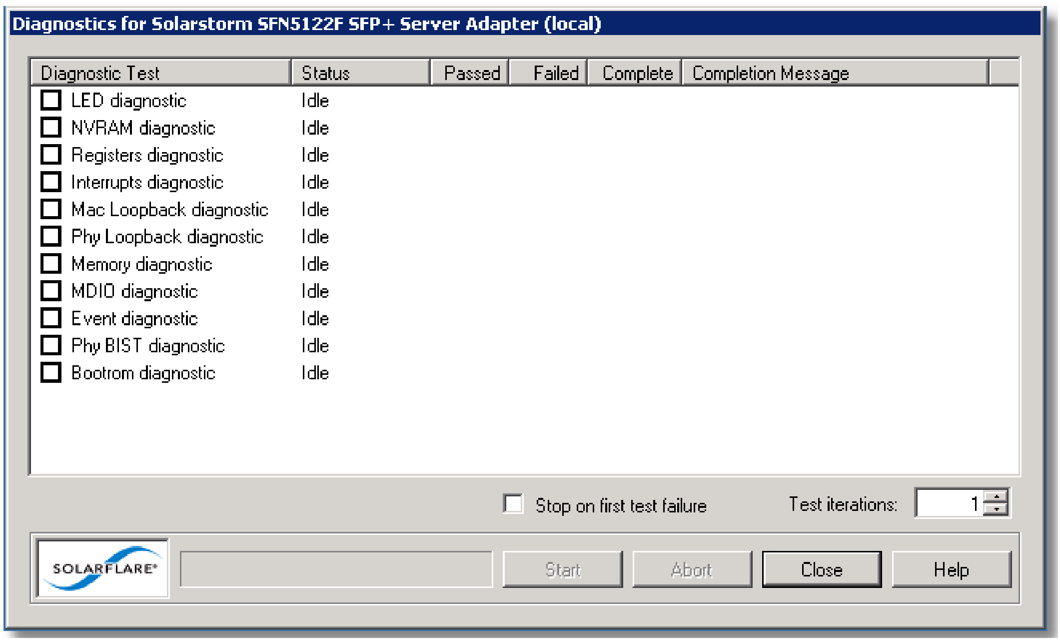


Figure 26: Adapter and Driver Diagnostics Window

1. Start SAM and select a Solarflare adapter from the Network Adapter list.
2. From the Action menu, select **Adapter Diagnostics**. The **Diagnostics for <adapter name>** window is displayed.
3. Select the test you want to run (no tests are selected by default). See Table 36 for a description of the tests that are available.
4. To stop as soon as a failure is detected, select **Stop on first test failure**.
5. To run all the tests more than once, change the value in the **Test iterations** box.
6. Click **Start** to begin testing. The results of each test will be displayed in the Diagnostics window, along with an entry in the Completion Message column describing the reason any particular test has failed.

CAUTION: The adapter will stop functioning while the tests are being run. Solarflare recommend only running diagnostics tests when disruption to network services can be tolerated.

NOTE: You can click **Abort** to abandon running tests at any time. This may take a while to complete, dependent on the test being run at the time.

The available tests depend on the installed adapter type.

Table 36: Adapter Diagnostic Tests

Diagnostic Test	Purpose
LED	Flashes the LEDs for 5 seconds.
NVRAM	Verifies the flash memory **board configuration** area by parsing and examining checksums.
Registers	Verifies the adapter registers by attempting to modify the writable bits in a selection of registers.
Interrupts	Examines the available hardware interrupts by requesting the controller to generate an interrupt and verifying that the interrupt has been processed by the network driver.
MAC loopback	Verifies that the network driver is able to pass packets to and from the network adapter using the MAC loopback layer.
PHY loopback	Verifies that the network driver is able to pass packets to and from the network adapter using the PHY loopback layer.
Memory	Verifies SRAM memory by writing various data patterns (incrementing bytes, all bit on and off, alternating bits on and off) to each memory location, reading back the data and comparing it to the written value.
MDIO	Verifies the MII registers by reading from PHY ID registers.
Event	Verifies the adapter’s event handling capabilities by posting a software event on each event queue created by the driver and checking it is delivered correctly. The driver creates an event queue for each CPU.
PHY BIST	Examines the PHY by initializing it and starting any available built-in self tests to run.
Bootrom	Verifies the Boot ROM configuration and image checksum. Will warn if no Boot ROM is present.

Running Cable Diagnostics

With high-speed data networking, the suitability of the cable in achieving maximum transfer rates is especially important. SAM's cable diagnostic tool can be used to verify the attached cable, reporting its condition, measured length and electrical characteristics for each cable pairing.

NOTE: Cable diagnostics are only available on Solarflare 10GBASE-T Adapters. For these adapters, Solarflare recommend using good quality Category 6, 6a or 7 cable up to the maximum length as determined by the cable category.

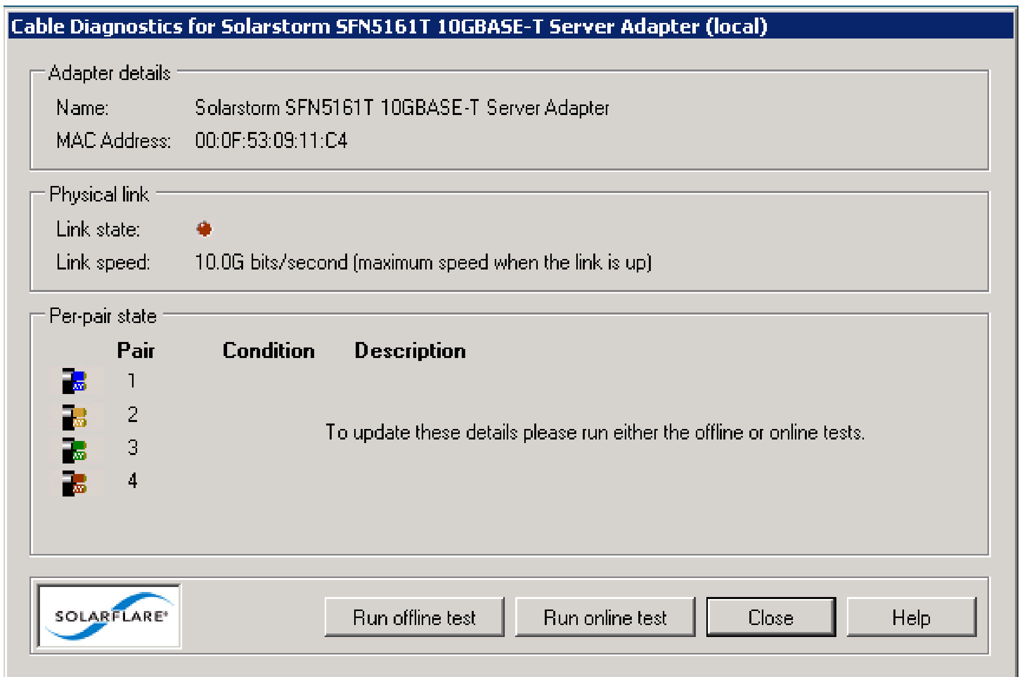


Figure 27: Cable Diagnostics Window

1. Start SAM and select a Solarflare adapter from the Network Adapter list.
2. From the Action menu, click **Diagnostics** then **Cable Diagnostics**. The **Cable Diagnostics for <adapter name>** dialog box is displayed.
3. Click **Run offline test** or **Run online test**. Offline testing produce more detailed results, but at the expense of disrupting the connection while tests are running.

CAUTION: The offline tests will cause the network link to momentarily drop and disrupt data flow. Solarflare recommend only running diagnostics tests when disruption to your services can be tolerated.

4 The results of the testing will be displayed in the diagnostics dialog box. For analysis of the cable pair results, see Table 37.

Table 37: Cable Pair Diagnostic Results

Result	Meaning
OK **Length measured = ..., SNR margin = ...**	Cable is operating correctly. The range is ±13dB (approximately). The SNR should be positive.
Error **Pair short at ...**	A short circuit has been detected at the indicated length. The cable or the connector is faulty and must be replaced.
Error **Pair is open circuit**	An open circuit has been detected. The cable or the connector is faulty and must be replaced.

4.17 Using SAM for Boot ROM Configuration

For booting of diskless systems, Solarflare adapters support Preboot Execution Environment (PXE) and iSCSI booting.

When booting the server directly from an iSCSI target, you will first need to enable iSCSI booting and configure the iSCSI initiator, target and user authentication to match your network and target settings, or rely on DHCP to configure the settings dynamically when the adapter initializes (this is the default setting for all iSCSI options).

Using SAM, you can access the adapter Boot ROM to configure your firmware settings for adapter booting, as described below.

Configuring the Boot ROM for PXE or iSCSI Booting

For more information on configuring the iSCSI target and DHCP settings from the Solarflare Boot Configuration Utility, and how to install an operating system that is enabled for remote iSCSI booting over a Solarflare adapter, See Solarflare Boot ROM Agent on page 360.

To configure PXE or iSCSI booting on the Solarflare Boot ROM:

1 Start SAM and select a Solarflare adapter from the Network Adapter list.

From the **Action** menu, select the **Configure Boot ROM** option. The **Configure Boot ROM** window displays with the **BIOS** tab selected.

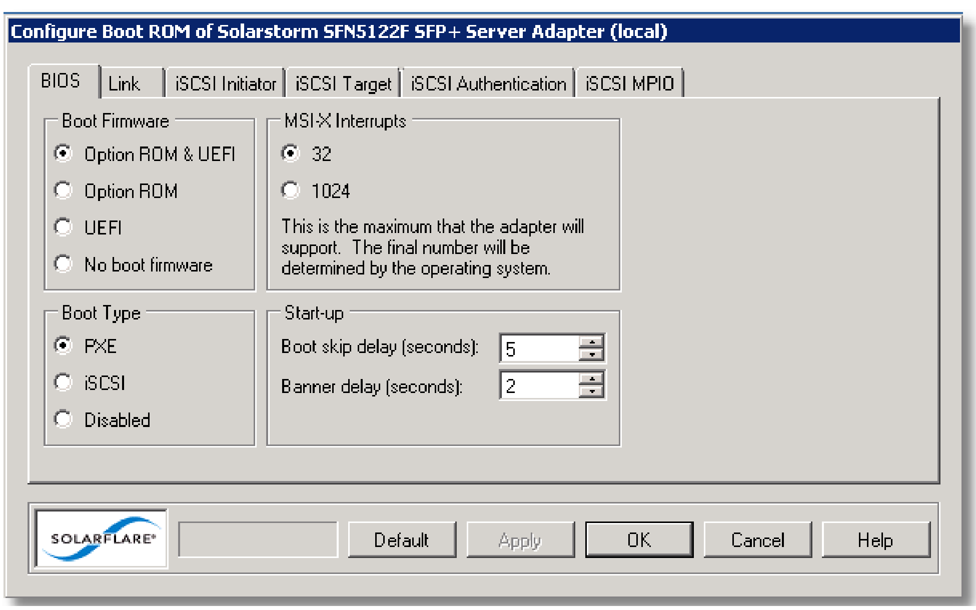


Figure 28: BIOS tab with firmware selected

2 From the **Boot Type** panel, select either PXE or iSCSI booting as required. You can also configure the types of Boot Firmware, the maximum number of MSI-X Interrupts supported and start-up configuration used by the Boot ROM utility. For more details on these options see

Sfboot: Boot ROM Configuration Tool on page 188.

> **NOTE:** iSCSI booting will not be available if the adapter is a member of a team or has VLANs.
>
> **NOTE:** Solarflare recommend not changing the MSI-X Interrupts setting.

3 If necessary, from the **Link** tab, change the **Link Speed** option depending on your link requirement. Note that **Auto-negotiated** is correct for most links and should not be changed unless advised. The Link Speed options will vary depending on the installed adapter

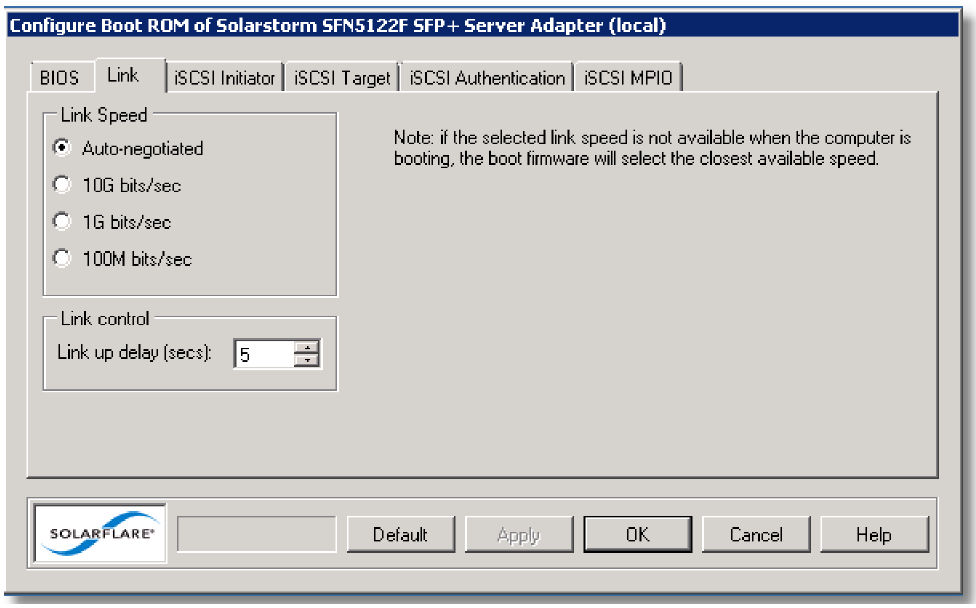


Figure 29: Link tab

4 The Link up delay specifies a wait time before the boot device will attempt to make a connection. This allows time for the network to start following power-up. The default setting is 5 seconds, but can be set from 0–255 seconds. This can be used to wait for spanning tree protocol on a connected switch to unblock the switch port after the physical network link is established.

5 If you selected **PXE** as the boot type, click **OK** to finish the setup procedure.

If you selected **iSCSI booting** as the boot type, click the **iSCSI Initiator** tab and continue with the following steps.

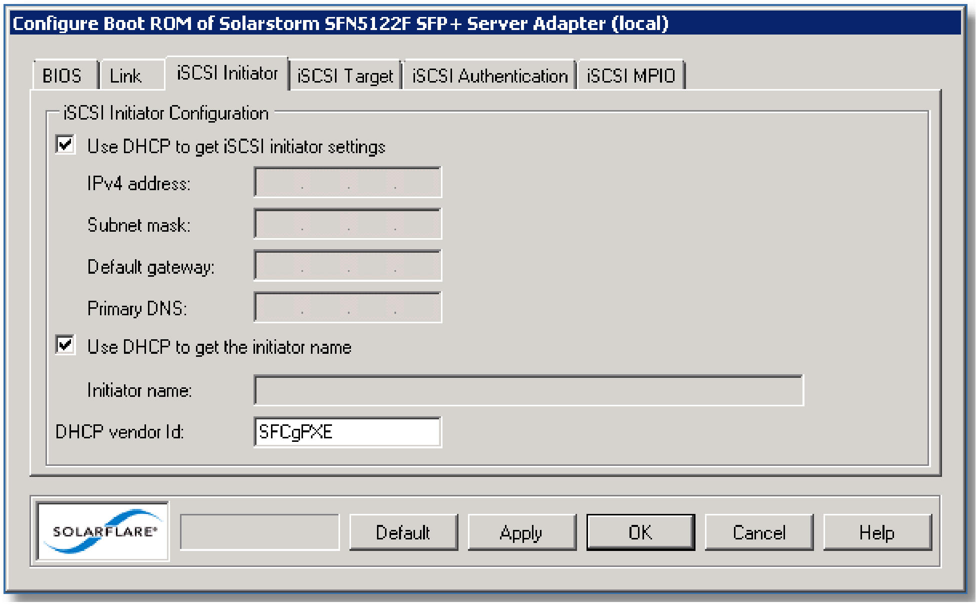


Figure 30: iSCSI Initiator tab

6 If using DHCP to configure the adapter's network settings at boot time, ensure **Use DHCP to get iSCSI Initiator settings** is selected. Otherwise, clear this option and enter network details for the adapter, as described in Table 38.

Table 38: iSCSI Initiator Options

Option	Description
IPv4 Address	An IPv4 address to assign to the adapter. Ensure this address is unique.
Subnet mask	Subnet mask. For example 255.255.255.0
Default Gateway	IPv4 address of your network router.
Primary DNS	IPv4 address of your Primary DNS server.

7 If you are not using DHCP to get the initiator name, clear **Use DHCP to get the initiator name** and enter a iSCSI Qualified Name (IQN) in the Initiator name field.

8 **DHCP vendor Id** specifies the device vendor ID to be advertised to the DHCP server. This setting is always enabled and not affected by any of the other DHCP options. See DHCP Server Setup on page 370 for more details on this and other DHCP options.

9 Click the **iSCSI Target** tab.

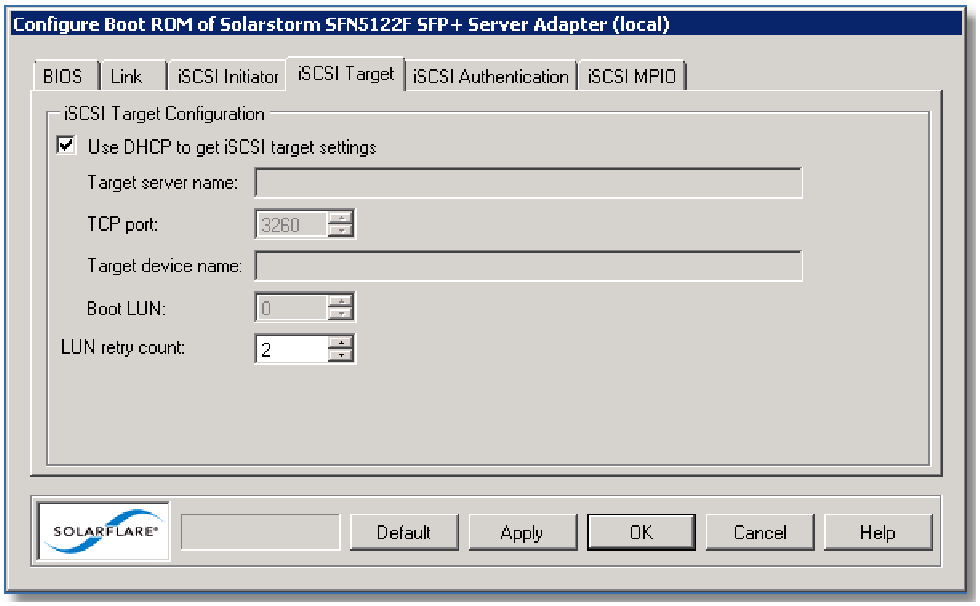


Figure 31: iSCSI Target tab

10 If using DHCP to discover the iSCSI target details, ensure **Use DHCP to get iSCSI target settings** is selected. Otherwise, clear the option and enter details for the iSCSI target, as described in Table 39.

Table 39: iSCSI Target Options

Option	Description
Target server name	Target server network address in the form of a dotted quad (i.e. 10.1.2.3) IPv4 address or fully qualified domain name (FQDN), such as mytarget.myorg.mycompany.com
TCP port	ISCSI port number that has been configured on the target. Default is 3260.
Target device name	The iSCSI Qualified Name (IQN) of the target server, which will look something like: **iqn:2009-01.com.solarflare**.
Boot LUN	Logical unit number which has been set up on the server. The system will attempt to attach to this LUN on boot up and attempt to load the target operating system from it.
LUN retry count	Specifies the number of times the boot device will attempt to connect to the target LUN (logical unit number) before failing. The default setting is 2 retries, but can be set from 0–255. This setting is enabled, even if using DHCP is being used.

11 Click the **iSCSI Authentication** tab.

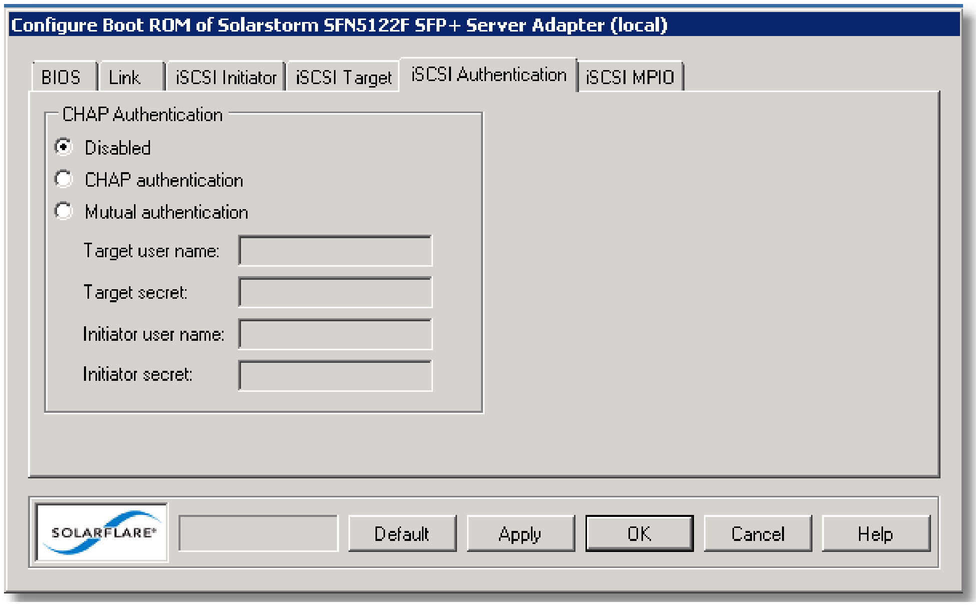


Figure 32: iSCSI Authentication tab

12 By default Challenge Handshake Application Protocol (CHAP) authentication is disabled. You have the following options:

- CHAP authentication - this is target initiated or **one way** authentication
- Mutual authentication - both the target and the initiator will authenticate the connection.

If CHAP authentication is configured on the iSCSI target, enter the correct settings to allow access to the target.

Table 40: CHAP Options

Option	Description
Target user name	Name of the target server, as set on the iSCSI target CHAP settings.
Target secret	Target password.
Initiator user name	Name of this initiator (as set on the target). A minimum of 9 characters. Used for Mutual authentication only
Initiator secret	Password of this initiator (as set on the target). A minimum of 12 characters. Used for Mutual authentication only.

13 Select the **iSCSI MPIO** tab

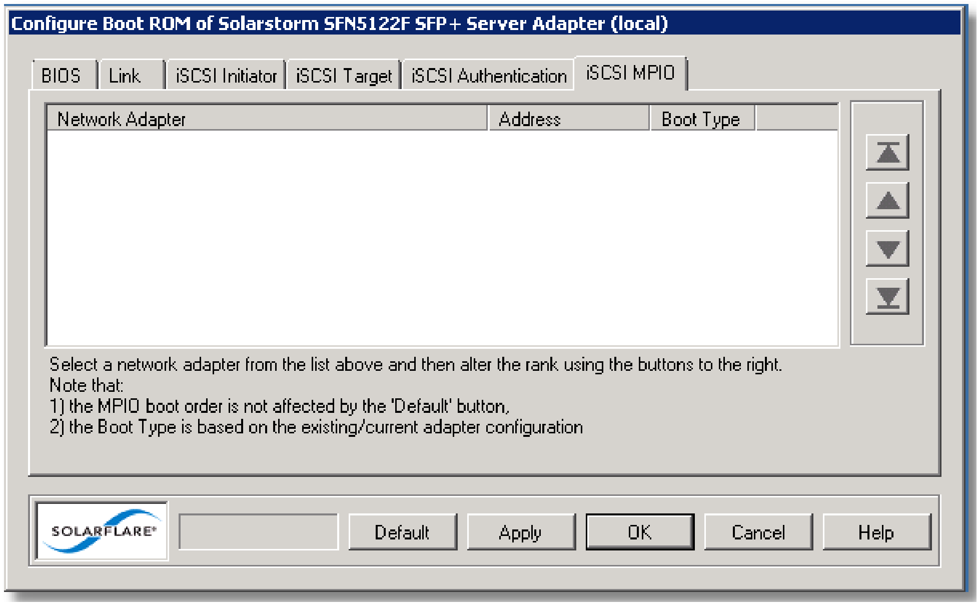


Figure 33: iSCSI MPIO tab

For iSCSI booting in multi-adapter environments, you can set the priority of each adapter. By default, all iSCSI enabled adapters are given an equal priority. The setting is used to determine how traffic is re-routed in case of one adapter entering a failed state.

14 When you have finished configuring the iSCSI settings, click **OK** or **Apply** to save your settings to the Boot ROM.

Disabling Adapter Booting

You can stop the adapter from attempting to initiate either a PXE or iSCSI boot after a restart.

1 Start SAM and select the Solarflare adapter from the Network Adapter list.

2 From the Action menu, click the **Configure Boot ROM** option. The Configure Boot ROM dialog box displays with the **BIOS** tab selected.

3 From the **Boot Type** panel, select **Disabled**.

4 Click **OK** or **Apply** to save your settings to the Boot ROM.

4.18 Managing Firmware with SAM

SAM allows you to monitor the firmware (PHY, Boot ROM and Adapter) for your Solarflare adapters. Either select **Manage firmware** from the **Actions** pane, or from the **Action** menu. The firmware update window is displayed:

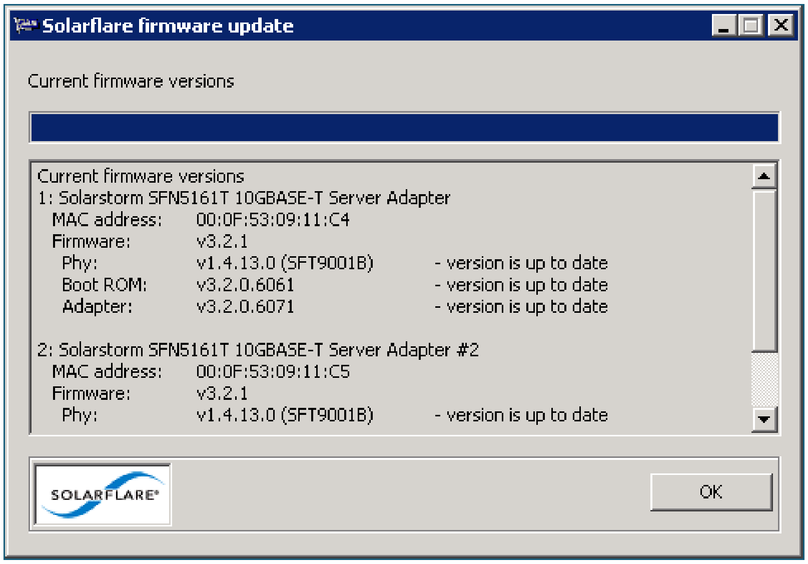


Figure 34: Solarflare firmware update window

If the firmware is up to date, the window will contain the **OK** button. If the firmware is out of date, the OK button is replaced with an **Update** and **Cancel** button. To update the firmware, click **Update**.

You can also use the sfupdate command line tool to manage the firmware on your Solarflare adapters. See Sfupdate: Firmware Update Tool on page 202 for more details.

4.19 Configuring Network Adapter Properties in Windows

Network adapter properties for the Solarflare adapter are available through the Windows Device Manager entry for the relevant network adapter. You can also access the adapter properties using SAM.

> **NOTE:** If SAM is open, any changes made in the adapter properties will not be reflected in SAM until you close the Advanced Properties page.

To configure network adapter properties:

1 From the **Control Panel**, select **System**.

2 In Windows Server 2003, Windows XP, select **System Properties > Hardware tab > Device Manager button**. I

3 In Windows Server 2008, 2008 R2, Windows 7 and Windows Server 2012, select **Device Manager** from the left hand menu.

4 Expand the Network adapters.

5 Right-click the on the Solarflare adapter, and then click **Properties** to display the properties dialog box.

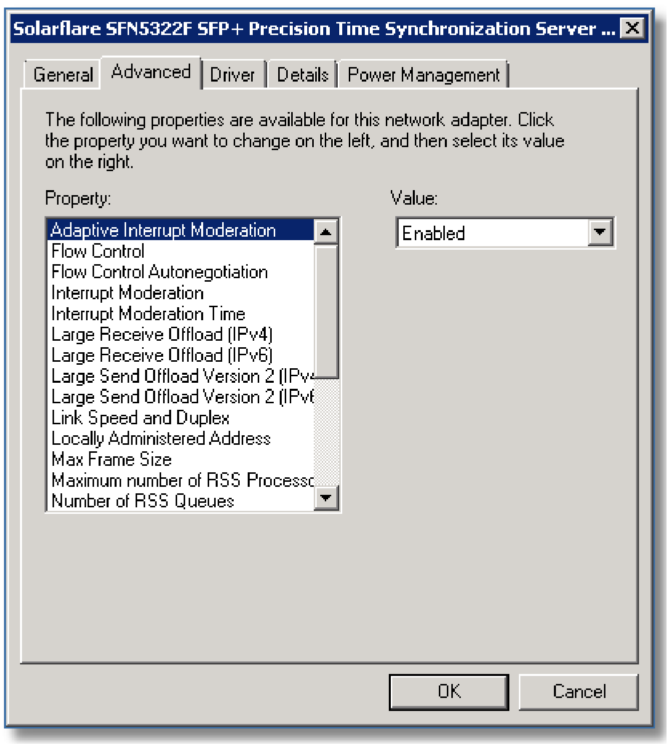


Figure 35: Adapter Properties Dialog

6 Click the **Advanced** tab to view and edit the NDIS properties. See Table 41 for a list of the available properties.

> **NOTE:** Changing these properties may impact the performance of your Solarflare adapter. You are strongly advised to leave them at their default values.

> **NOTE:** Before making any changes to your Solarflare adapter features, read the Performance Tuning on Windows section on 236 first.

Table 41: Solarflare Network Adapter Properties

Property Name	Values	Description
Adaptive Interrupt Moderation	Enabled Disabled	This setting is dependent on the **Interrupt Moderation** setting. If **Interrupt Moderation** is enabled, **Adaptive Interrupt Moderation** allows the adapter to vary it's interrupt moderation automatically, according to network traffic demands. If **Adaptive Interrupt Moderation** is disabled, interrupt moderation interval is fixed at the setting specified in Interrupt Moderation Time. Default setting: **Enabled**
Flow Control	Generate Generate and Respond Respond Off	Ethernet flow control (802.3x) is a way for a network device to signal to a sending device that it is overloaded, such as when a device is receiving data faster than it can process it. The adapter does this by generating a 'pause frame' to request the sending device to temporarily stop transmitting data. Conversely, the adapter can respond to pause frames by suspending data transmission, allowing time for the receiving device to process its data. Default setting: **Generate and Respond**
Flow Control Autonegotiation	Enabled Disabled	Flow control settings are auto-negotiated with the link partner if possible. Default setting: **Enabled**

Table 41: Solarflare Network Adapter Properties

Property Name	Values	Description
Interrupt Moderation	Enabled Disabled	Interrupt moderation is a technique used to reduce the number of interrupts sent to the CPU. With interrupt moderation, the adapter will not generate interrupts closer together than the interrupt moderation time. An initial packet will generate an interrupt immediately, but if subsequent packets arrive before the interrupt moderation time period, interrupts are delayed. Default setting: **Enabled**
Interrupt Moderation Time	1–1000 us	Specifies the interrupt moderation period when **Interrupt Moderation** is enabled. The default setting (60µs) has been arrived at by lengthy and detailed system analysis, balancing the needs of the operating system against the performance of the network adapter. Default setting: **60µs**
Large Receive Offload (IPv4 and IPv6)	Enabled Disabled	Large Receive Offload (LRO) is an offload technology for reducing the load on a CPU by processing TCP segmentation for received packets in the adapter. Default setting: **Disabled**
Large Send Offload Version 2 (IPv4 and IPv6)	Enabled Disabled	Large Send Offload (LSO) is an offload technology for reducing the load on a CPU by processing TCP segmentation for transmitted packets in the adapter. **Caution**: Disabling LSO may reduce the performance of the Solarflare adapter. Default setting: **Enabled**

Table 41: Solarflare Network Adapter Properties

Property Name	Values	Description
Link Speed	100 Mbps Full duplex 1000 Mbps Full Duplex 10000 Mbps Full Duplex Auto Detect	Specifies the network link speed of the adapter - the default is auto. On the 10GBASE-T adapters "auto" instructs the adapter to negotiate the highest speed supported in common with the link partner. On SFP+ adapters "auto" instructs the adapter to use the highest link speed supported by the inserted SFP+ module. On 10GBASE-T and SFP+ adapters, any other value specified will fix the link at that speed, regardless of the capabilities of the link partner, which may result in an inability to establish the link. Default setting: **Auto Detect**
Locally Administered Address	Value: (MAC address) Not Present	Assigns the specified MAC address to the adapter, overriding the permanent MAC address assigned by the adapter's manufacturer. Addresses are entered as a block of six groups of two hexadecimal digits separated by hyphens (-), for example: **12-34-56-78-9A-BC** **Note**: To be a valid address, the second most significant digit must be a 2, 6, A or E, as in the above example. Check the System Event Log for any configuration issues after setting this value. Default setting: **Not Present**.
Max Frame Size	1514–9216	Specifies the maximum Ethernet frame size supported by the adapter. **Note**: Devices will drop frames if they are unable to support the specified frame size, so ensure the value you set here is supported by other devices on the network. Default settings: Solarflare adapter: **1514** bytes Teamed adapter: **1518** bytes **Note**: The setting must be a multiple of 2.

Table 41: Solarflare Network Adapter Properties

Property Name	Values	Description
Offload IPv4 Checksum	Disabled Enabled (Receive Only) Enabled (Transmit and Receive) Enabled (Transmit Only)	IP checksum offload is a hardware offload technology for reducing the load on a CPU by processing IP checksums in the adapter hardware. Offload IP Checksum is enabled by default for transmitted and received data. Default setting: **Enabled (Transmit and Receive)**
Offload TCP Checksum (IPv4 and IPv6)	Disabled Enabled (Receive Only) Enabled (Transmit and Receive) Enabled (Transmit Only)	TCP checksum offload is a hardware offload technology for reducing the load on a CPU by processing TCP checksums in the adapter hardware. Default setting: **Enabled (Transmit and Receive)**
Offload UDP Checksum (IPv4 and IPv6)	Disabled Enabled (Receive Only) Enabled (Transmit and Receive) Enabled (Transmit Only)	UDP checksum offload is a hardware offload technology for reducing the load on a CPU by processing UDP checksums in the adapter hardware. Default setting: **Enabled (Transmit and Receive)**
Number of RSS Queues	Balanced	Specify the number of RSS receive queues are created by the adapter driver. Range is 1-64 - default is Balanced - equal number created for each CPU core.
Receive Side Scaling (RSS)	Enabled Disabled	Receive Side Scaling (RSS) is a technology that enables packet receive processing to scale with the number of available processors (CPUs), distributing the processing workload across the available resources. Default setting: **Enabled**

Table 41: Solarflare Network Adapter Properties

Property Name	Values	Description
RSS Algorithm	Microsoft Optimized	Specifies how the interrupts are spread over the available CPU cores. The **Microsoft** setting uses the algorithm supported by the Windows version. **Optimized** uses an algorithm found to improve performance and reduce CPU utilization over a range of traffic patterns. Default setting: **Optimized**
RSS NUMA Node id	All 1 to 9	The adapter attempts to use only the CPUs from the specified NUMA node for RSS. If this is set to **All** or is greater than or equal to the number of NUMA nodes in the system all NUMA nodes are used. Default setting: **All**
Virtual Machine Queues (VMQ)	Enabled Disabled	VMQ is a Windows Server 2008 R2 and Windows Server 2012 specific feature. This offloads classification and delivery of network traffic destined for Hyper-V virtual machines to the network adapter, reducing CPU utilization on Hyper-V hosts. Default setting: **Enabled.**
VMQ Lookahead Split	Enabled Disabled	Allows the adapter to split network packets into header and payload portions in hardware. They payload is delivered directly into the address space of the destination Hyper-V virtual machine by the adapter hardware. Performance can be affected when this option is disabled as the payload is delivered to the virtual machine address space by software. Default setting: **Enabled.** Not available on Windows Server 2012.
VMQ VLAN Filtering	Enabled Disabled	VLAN filtering allows the adapter to use the VLAN identifier for filtering traffic intended for Hyper-V virtual machines. When disabled only the destination MAC address is used for filtering. Default setting: **Enabled.**

4.20 Windows Command Line Tools

The command line tools (see Table 42) provide an alternative method of managing Solarflare network adapters to SAM. They are especially useful on a Windows Server Core installation, where SAM cannot be run locally. As with SAM, you can run the command line tools remotely. The tools can also be scripted.

The command line tools are installed as part of the drivers installation on Windows. See Installing the Solarflare Driver Package on Windows on page 110.

Table 42: List Available Command Line Utilities

Utility	Description
`sfboot.exe`	A tool for configuring adapter Boot ROM options for PXE and iSCSI booting. See Sfboot: Boot ROM Configuration Tool on page 188.
`sfupdate.exe`	A tool for updating adapter Boot ROM and PHY firmware. See Sfupdate: Firmware Update Tool on page 202.
`sfteam.exe`	A tool for managing fault-tolerant adapter teams and VLANs. See Sfteam: Adapter Teaming and VLAN Tool on page 206.
`sfcable.exe`	A tool for that runs cable diagnostics for Solarflare 10GBASE-T server adapters. See Sfcable: Cable Diagnostics Tool on page 213.
`sfnet.exe`	Allows you to display and/or set the offload, Ethernet, RSS, interrupt moderation and VMQ features of any one adapter, VLAN or Team. See Sfnet on page 216.

To start a command line tool, open a Command Line Interface windows and enter the command tool.exe:

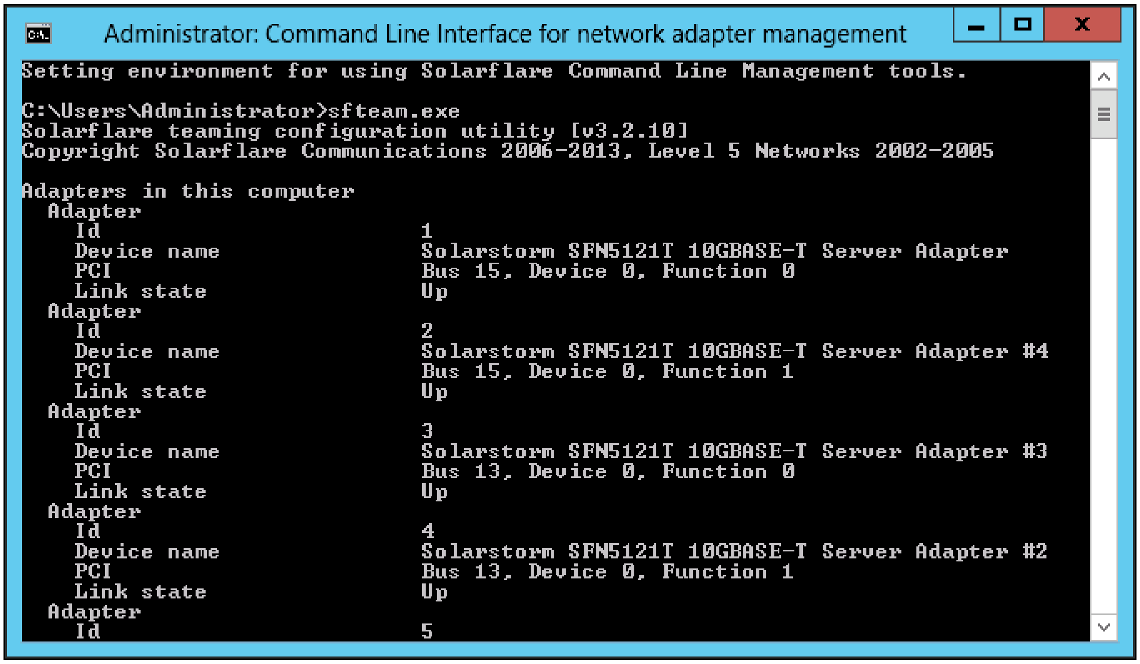


Figure 36: Windows console to run Solarflare command line tools.

NOTE: For all the utilities, the options are documented with the forward slash (/) prefix. You can also use a single dash (- -) or a double dash (--) as a prefix.

NOTE: In Windows Server 2003 onwards, you must run the utilities as an administrator to make any changes. If you try to run the tools as a non administrator, an error message will be displayed.

4.21 Sfboot: Boot ROM Configuration Tool

Sfboot is a Windows command line utility for configuring the Solarflare adapter Boot ROM for PXE and iSCSI booting. Using sfboot is an alternative to using **Ctrl+B** to access the Boot Rom agent during server startup.

See Configuring the Solarflare Boot ROM Agent on page 360 for more information on the Boot Rom agent.

Sfboot: Command Usage

1. Login with an administrator account.
2. Click **Start > All Programs > Solarflare Network Adapters > Command Line Interface for Network Adapters**.
3. From the Command Prompt, enter the command using the following syntax:

```
sfboot [/Adapter <Identifier>] [options] [parameters]
```

where:

`Identifier` is the name or ID of the adapter that you want to manage. Specifying the adapter is optional - if it is not included the command is applied to all Solarflare adapters in the machine.

`option` is the option you want to apply. See Sfboot: Command Line Options for a list of available options.

If using sfboot in a configuration script, you can include the environment variable %SFTOOLS% to set the path to the Solarflare tools. For example:

```
SET PATH=%PATH%;%SFTOOLS%
```


Sfboot: Command Line Options

Table 43 lists the options for `sfboot.exe` and Table 44 lists the available parameters. Note that command line options are case insensitive and may be abbreviated.

NOTE: Abbreviations in scripts should be avoided, since future updates to the application may render abbreviated scripts invalid.

Table 43: Sfboot Options

Option	Description
`/Help`	Displays command line syntax and provides a description of each sfboot option.
`/Version`	Shows detailed version information and exits.
`/Nologo`	Hide the version and copyright message at startup.
`/Verbose`	Shows extended output information for the command entered.
`/Quiet` `Aliases: /Silent`	Suppresses all output, including warnings and errors; no user interaction. You should query the completion code to determine the outcome of commands when operating silently.
`/Log <Filename>`	Logs output to the specified file in the current folder or an existing folder. Specify `/Silent` to suppress simultaneous output to screen, if required.
`/Computer <ComputerName>`	Performs the operation on a specified remote computer. Administrator rights on the remote computer is required.
`/List`	Lists all available Solarflare adapters. This option shows the adapter's ID number, ifname and MAC address. Note: this option may not be used in conjunction with the any other option. If this option is used with configuration parameters, those parameters will be silently ignored.
`/Adapter =<Identifier>`	Performs the action on the identified Solarflare network adapter. The adapter identifier can be the adapter ID number, ifname or MAC address, as output by the `/List` option. If `/Adapter` is not included, the action will apply to all installed Solarflare adapters.

Table 43: Sfboot Options

Option	Description
`/Clear`	Resets all adapter options except `boot-image` to their default values. Note that `/Clear` can also be used with parameters, allowing you to reset to default values, and then apply the parameters specified.
`/DbgFill`	Fill the config with PAD before validation (debug-only).
`/DbgTrash`	Trash the checksum just before writing to the flash (debug-only).
`/DbgTerminator`	Replace the DHCP_END with DHCP_PAD and fixup the checksum (done before DbgTrash - debug-only).
`/DbgReportOnly`	Only run debug tasks before sfgpxe_report() (debug-only).

The following parameters in Table 44 are used to control the options for the Boot ROM driver when running prior to the operating system booting.

Table 44: Sfboot Parameters

Parameter	Description
`boot-image=<all|optionrom|uefi|disabled>`	Specifies which boot firmware images are served-up to the BIOS during start-up. This parameter can not be used if the `/Adapter` option has been specified. This option is not reset if `/Clear` is used.
`link-speed=<auto|10g|1g|100m>`	Specifies the network link speed of the adapter used by the Boot ROM the default is `auto.` On the 10GBASE-T adapters “auto” instructs the adapter to negotiate the highest speed supported in common with it’s link partner . On SFP+ adapters, “auto” instructs the adapter to use the highest link speed supported by the inserted SFP+ module. On 10GBASE-T and SFP+ adapters, any other value specified will fix the link at that speed, regardless of the capabilities of the link partner, which may result in an inability to establish the link `auto` Auto-negotiate link speed (default) `10G` 10G bit/sec `1G` 1G bit/sec `100M` 100M bit/sec

Table 44: Sfboot Parameters

Parameter	Description
`linkup-delay=<seconds>`	Specifies the delay (in seconds) the adapter defers its first connection attempt after booting, allowing time for the network to come up following a power failure or other restart. This can be used to wait for spanning tree protocol on a connected switch to unblock the switch port after the physical network link is established. The default is 5 seconds.
`banner-delay=<seconds>`	Specifies the wait period for **Ctrl+B** to be pressed to enter adapter configuration tool. `seconds` = 0-256
`bootskip-delay=<seconds>`	Specifies the time allowed for **Esc** to be pressed to skip adapter booting. `seconds` = 0-256
`boot-type=<pxe|iscsi|disabled>`	Sets the adapter boot type. `pxe` – PXE (Preboot eXecution Environment) booting `iscsi` – iSCSI (Internet Small Computer System Interface) booting `disabled` – Disable adapter booting

`initiator-dhcp=<enabled|disabled>`	Enables or disables DHCP address discovery for the adapter by the Boot ROM except for the Initiator IQN (see `initiator-iqn-dhcp`). This option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).
	If initiator-DHCP is set to disabled, the following options will need to be specified:
	`initiator-ip=<ip_address>`
	`netmask=<subnet>`
	The following options may also be needed:
	`gateway=<ip_address>`
	`primary-dns=<ip_address>`

Table 44: Sfboot Parameters

Parameter	Description
`initiator-ip=<ipv4 address>`	Specifies the IPv4 address (in standard "." notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled initiator-ip=<192.168.1.3>`
`netmask=<ipv4 subnet>`	Specifies the IPv4 subnet mask (in standard "." notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled netmask=255.255.255.0`
`gateway=<ipv4 address>`	Specifies the IPv4 subnet mask (in standard "." notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled gateway=192.168.0.10`
`primary-dns=<ipv4 address>`	Specifies the IPv4 address (in standard "." notation form) of the Primary DNS to be used by the adapter when `initiator-dhcp` is disabled. This option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled primary-dns=192.168.0.3`
`initiator-iqn-dhcp=<enabled|disabled>`	Enables or disables use of DHCP for the initiator IQN only.

Table 44: Sfboot Parameters

Parameter	Description
`initiator-iqn=<IQN>`	Specifies the IQN (iSCSI Qualified Name) to be used by the adapter when `initiator-iqn-dhcp` is disabled. The IQN is a symbolic name in the "." notation form; for example: iqn.2009.01.com.solarflare, and is a maximum of 223 characters long. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot initiator-iqn-dhcp=disabled initiator-iqn=iqn.2009.01.com.solarflare adapter=2`
`lun-retry-count=<count>`	Specifies the number of times the adapter attempts to access and login to the Logical Unit Number (LUN) on the iSCSI Target before failing. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot lun-retry-count=3`

`target-dhcp=<enabled|disabled>`	Enables or disables the use of DHCP to discover iSCSI target parameters on the adapter.
	
	If `target-dhcp` is disabled, you must specify the following options:
	
	`target-server=<address>`
	
	`target-iqn=<iqn>`
	
	`target-port=<port>`
	
	`target-lun=<LUN>`
	
	Example - Enable the use of DHCP to configure iSCSI Target settings:
	
	`sfboot boot-type=iscsi target-dhcp=enabled`

Table 44: Sfboot Parameters

Parameter	Description
`target-server=<DNS name or ipv4 address>`	Specifies the iSCSI target's DNS name or IPv4 address to be used by the adapter when `target-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi target-dhcp=disabled target-server=192.168.2.2`
`target-port=<port_number>`	Specifies the Port number to be used by the iSCSI target when `target-dhcp` is disabled. The default Port number is Port 3260. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi target-dhcp=disabled target-port=3262` This option should only be used if your target is using a non-standard TCP Port.
`target-lun=<LUN>`	Specifies the Logical Unit Number (LUN) to be used by the iSCSI target when `target-dhcp` is disabled. The default LUN is 0. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).
`target-iqn=<IQN>`	Specifies the IQN of the iSCSI target when `target-dhcp` is disabled. Maximum of 223 characters. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Note that if there are spaces contained in `<IQN>`, then the IQN must be wrapped in double quotes ("""). Example: `sfboot target-dhcp=disabled target-iqn=iqn.2009.01.com.solarflare adapter=2`
`vendor-id=<dhcp_id>`	Specifies the device vendor ID to be advertised to the DHCP server. This must match the vendor id configured at the DHCP server when using DHCP option 43 to obtain the iSCSI target .

Table 44: Sfboot Parameters

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>chap=<enabled|disabled></td><td>Enables or disables the use of Challenge Handshake Protocol (CHAP) to authenticate the iSCSI connection.

Note that this option is only valid if iSCSI booting is enabled (boot-type=iscsi).

To be valid, this option also requires the following sub-options to be specified:

username=<initiator username>

secret=<initiator password>

Example:

sfboot boot-type=iscsi chap=enabled username=initiatorusername secret=initiatorsecret</td></tr>
<tr><td>username=<username></td><td>Specifies the CHAP initiator username (maximum 64 characters).

Note that this option is required if either CHAP or Mutual CHAP is enabled (chap=enabled, mutual-chap=enabled).

Note that if there are spaces contained in <username>, then it must be wrapped in double quotes (“”).

Example:

sfboot boot-type=iscsi chap=enabled username=username</td></tr>
<tr><td>secret=<secret></td><td>Specifies the CHAP initiator secret (minimum 12 characters, maximum 20 characters).

Note that this option is valid if either CHAP or Mutual CHAP is enabled (chap=enabled, mutual-chap=enabled).

Note that if there are spaces contained in <secret>, then it must be wrapped in double quotes (“”).

Example:

sfboot boot-type=iscsi chap=enabled username=username secret=veryverysecret</td></tr>
</table>

Table 44: Sfboot Parameters

Parameter	Description

`mutual-chap=<enabled|disabled>`	Enables/disables Mutual CHAP authentication when iSCSI booting is enabled.
	This option also requires the following sub-options to be specified:
	`target-username=<username>`
	`target-secret=<password>`
	`username=<username>`
	`secret=<password>`
	Example:
	`sfboot boot-type=iscsi mutual-chap=enabled username=username secret=veryverysecret target-username=targetusername target-secret=anothersecret`

`target-username=<username>`	Specifies the username that has been configured on the iSCSI target (maximum 64 characters). Note that this option is necessary if Mutual CHAP is enabled on the adapter (`mutual-chap=enabled`). Note that if there are spaces contained in `<username>`, then it must be wrapped in double quotes (“”).
`target-secret=<secret>`	Specifies the secret that has been configured on the iSCSi target (minimum 12 characters; maximum 20 characters). Note: This option is necessary if Mutual CHAP is enabled on the adapter (`mutual-chap=enabled`). Note that if there are spaces contained in `<secret>`, then it must be wrapped in double quotes (“”).
`mpio-priority=<MPIO priority>`	Specifies the Multipath I/O (MPIO) priority for the adapter. This option is only valid for iSCSI booting over multi-port adapters, where it can be used to establish adapter port priority. The range is 1- 255, with 1 being the highest priority.
`mpio-attempts=<attempt count>`	Specifies the number of times MPIO will try and use each port in turn to login to the iSCSI target before failing.

Table 44: Sfboot Parameters

Parameter	Description
`msix-limit=<8|16|32|64|128|128|256|512|1024>`	Specifies the maximum number of MSI-X interrupts the specified adapter will use. The default is 32. Note: Using the incorrect setting can impact the performance of the adapter. Contact Solarflare technical support before changing this setting.
`sriov=<enabled|disabled>`	Enable SR-IOV support for the operating systems that support it. SR-IOV is not supported by Solarflare SFN5xxx and SFN6xxx adapters on Windows Hyper-V servers.
`vf-count=<vf count>`	The number of virtual functions advertised to the operating system. The Solarflare SFC9000 series device has a limit of 1024 interrupts. Depending on the value of msix-limit and vf-msix-limit, some of these virtual functions my not be usable.
`vf-msix-limit=<1|2|4|8>`	Maximum number of MSI-X interrupts a virtual function may use.

Sfboot: Examples

- Show the current boot configuration for all adapters:

`sfboot`

```
Solarstorm SFN5122F SFP+ Server Adapter - MAC: 00:0F:53:01:3C:BD
  Boot image                        Option ROM and UEFI
    Link speed                      Negotiated automatically
    Link-up delay time              5 seconds
    Banner delay time               2 seconds
    Boot skip delay time            5 seconds
    Boot type                       PXE
  MSI-X interrupt limit             32
  SR-IOV                            Enabled
    Number of Virtual Functions     8
    VF MSI-X interrupt limit        1

Solarstorm SFN5122F SFP+ Server Adapter #2 - MAC: 00:0F:53:01:3C:BC
  Boot image                        Disabled
  MSI-X interrupt limit             32
  SR-IOV                            Enabled
    Number of Virtual Functions     8
    VF MSI-X interrupt limit        1
```

- List all Solarflare adapters installed on the localhost:

  `sfboot /List`

Sample console output:

```
Solarflare boot ROM configuration utility [v3.2.1]
Copyright Solarflare Communications 2006-2012, Level 5 Networks 2002-2005

Network adapters in this computer:
  1 : Solarstorm SFN5122F SFP+ Server Adapter
      MAC address: 00:0F:53:01:3C:BD
  2 : Solarstorm SFN5122F SFP+ Server Adapter #2
      MAC address: 00:0F:53:01:3C:BC
  3 : Solarflare SFN5322F SFP+ Precision Time Synchronization Server
Adapter #2
      MAC address: 00:0F:53:16:04:78
  4 : Solarflare SFN5322F SFP+ Precision Time Synchronization Server
Adapter
      MAC address: 00:0F:53:16:04:79
```

- List adapters installed on the remote host named “Mercutio”:


```
sfboot /Computer Mercutio /List
```

- Sample console output (remote host has two adapters present):

```
Solarflare boot ROM configuration utility [v3.0.2]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

Network adapters in Mercutio:
  1 : Solarflare SFN4112F SFP+ Server Adapter
      MAC address: 00:0F:53:01:34:0E
  2 : Solarflare SFN4112F SFP+ Server Adapter #2
      MAC address: 00:0F:53:01:34:1E
```

- Enable iSCSI booting on adapter 2. Implement default iSCSI settings:

```
sfboot /Adapter 2 boot-type=iscsi
```

Sample console output:

```
Solarflare boot ROM configuration utility [v3.0.2]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

Solarflare SFN5122F Dual Port SFP+ Server Adapter #2 - MAC: 00:0F:53:01:39:0D
  Boot image                      Option ROM and UEFI
    Link speed                    Negotiated automatically
    Link-up delay time            5 seconds
    Banner delay time             2 seconds
    Boot skip delay time          5 seconds
    Boot type                     iSCSI
      Use DHCP for Initiator      Enabled
      Use DHCP for Initiator IQN  Enabled
      LUN busy retries            2
      Use DHCP for Target         Enabled
      DHCP Vendor Class ID        SFCgPXE
      CHAP authentication         Disabled
      Mutual CHAP authentication  Disabled
      MPIO priority               2
      MPIO boot attempts          3
  MSI-X interrupt limit           32
```

- Enable iSCSI booting on adapter 2 with the following options:
  - Disable DHCP for the Initiator.
  - Specify adapter (iSCSI initiator) IP address 192.168.0.1 and netmask 255.255.255.0.

```
sfboot /Adapter 2 boot-type=iscsi initiator-dhcp=disabled initiator-
ip=192.168.0.1 netmask=255.255.255.0
```

Sample console output:

```
Solarflare boot ROM configuration utility [v3.0.2]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

Solarflare SFN5122F Dual Port SFP+ Server Adapter #2 - MAC: 00:0F:53:01:39:0D
  Boot image                       Option ROM and UEFI
    Link speed                     Negotiated automatically
    Link-up delay time             5 seconds
    Banner delay time              2 seconds
    Boot skip delay time           5 seconds
    Boot type                      iSCSI
      Use DHCP for Initiator       Disabled
        Initiator IP address       192.168.0.1
        Initiator netmask          255.255.255.0
        Initiator default gateway  0.0.0.0
        Initiator primary DNS      0.0.0.0
      Use DHCP for Initiator IQN   Enabled
      LUN busy retries             2
      Use DHCP for Target          Enabled
      DHCP Vendor Class ID         SFCgPXE
      CHAP authentication          Disabled
      Mutual CHAP authentication   Disabled
      MPIO priority                2
      MPIO boot attempts           3
  MSI-X interrupt limit            32
```


- On adapter 2, set the following CHAP options:
  - User name “username1”
  - Secret “password12345”

```
sfboot /Adapter 2 boot-type=iscsi chap=enabled username=username1
secret=password12345
```

Sample output:

```
Solarflare boot ROM configuration utility [v3.0.2]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

Solarflare SFN5122F Dual Port SFP+ Server Adapter #2 - MAC: 00:0F:53:01:39:0D
  Boot image                        Option ROM and UEFI
    Link speed                      Negotiated automatically
    Link-up delay time              5 seconds
    Banner delay time               2 seconds
    Boot skip delay time            5 seconds
    Boot type                       iSCSI
      Use DHCP for Initiator        Enabled
      Use DHCP for Initiator IQN    Enabled
      LUN busy retries              2
      Use DHCP for Target           Enabled
      DHCP Vendor Class ID          SFCgPXE
      CHAP authentication           Enabled
        Target user name            username1
        Target secret               *************
      Mutual CHAP authentication    Disabled
      MPIO priority                 2
      MPIO boot attempts            3
  MSI-X interrupt limit             32
```


4.22 Sfupdate: Firmware Update Tool

Sfupdate is a Windows command line utility used to manage and upgrade the Solarflare adapter Boot ROM, PHY and adapter firmware. Embedded within the sfupdate executable are firmware images for various Solarflare adapters - the exact updates available via sfupdate are therefore depend on your adapter.

Sfupdate: Command Usage

1. Login with an administrator account.
2. Click **Start > All Programs > Solarflare Network Adapters > Command Line Interface for network adapters**. If you installed the Solarflare system tray icon, you can right-click the icon and choose **Command-line tools** instead.
3. In the Command Prompt window, enter your command using the following syntax:

   `sfupdate [/Adapter <Identifier>] [options]`

   where:

   `Identifier` is the name or ID of the adapter that you want to manage. Specifying the adapter is optional - if it is not included the command is applied to all Solarflare adapters in the machine.

   `options` is the option to apply. See Sfupdate: Command Line Options for a list of available options.

Running the command `sfupdate` with no additional parameters will show the current firmware version for all Solarflare adapters and whether the firmware within sfupdate is more up to date. To update the firmware for all Solarflare adapters run the command `sfupdate /Write`

Solarflare recommend that you use sfupdate in the following way:

1. Run `sfupdate` to check that the firmware on all your adapters are up to date.
2. Run `sfupdate /write` to update the firmware on all adapters.

Sfupdate: Command Line Options

Table 45 lists the command options for sfupdate. Note that command line options are case insensitive and may be abbreviated.

NOTE: Abbreviations in scripts should be avoided, since future updates to the application may render your abbreviated scripts invalid.

See Sfupdate: Examples on page 204 for example output.

Table 45: Sfupdate Options

Option	Description
`/Help or /H or /?`	Displays command line syntax and provides a description of each sfboot option.
`/Version`	Shows detailed version information and exits.
`/Nologo`	Hides the version and copyright message at startup.
`/Verbose`	Shows extended output information for the command entered.
`/Quiet` `Aliases: /Silent`	Suppresses all output, including warnings and errors; no user interaction. You should query the completion code to determine the outcome of commands when operating silently.
`/Log <Filename>`	Logs output to the specified file in the current folder or an existing folder. Specify `/Silent` to suppress simultaneous output to screen, if required.
`/Computer <ComputerName>`	Performs the operation on the identified remote computer. Administrator rights on the remote host computer is required.
`/Adapter <Identifier>`	Performs the action on the identified Solarflare network adapter. The identifier can be the adapter ID number, name or MAC address.
`/Force`	Forces a firmware update. Can be used to force an update to an older revision of firmware when used with `/Write`.

Table 45: Sfupdate Options

Option	Description
`/Write`	Writes the updated firmware to the adapter. If the `/Image` option is not specified, `/Write` will write the embedded image from sfupdate to the hardware. The update will fail if the image on the adapter is current or newer; to force an update, specify `/Force` in the command line.
`/Yes`	Update without prompting for a final confirmation. This option may be used with the `/Write` and `/Force` options, but is not required with the `/Quiet` option.
`/Image <ImageFileName>`	Sources firmware image from an external file.
`/Spin`	Spin for the debugger (debug-only).
`/NoWarning`	Suppress update warnings.

Sfupdate: Examples

- Display firmware versions for all adapters:

  ```
  sfupdate
  ```

Sample output from a host with a single SFN5122F adapter installed:

```
Solarflare firmware update utility [v3.2.1]
Copyright Solarflare Communications 2006-2012, Level 5 Networks 2002-2005

1: Solarstorm SFN5122F SFP+ Server Adapter
   MAC address: 00:0F:53:01:3C:BD
   Firmware:    v3.2.1
     Boot ROM:  v3.2.0.6061             - version is up to date
     Adapter:   v3.2.0.6071             - version is up to date

2: Solarstorm SFN5122F SFP+ Server Adapter #2
   MAC address: 00:0F:53:01:3C:BC
   Firmware:    v3.2.1
     Boot ROM:  v3.2.0.6061             - version is up to date
     Adapter:   v3.2.0.6071             - version is up to date
```


- Update all adapters to latest version of PHY and Boot ROM firmware:

  `sfupdate /Write`

Sample output:

```
Solarflare firmware update utility [v3.0.2]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

1: Solarflare SFN5122F Dual Port SFP+ Server Adapter
   MAC address: 00:0F:53:01:39:70
   Firmware:    v3.0.2
     PHY:       v2.0.1.0                - version is up to date
     Boot ROM:  v3.0.2.2057             - version is up to date
     Adapter:   v3.0.2.2057             - version is up to date
```

4.23 Sfteam: Adapter Teaming and VLAN Tool

Sfteam is a Windows command line utility used to configure and manage the teaming and VLAN features of the Solarflare adapters. You may find it easier to create and manage teams and VLANs with SAM, Solarflare's graphical adapter manager. As an alternative, or where SAM is not available, sfteam provides a method of creating teams and VLANs from the command line or configuration script.

For general information on teaming and VLANs, see Teaming and VLANs on page 223.

Sfteam: Command Usage

1 Login with an administrator account.

2 Click **Start > All Programs > Solarflare Network Adapters > Command Line Interface for network adapters**. If you installed the Solarflare system tray icon, you can right-click the icon and choose **Command-line tools** instead.

3 In the Command Prompt window, enter your command using the following syntax:

```
sfteam [option]
```

where:

`option` is the command to apply. See Table 46 for a list of available options.

If using sfteam in a configuration script, you can include the environment variable %SFTOOLS% to set the path to the Solarflare tools. For example:

```
SET PATH=%PATH%;%SFTOOLS%
```

or refer to sfteam as:

```
%SFTOOLS%\sfteam
```

Sfteam: Command Line Options

Table 46 lists the command line options sfteam. Note that command line options are case insensitive and may be abbreviated.

> **NOTE:** Abbreviations in scripts should be avoided, since future updates to the application may render your abbreviated scripts invalid.

Table 46: Sfteam Options

Option	Description
`/Help or /? or /H`	Displays command line syntax and provides a description of each sfteam option.
`/Version`	Shows detailed version information and exits.
`/Nologo`	Hides the version and copyright message at startup.
`/Verbose`	Shows extended output information for the command entered.
`/Quiet` `Aliases: /Silent`	Suppresses all output, including warnings and errors; no user interaction. You should query the completion code to determine the outcome of commands when operating silently.
`/Log <Filename>`	Logs output to the specified file in the current folder or an existing folder. Specify `/Silent` to suppress simultaneous output to screen, if required.
`/Computer <ComputerName>`	Performs the operation on the identified remote computer. Administrator rights on the remote host computer is required.
`/List`	Lists all available Solarflare adapters and any teams and VLANs. This options shows the adapter’s ID number, name and MAC address.
`/Create`	Creates a team or VLAN. To be valid, this option must be used with the `/Adapter` option for each adapter that you want to add to the team. To specify a name for the team, include the `/Name` option. To add VLANs to a team, include the `/Vlan` option. Note that once a team has been created, sfteam does not allow you to change its adapters, VLANs or team name. Either delete the team and set it up again, or use SAM instead to configure the team.
`/Delete <team name or vlan group>`	Deletes the identified team or group. The team identity can be specified as the team name or group ID. This option cannot be used to delete VLANs.
`/Clear`	Deletes all teams and VLANS.

Table 46: Sfteam Options

Option	Description
`/Adapter <Adapter_id>`	Specifies the adapter to add to the team. Repeat this option for each adapter that you want to include in the team. This option must be used when a team is first created. It cannot be applied to a team once it has been setup.

Table 46: Sfteam Options

Option	Description
`/Vlan <VLAN tag[,priority[,name[,DHCP|addr,mask[,gateway]]]>`	Creates a VLAN with the specified ID and sets priority traffic handling option. P – Handles priority traffic N - Does not handle priority traffic This option must be used when a team is first created. It cannot be applied to a team once it has been setup. If you specify an IP address, you must specify a netmask as well. If the IP address is specified, then DHCP is assured. You can also use `tag, priority,name,`DHCP to be explicit. Formats: <tag> e.g. 2 (assumes no priority) "<tag>,<priority>" e.g. "2,p" "<tag>,<priority>,<name>" e.g. "2,p,my name" "<tag>,<priority>,DHCP" e.g. "2,p,my name,DHCP" "<tag>,<priority>,<name>,<addr>,<mask>" e.g. "2,p,my name,10.1.2.3,255.255.255.0" "<tag>,<priority>,<name>,<addr>,<mask>,<gateway>" e.g. "2,p,my name,10.1.2.3,255.255.255.0,10.1.2.1" Tag: 0 to 4094 Priority: either P (priority supported) or N (no priority) DHCP: may be omitted, and will be assumed, if it's the last field IP Addresses: IPv4, dotted-quad format note that <mask> must be present if <addr> is present

Table 46: Sfteam Options

Option	Description
`/Name <Team_name>`	Specifies a name for the adapter team. This option must be used when a team is first created. It cannot be applied to a team once it has been setup.
`/DebugId <adapter_id>`	Debug-only. Identify an adapter id to treat as being as iSCSI boot device.
`/DebugIscsi`	Debug-only. Pretend the adapter is configured for iSCSI booting.
`/Type <team_type>`	Defines what kind of team is being created. The options are: • tolerant (default) • dynamic • static See Teaming and VLANs on page 223 for an explanation on the different teaming types.
`/Mode <mode>`	Specifies how the driver will select adapters to be part of the link aggregation. The option is only relevant when the /Type option is either dynamic or static. The options are: • auto (default) • faulttolerant • bandwidth • key adapter See Teaming and VLANs on page 223 for an explanation of the different teaming modes.
`/Distribution <type>`	Specify how the driver distributes conversations across dynamic or static link aggregation team members. The available types are: • auto (default) • activeadapter • layer2hash • layer3hash • layer4hash

Table 46: Sfteam Options

Option	Description
`/Statistics`	Display adapter and link-aggregation statistics
`/Detailed`	Display detailed configuration statistics

Sfteam: Examples

- Create **TeamA** with adapter ID 1 and adapter ID 2:

```
sfteam /Create /Adapter 1 /Adapter 2 /Name Team_A
```

Sample output:

```
Solarflare teaming configuration utility [v3.0.3]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

Creating team done (new id=2F)
Setting team name "Team_A" ...  done
Adding adapter 1 ...  done
Adding adapter 2 ...  done
Creating network interface
 - Using DHCP
 - Waiting for the new VLAN device ..
 - Waiting for the new LAN interface
 - Waiting for access to the IP stack
 - Using DHCP  done
```

- Create a VLAN to adapter #2 with VLAN tag 4 and priority traffic handling enabled:

```
sfteam /Create /Adapter 2 /Vlan 4,P
```

Sample output:

```
Solarflare teaming configuration utility [v3.0.3]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

Creating VLAN group done (new id=4V)
Setting VLAN group name (using default name "Group 4V") ...  done
Adding adapter 2 ...  done
Creating VLAN
 - id=4, priority, unnamed
 - Using DHCP
 - Waiting for the new VLAN device ..
 - Waiting for the new LAN interface
 - Waiting for access to the IP stack
 - Using DHCP  done
```


4.24 Sfcable: Cable Diagnostics Tool

Sfcable is a Windows command line utility to run cable diagnostics on the Solarflare 10GBASE-T server adapters. A warning will be given if the adapter is not a 10GBASE-T adapter.

Sfcable: Command Usage

1 Login with an administrator account.

2 Click **Start > All Programs > Solarflare Drivers > Command Line Tools**. If you installed the Solarflare system tray icon, you can right-click the icon and choose **Command-line tools** instead.

3 In the Command Prompt window, enter the following command:

```
sfcable [/Adapter <Identifier>] [options]
```

where:

`Identifier` is the name or ID of the adapter that you want to manage. Specifying the adapter is optional - if it is not included the command is applied to all Solarflare adapters in the machine.

`option` is the option you to apply. See Table 47 for a list of available options.

Sfcable: Command Line Options

Table 47 lists the command options for sfcable. Note that command line options are case insensitive and may be abbreviated.

NOTE: Abbreviations in scripts should be avoided, since future updates to the application may render your abbreviated scripts invalid.

Table 47: Sfcable Options

Options	Description
`/Help or /? or /H`	Displays command line syntax and provides a description of each sfcable option.
`/Version`	Shows detailed version information and exits.
`/Nologo`	Hides the version and copyright message at startup.

Table 47: Sfcable Options

Options	Description
`/Verbose`	Shows extended output information for the command entered.
`/Quiet` `Aliases: /Silent`	Suppresses all output, including warnings and errors. User should query the completion code to determine the outcome of commands when operating silently (see, Performance Tuning on Windows on page 236).
`/Log <Filename>`	Logs output to the specified file in the current folder or an existing folder. Specify `/Silent` to suppress simultaneous output to screen, if required.
`/Computer <ComputerName>`	Performs the operation on the identified remote computer. Administrator rights on the remote host computer is required.
`/Adapter <Identifier>`	Performs the action on the identified Solarflare network adapter. The identifier can be the adapter ID number, name or MAC address, as given by the `/List` option.
`/List`	Lists all available Solarflare adapters. This options shows the adapter's ID number, name and MAC address.
`/Offline`	Stops network traffic while the diagnostic tests are running. Running tests offline will produce more detailed results. **Caution**: The offline tests will disrupt data flow. It is not recommended that the tests are run on a live system.
`/DebugId (adapter_id>`	Debug-only. Identify an adapter to treat as being an iSCSI boot device.

Sfcable: Sample Commands

- Run tests offline

```
sfcable /Offline
```

Sample output from a computer with two Solarflare adapters installed:

```
C:\Users\mas-admin>sfcable /Offline
Solarflare cable diagnostics utility [v3.0.3]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

1 : Solarflare SFN5121T 10GBASE-T Server Adapter
    MAC address:          00:0F:53:01:40:8C
    Link state:           Up
    Link speed:           10 Gbps
      Pair 1:             OK, length=9m
      Pair 2:             OK, length=9m
      Pair 3:             OK, length=9m
      Pair 4:             OK, length=9m

2 : Solarflare SFN5121T 10GBASE-T Server Adapter #2
    MAC address:          00:0F:53:01:40:8D
    Link state:           Up
    Link speed:           10 Gbps
      Pair 1:             OK, length=9m
      Pair 2:             OK, length=9m
      Pair 3:             OK, length=9m
      Pair 4:             OK, length=9m
```


4.25 Sfnet

Sfnet is a Windows command line utility to configure the physical or virtual adapter settings, such as checksum offloading, RSS, VMQ and Power Management.

NOTE: Changing these settings may significantly alter the performance of the adapter. You should contact Solarflare technical support before changing any of these settings.

Sfnet: Command Usage

1. Login with an administrator account.
2. Click **Start > All Programs > Solarflare Network Adapter > Command Line Interface for network adapters**. If you installed the Solarflare system tray icon, you can right-click the icon and choose **Command-line tools** instead.
3. In the Command Prompt window, enter your command using the following syntax:

```
sfnet [/Adapter Identifier] [options]
```

where:

`Identifier` is the name or ID of the adapter that you want to manage. Specifying the adapter is optional - if it is not included the command is applied to all Solarflare adapters in the machine.

`option` is the option to apply. See Sfnet: Command Line Options for a list of available options.

To see all adapters installed on the computer and their current options and parameter settings use the `sfnet /List` option.

Sfnet: Command Line Options

Table 48 lists the command options for sfnet. Note that command line options are case insensitive and may be abbreviated.

NOTE: Abbreviations in scripts should be avoided, since future updates to the application may render your abbreviated scripts invalid.

Table 48: Sfnet Options

Options	Description
`/Help or /? or /H`	Displays command line syntax and provides a description of each sfnet option.
`/Version`	Shows detailed version information and exits.
`/Nologo`	Hides the version and copyright message at startup.
`/Verbose`	Shows extended output information for the command entered.

`/Quiet`
 	
`Aliases: /Silent`
	Suppresses all output, including warnings and errors; no user interaction. You should query the completion code to determine the outcome of commands when operating silently.

`/Log <Filename>`	Logs output to the specified file in the current folder or an existing folder. Specify silent to suppress simultaneous output to screen, if required.
`/Computer <ComputerName>`	Performs the operation on the identified remote host. Administrator rights on the remote host computer is required.
`/Adapter <Identifier>`	Perform the action on the identified Solarflare physical or virtual network adapter.
`/List`	Lists all available Solarflare adapters, options and current parameter settings.
`/Id`	List output is limited to one line, containing the Id and name, per adapter.
`/StopOnWarning`	Exit the utility if a warning is output.
`/Statistics`	Display adapter statistics and configuration settings for Solarflare interfaces.

Table 49: Supported Key Value Parameter

Parameter	Description
`ipoffload=<enabled|disabled>`	Specify whether IPv4 checksum offload is enabled.
`tcpoffload=<enabled|disabled>`	Specify whether TCP checksum offload is enabled. Configures TCPv4 and TCPv6 where applicable.
`udpoffload=<enabled|disabled>`	Specify whether UDP checksum offload is enabled. Configures UDPv4 and UDPv6 where applicable.
`lso=<enabled|disabled>`	Specify whether large send offload (LSO) is enabled. Configures LSOv4 and LSOv6 where applicable.
`lro=<enabled|disabled>`	Specify whether large receive offload (LRO) is enabled. Configures LROv4 and LROv6 where applicable.
`flowcontrol=<auto|enabled|generate|respond|disabled>`	Specify Ethernet flow control. This option covers the "Flow Control" and "Flow Control Autonegotiation" device driver advanced properties.
`speed=<auto|10g|1g|100m>`	Specify the Ethernet link speed.
`mtu=<MTU length>`	Specify the maximum Ethernet frame length. From 1518 to 9216 bytes (even values only).
`rss=<disabled|optimized|system|value|closest|closeststatic|numa|numastatic|conservative>`	Specify the receive side scaling (RSS) mode. If a value is given it must be in the range 0 to 16383.
`rssbaseprocessor=<group>:<number>`	The base processor available for RSS. If a value is given it must formated as <group>:<number> where group is in the range 0-15 and number in the range 0 to 63.
`rssmaxprocessor=<group>:<number>`	The maximum number of processors available for RSS. If a value is given it must formated as <group>:<number> where group is in the range 0-15 and number in the range 0 to 63.
`maxrssprocessors=<count>`	The maximum number of processors available for RSS. If count is specified it must be in the range 1-256. Support for this option is independent of the version of the operating system and networking stack.

Table 49: Supported Key Value Parameter

Parameter	Description
`rssqueuecount=<balanced|count>`	Specify the maximum number of receive queues to use for RSS. If set to balanced the network adapter will choose the number of queues based on the system processor topology. If specified, count must be one of 1|2|4|8|12|16|24|32|48|64. Support for this option is independent of the version of the operating system and networking stack.
`numanode=<all|value>`	The preferred NUMA node used by RSS. If a value is given, it must be in the range 0-15. Support for this option is independent of the version of the operating system and networking stack.
`moderation=<disabled|value>`	Specify interrupt moderation time (in micro-seconds). If a value is given it must be in the range 1 to 1000. NOTE: this option covers the device driver advanced properties "interrupt moderation time" and "interrupt moderation".
`adaptive=<enabled|disabled>`	Allows the adapter to vary interrupt moderation automatically if `interruptmoderation` is enabled.
`wake=<enabled|disabled>`	Specify whether Wake-on-LAN is enabled.
`sleep=<enabled|disabled>`	Specify whether the operating system can put the device to sleep when the physical link goes down.
`vmq=<enabled|nosplit|novlan|basic|disabled>`	enabled = VMQ enabled. nosplit = VMQ enabled without lookahead split. novlan = VMQ enabled without VLAN filtering. basic = VMQ enabled MAC address filtering only. disabled = VMQ disabled.
`txbuffers=<count>`	Transmit buffer count (debug-only).
`rxbuffers=<count>`	Receive buffer count (debug-only).

Sfnet: Sample Commands

List settings for all Solarflare adapters installed on the localhost:

`sfnet /List`

```
Solarflare Adapter CLI Application [v3.0.2]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

Solarflare SFN5122F Dual Port SFP+ Server Adapter:
  Id                                  1D1
  MAC address                         00:0F:53:01:39:0C
  IP checksum offload                 Enabled
  TCP checksum offload                Enabled
  UDP checksum offload                Enabled
  LSO                                 Enabled
  LRO                                 Disabled
  Ethernet flow control               Negotiated automatically
  Link speed                          Negotiated automatically
  MTU/frame length                    1518
  RSS                                 Optimized
  NUMA node id                        All
  Interrupt moderation                60 micro-seconds
  Wake on LAN                         Not supported
  Sleep on link down                  Not supported

Solarflare SFN5122F Dual Port SFP+ Server Adapter #2:
  Id                                  2D1
  MAC address                         00:0F:53:01:39:0D
  IP checksum offload                 Enabled
  TCP checksum offload                Enabled
  UDP checksum offload                Enabled
  LSO                                 Enabled
  LRO                                 Disabled
  Ethernet flow control               Negotiated automatically
  Link speed                          Negotiated automatically
  MTU/frame length                    1518
  RSS                                 Optimized
  NUMA node id                        All
  Interrupt moderation                60 micro-seconds
  Wake on LAN                         Not supported
  Sleep on link down                  Not supported
```


4.26 Completion codes (%errorlevel%)

Table 50 lists the completion codes returned by the command line utilities. The code may be determined by inspecting `%errorlevel%`

Table 50: Completion Codes

Error code	Description
0	Success.
1	The application was invoked with /? or /help.
3	The application was invoked with /version.
16	Application cancelled (user probably pressed CTRL-C).
17	Application has requested a reboot.
18	Reboot is necessary to complete the action.
19	Incomplete team creation. Team has been created and whatever adapters that could be added have been, and the VLANs (if any) have been created. Some adapters were not able to be added.
32	Application failed initialization.
33	Access denied. Either the remote host refused a connection on the basis of account privileges, or a file could not be opened.
34	Cannot connect. The remote host could not be found or refused the connection because the WMI service was inaccessible (either because the service is not running or because there is a firewall or security policy preventing it being accessed remotely).
35	WMI classes exposed by the Solarflare drivers missing. Usually this means that either the driver have not been installed, no Solarflare adapters are present, or adapters have been disabled.
36	Failed to obtain driver lock. The application has tried to take the Solarflare driver lock because it wants to do something that must not be interrupted by another utility (or SAM) and failed to do so.
37	Adapter not found. Cannot find the adapter specified by /adapter.

Table 50: Completion Codes

Error code	Description
38	Adapter not specified. Command line is missing the /adapter option.
39	Later version already installed.
128	User entered an invalid command line.
129	Could not open log file.
130	A general WMI error occurred. Can occur when the connection is lost.
131	Missing prerequisite. The application needs something that is not present in the system.
132	Not supported.
133	Platform/System not supported.
255	General exit failure.

4.27 Teaming and VLANs

About Teaming

Solarflare adapters support the following teaming configurations:

- IEEE 802.1AX (802.3ad) Dynamic link aggregation
- Static link aggregation
- Fault tolerant teams

Teaming allows the user to configure teams consisting of all Solarflare adapter ports on all installed Solarflare adapters or might consist only of selected ports e.g. from a dual port Solarflare adapter, the first port could be a member of team A and the second port a member of team B or both ports members of the same team.

This section is only relevant to teams of Solarflare adapters. Solarflare adapters can be used in multi-vendor teams when teamed using another vendor's teaming driver.

NOTE: Adapter teaming and VLANs are not supported in Windows for iSCSI remote boot enabled Solarflare adapters. To configure load balancing and failover support on iSCSI remote boot enabled adapters, you can use Microsoft MultiPath I/O (MPIO), which is supported on all Solarflare adapters.

NOTE: Windows Server 2012 has native Windows teaming support. The user can elect to use native windows driver of the Solarflare teaming, but the two methods should not be mixed.

Creating Teams and VLANs

To set up teams and VLANs in Windows using SAM, see Using SAM to Configure Teams and VLANs on page 158.

To set up teams and VLANs in Windows using the sfteam command line tool, see Sfteam: Adapter Teaming and VLAN Tool on page 206.

Link Aggregation

Link aggregation is a mechanism for supporting load balancing and fault tolerance across a team of network adapters and their associated switch. Link aggregation is a partner teaming mode that requires configuration at both ends of the link. Once configured, all links in the team are bonded into a single virtual link with a single MAC address.

Two or more physical links are used to increase the potential throughput available between the link partners, and also improve resilience against link failures. To be aggregated, all links in the team must be between the same two link partner and each link must be full-duplex. Traffic is distributed evenly to all links connected to the same switch. In case of link failover, traffic on the failed link will be re-distributed to the remaining links.

Link aggregation offers the following functionality:

- Teams can be built from mixed media (i.e. UTP and Fibre).
- All protocols can be load balanced without transmit or receive modifications to frames.
- Multicast and broadcast traffic can be load balanced.
- Short recovery time in case of failover.
- Solarflare supports up to 64 link aggregation port groups per system.
- Solarflare supports up to 64 ports and VLANs in a link aggregation port group.

There are two methods of link aggregation, dynamic and static.

Dynamic Link Aggregation

Dynamic link aggregation uses the Link Aggregation Control Protocol (LACP) as defined in the IEEE 802.1AX standard (previously called 802.3ad) to negotiate the ports that will make up the team. LACP must be enabled at both ends of the link for a team to be operational.

LACP will automatically determine which physical links can be aggregated, and will then perform the aggregation.

An optional LACP marker protocol provides functionality when adding and removing physical links ensuring that no frames are lost, reordered or duplicated.

Dynamic link aggregation offers both fault tolerance and load balancing.

Standby links are supported, but are not considered part of a link aggregation until a link within the aggregation fails.

VLANs are supported within 802.1AX teams.

In the event of failover, the load on the failed link is redistributed over the remaining links.

NOTE: Your switch must support 802.1AX (802.3ad) dynamic link aggregation to use this method of teaming.

Figure 37 shows a 802.1AX Team configuration.

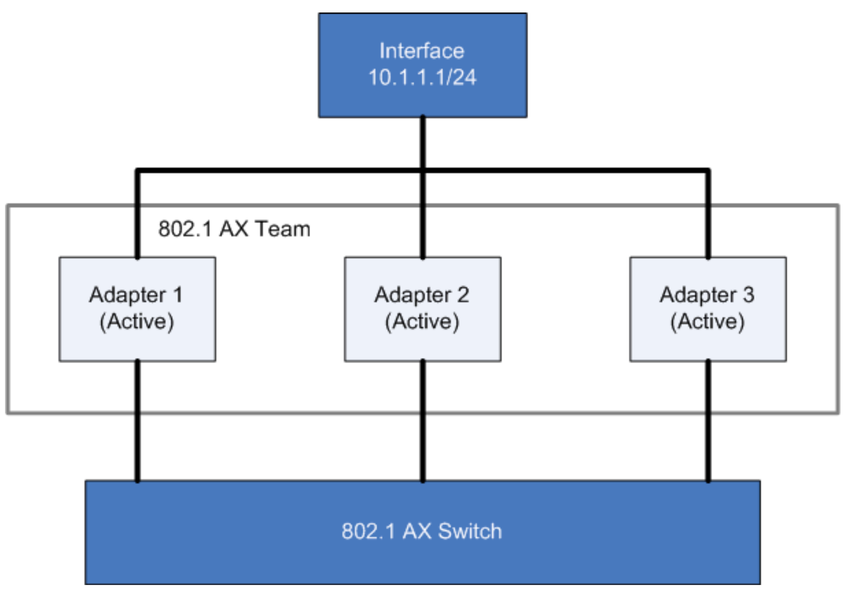


Figure 37: 802.1AX Team

Figure 38 shows a 802.1AX team with a failed link. All traffic is re-routed and shared between the other team links.

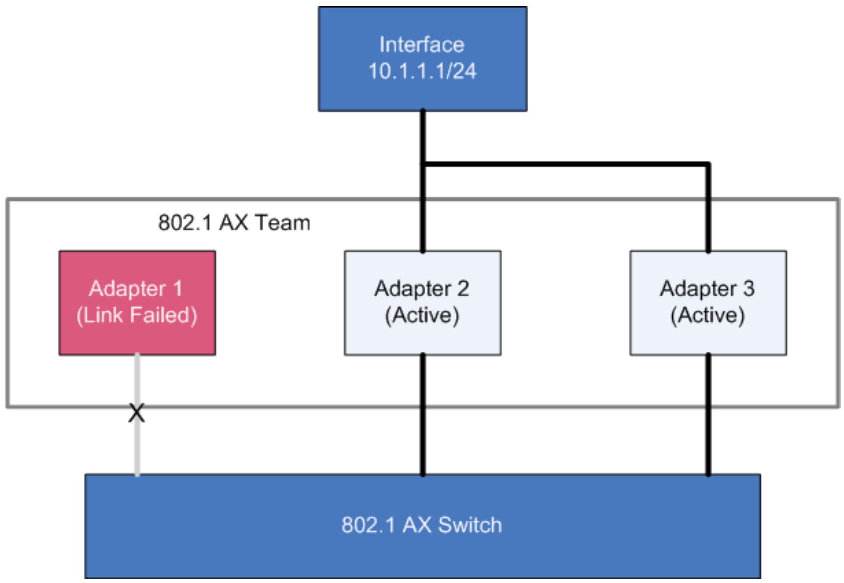


Figure 38: 802.1AX with Failed Link

Static Link Aggregation

Static link aggregation is a switch assisted teaming mode that requires manual configuring of the ports at both ends of the link. Static link aggregation is protocol independent and typically inter-operates with common link aggregation schemes such as Intel Link Aggregation, Cisco Fast EtherChannel and Cisco Gigabit EtherChannel.

With static link aggregation, all links share the traffic load and standby links are not supported.

Static link aggregation offers both fault tolerance and load balancing.

In the event of failover, the load on the failed link is redistributed over the remaining links.

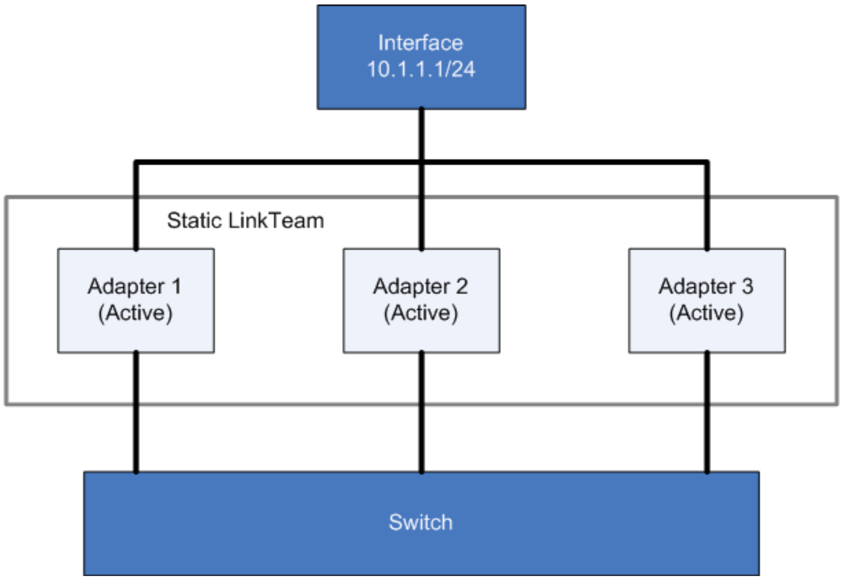


Figure 39: Static Link Aggregation Team

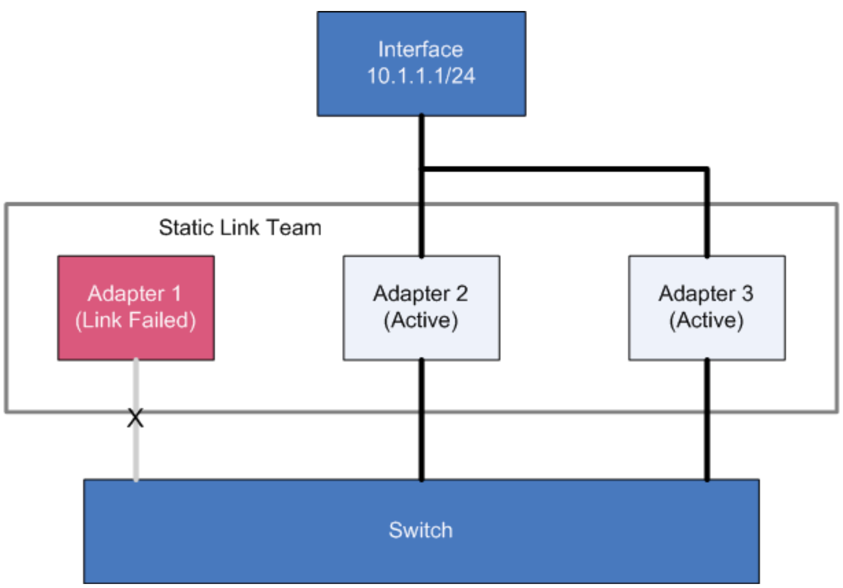


Figure 40: Static Link Team with Failed Link

Fault-Tolerant Teams

Fault tolerant teaming can be implemented on any switch. It can also be used with each network link connected to separate switches.

A fault-tolerant team is a set of one or more network adapters bound together by the adapter driver. A fault-tolerant team improves network availability by providing standby adapters. At any one moment no more than one of the adapters will be active with the remainder either in standby or in a fault state. In Figure 41, Adapter 1 is active and all data to and from the switch passes through it.

NOTE: All adapters in a fault-tolerant team must be part of the same broadcast domain.

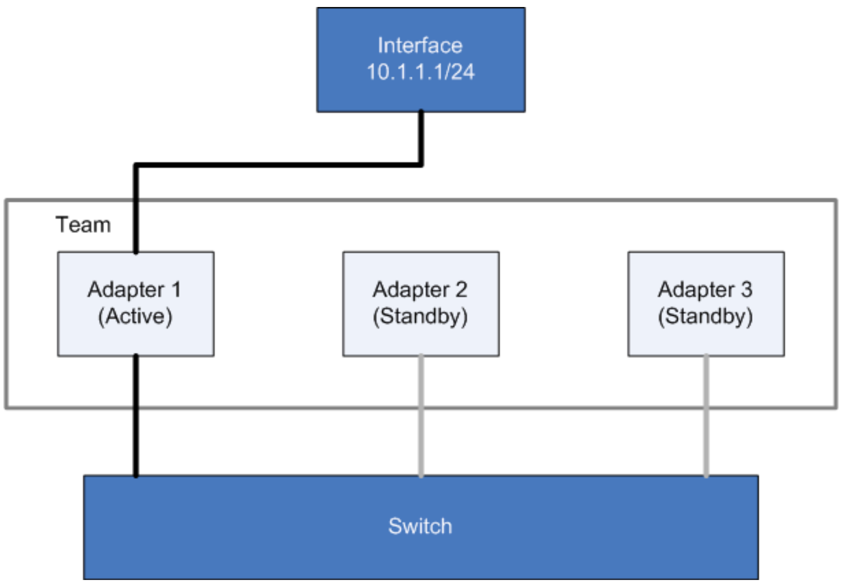


Figure 41: Fault Tolerant Team

Failover

The teaming driver monitors the state of the active adapter and, in the event that its physical link is lost (down) or that it fails in service, swaps to one of the standby adapters. In Figure 42 the previously active adapter has entered a failed state and will not be available in the standby list while the failed state persists.

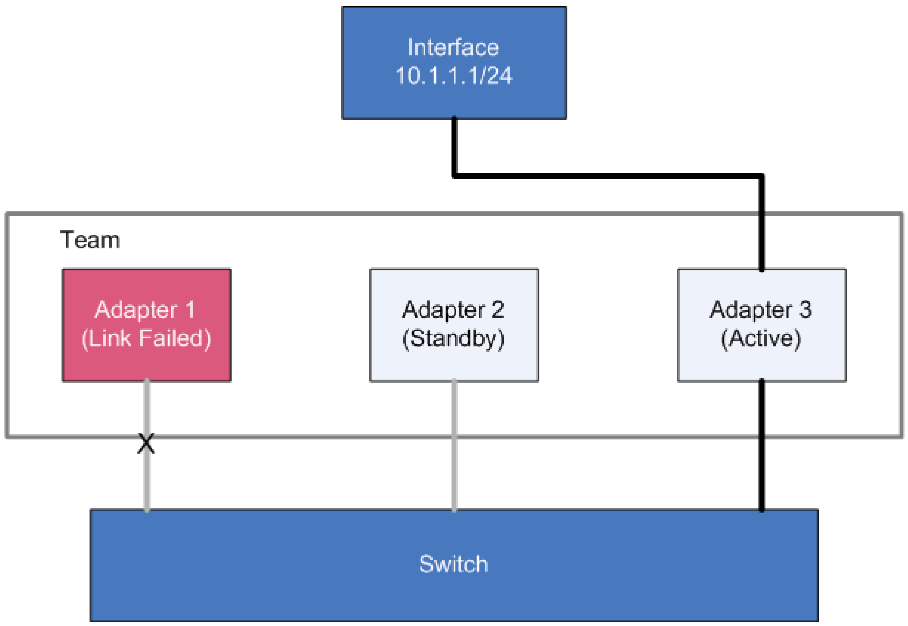


Figure 42: Adapter 1 Failure

Note that, in this example, Adapter 3 is now active. The order in which the adapters are used is determined by a number of factors, including user-definable rank.

VLANs

VLANs offer a method of dividing one physical network into multiple broadcast domains.

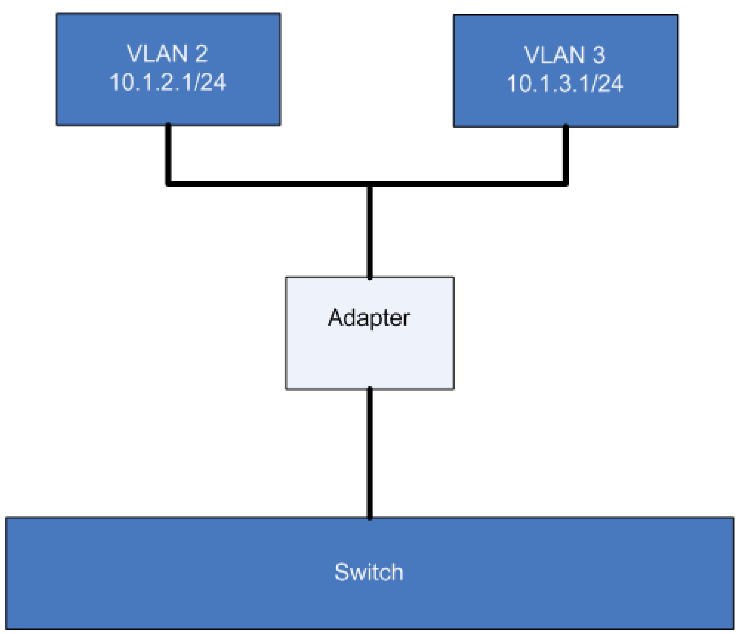


Figure 43: VLANs routing through Solarflare adapter

VLANs and Teaming

VLANs are supported on all Solarflare adapter teaming configurations.

VLANs with Fault Tolerant Teams

Figure 44 shows a fault tolerant team with two VLANs.

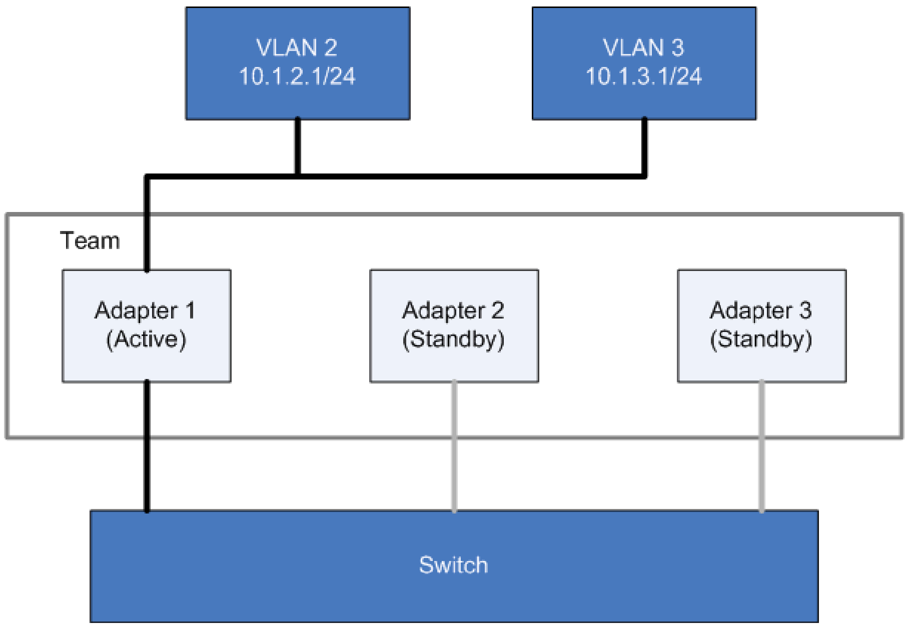


Figure 44: Fault Tolerant VLANs

Failover works in the same way regardless of the number of VLANs, as show in Figure 45.

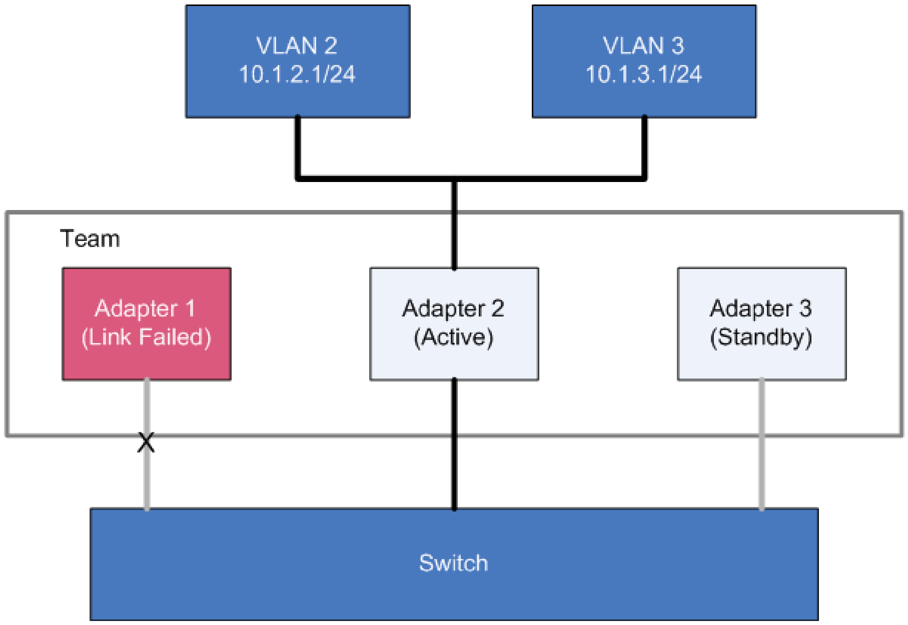


Figure 45: Failover in Fault Tolerant Team VLAN

VLANs with Dynamic or Static Link Aggregation Teams

VLANs work in the same way with either Dynamic or Static Link Aggregation teaming configurations.Figure 46 shows how VLANs work with these teams.

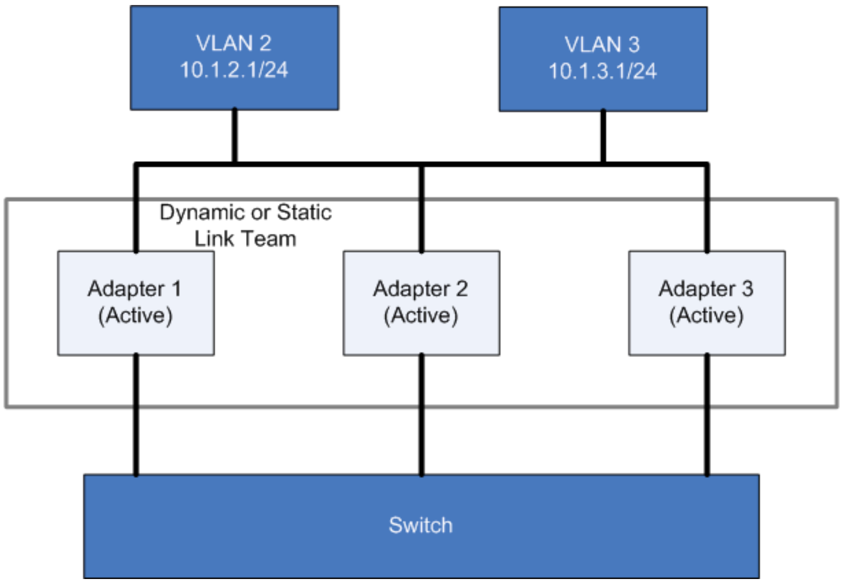


Figure 46: VLAN with Dynamic or Static Link Team

In case of link failure, all traffic is distributed over the remaining links, as in Figure 47.

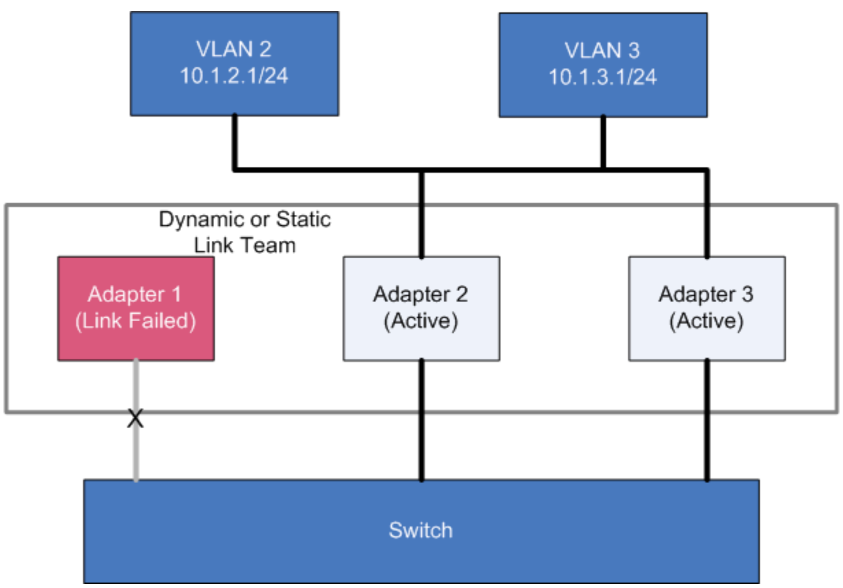


Figure 47: VLAN with Failed Dynamic or Static Team Link

Key Adapter

Every team must have a key adapter. Figure 48 shows Adapter 1 as both the Key and the active adapter. in a Fault-Tolerant Team.

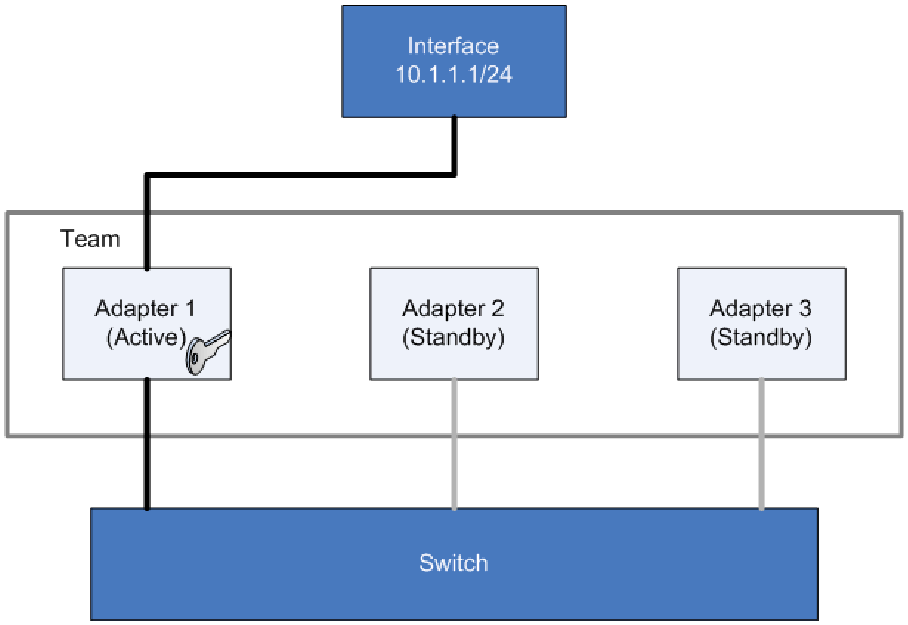


Figure 48: Key Adapter in Fault Tolerant Team

The key adapter must be a member of a team. However, it does not need to be the active adapter. It doesn't even need to be in the list of standby adapters but it must physically be within its host. The Key Adapter defines the team's RSS support (see Receive Side Scaling (RSS) on page 240) and provides the MAC Address that will be used for all traffic sent and received by the team.

When a link failure occurs in the active adapter (for example the physical link is lost) the driver will select another adapter to become active but it will not re-assign the Key Adapter. In Figure 49, Adapter 1 has failed and the team is now using Adapter 2 for all traffic.

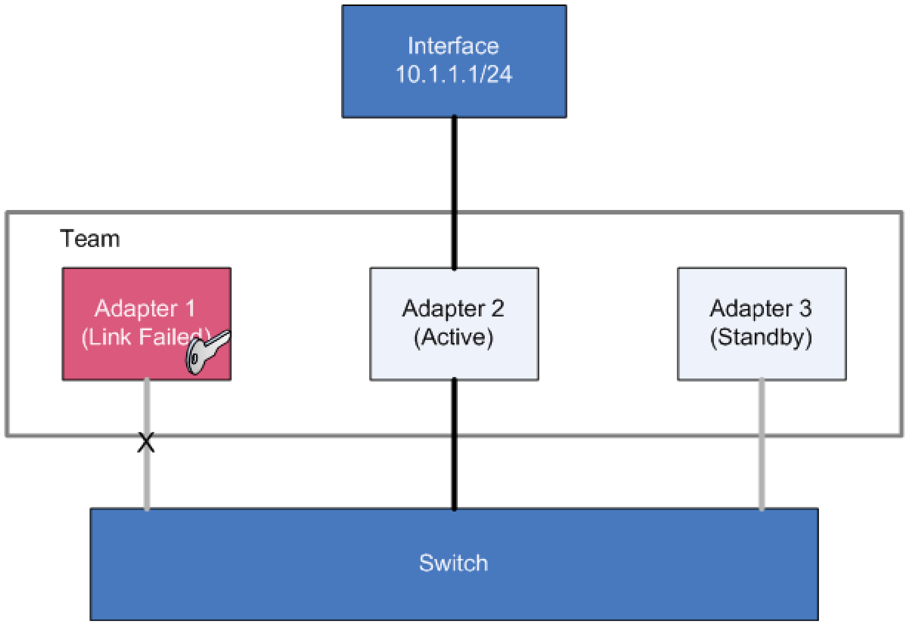
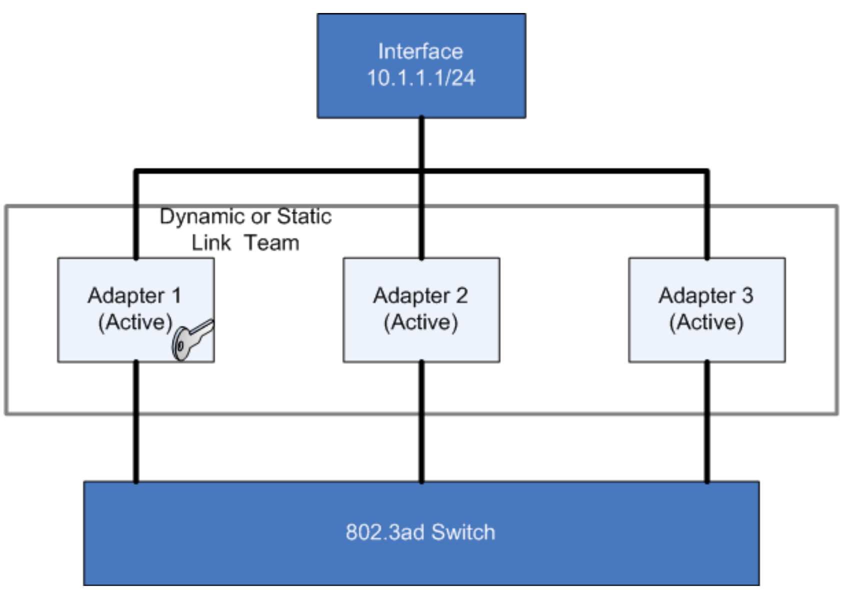


Figure 49: Failover Key Adapter

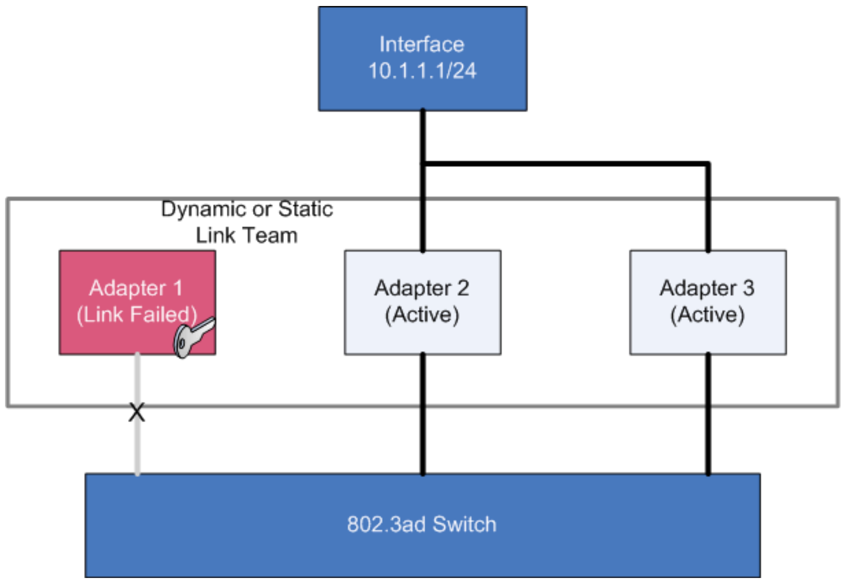
Note that although the Key Adapter (Adapter 1) has a link failure, the integrity of the team is not affected by this failure.

Dynamic and Static Link Aggregation Teams

The assignment of key adapters is supported in both dynamic and static link aggregated teams, and works in the same way for both.



Any link failure on the key adapter does not affect the redistribution of traffic to the other links in the team.



4.28 Performance Tuning on Windows

Introduction

The Solarflare family of network adapters are designed for high-performance network applications. The adapter driver is pre-configured with default performance settings that have been designed to give good performance across a broad class of applications. Occasionally, application performance can be improved by tuning these settings to best suit the application.

There are three metrics that should be considered when tuning an adapter:

- Throughput
- Latency
- CPU utilization

Different applications may be more or less affected by improvements in these three metrics. For example, transactional (request-response) network applications can be very sensitive to latency whereas bulk data transfer applications are likely to be more dependent on throughput.

The purpose of this section is to highlight adapter driver settings that affect the performance metrics described. This guide covers the tuning of all Solarflare adapters.

Latency will be affected by the type of physical medium used: 10GBase-T, twinaxial (direct-attach), fiber or KX4. This is because the physical media interface chip (PHY) used on the adapter can introduce additional latency.

This section is designed for performance tuning Solarflare adapters on Microsoft Windows. This should be read in conjunction with the reference design board errata documents and the following Microsoft performance tuning guides:

- Performance Tuning Guidelines for Windows Server 2008

  http://www.microsoft.com/whdc/system/sysperf/Perf_tun_srv.mspx
- Performance Tuning Guidelines for Windows Server 2008 R2

  http://msdn.microsoft.com/en-us/library/windows/hardware/gg463392.aspx
- Performance Tuning Document for Windows Server 2003

  http://download.microsoft.com/download/2/8/0/2800a518-7ac6-4aac-bd85-74d2c52e1ec6/tuning.doc
- Performance Tuning Guidelines for Windows XP
- http://technet.microsoft.com/en-us/library/bb457057.aspx

In addition, you may need to consider other issues influencing performance, such as application settings, server motherboard chipset, CPU speed, Cache size, RAM size, additional software installed on the system, such as a firewall, and the specification and configuration of the LAN. Consideration of such issues is not within the scope of this guide.

Tuning Settings

Tuning settings for the Solarflare adapter are available through the Solarflare Adapter Manager (SAM) utility, or via the **Advanced** tab in the **Windows Device Manager** (right-click the adapter and select **Properties)**. See Using SAM to Configure Adapter Features on page 146 and Configuring Network Adapter Properties in Windows on page 180 for more details.

Table 51 lists the available tuning settings for Solarflare adapters on Windows.

Table 51: Tuning Settings

Setting	Supported on Windows Server 2003/2003 R2/Windows XP	Supported on Windows Server 2008/2008 R2/Windows 7 /Windows Server 2012
Adaptive Interrupt Moderation	Yes	Yes
Interrupt moderation	Yes	Yes
Interrupt Moderation Time	Yes	Yes
Large receive offload (IPv4)	No	Yes
Large Receive Offload (IPv6)	No	not SFN4112F
Large send offload (IPv4) version 1	Yes	No
Large send offload (IPv6) version 1	not SFN4112F	No
Large send offload (IPv4) version 2	No	Yes
Large send offload (IPv6) version 2	No	not SFN4112F
Max Frame Size	Yes	Yes
Offload IPv4 checksum	Yes	Yes
Offload TCP checksum (IPv4)	Yes	Yes
Offload TCP checksum (IPv6)	not SFN4112F	not SFN4112F
Offload UDP checksum (IPv4)	Yes	Yes
Offload UDP checksum (IPv6)	not SFN4112F	not SFN4112F

Table 51: Tuning Settings

Setting	Supported on Windows Server 2003/2003 R2/Windows XP	Supported on Windows Server 2008/2008 R2/Windows 7 /Windows Server 2012
Receive Side Scaling (RSS)	Yes	Yes
RSS Interrupt Balancing	Yes	Yes
RSS Numa Node	No	Yes

Maximum Frame Size

The default maximum frame size ensures that the adapter is compatible with legacy 10/100Mbps Ethernet endpoints. However if a larger maximum frame size is used, adapter throughput and CPU utilization can be improved. CPU utilization is improved, because it takes fewer packets to send and receive the same amount of data. Solarflare adapters supports maximum frame sizes up to 9216 bytes (this does not include CRC).

NOTE: The maximum frame size setting should include the Ethernet frame header. The Solarflare drivers support 802.1p. This allows Solarflare adapters on Windows to optionally transmit packets with 802.1p tags for QOS applications. It requires an Ethernet frame header size of 18bytes (6bytes source MAC address, 6bytes destination MAC. 2bytes ethertype and 4bytes priority tag. The default maximum frame sizes is therefore: 1518 bytes.

Since the maximum frame size should ideally be matched across all endpoints in the same LAN (VLAN) and the LAN switch infrastructure must be able to forward such packets, the decision to deploy a larger than default maximum frame size requires careful consideration. It is recommended that experimentation with maximum frame size be done in an application test environment.

The maximum frame size is changed by changing the Max Frame Size setting in the Network Adapter’s Advanced Properties Page.

Interrupt Moderation (Interrupt Coalescing)

Interrupt moderation reduces the number of interrupts generated by the adapter by coalescing multiple received packet indications and/or transmit completion events together into a single interrupt. The amount of time the adapter waits after the first event until the interrupt is generated is the interrupt moderation interval.

Solarflare adapters, by default, use an adaptive algorithm where the interrupt moderation delay is automatically adjusted between zero (no interrupt moderation) and 60 microseconds. The adaptive algorithm detects latency sensitive traffic patterns and adjusts the interrupt moderation interval accordingly. The adaptive algorithm can be disabled to reduce jitter and the moderation interval set higher/lower as required to suit conditions.

For lowest latency, interrupt moderation should be disabled. This will increase the number of interrupts generated by the network adapter and as such increase CPU utilization.

Interrupt moderation settings are **critical for tuning adapter latency**. Increasing the moderation time may increase latency, but reduce CPU utilization and improve peak throughput, if the CPU is fully utilized. Decreasing the moderation time value or turning it off will decrease latency at the expense of CPU utilization and peak throughput. However, for many transaction request-response type network applications, the benefit of reduced latency to overall application performance can be considerable. Such benefits typically outweigh the cost of increased CPU utilization.

Interrupt moderation can be disabled by setting the Interrupt Moderation setting to disabled in the Network Adapter's Advanced Properties Page. The interrupt moderation time value can also be configured from the Network Adapter's Advanced Properties Page.

Interrupt Moderation Interval

The interrupt moderation interval is measured in microseconds. When the interval expires the adapter will generate a single interrupt for all packets received since the last interrupt and/or for all transmit complete events since the last interrupt.

Increasing the interrupt moderation interval will:

- generate less interrupts
- reduce CPU utilization (because there are less interrupts to process)
- increase latency
- improve peak throughput

Decreasing the interrupt moderation interval will:

- generate more interrupts
- increase CPU utilization (because there are more interrupts to process)
- decrease latency
- reduce peak throughput

TCP/IP Checksum Offload

Checksum offload defers the calculation and verification of IP Header, TCP and UDP packet checksums to the adapter. The driver has all checksum offload features enabled by default. Therefore, there is no opportunity to improve performance from the default.

Checksum offload configuration is changed by changing the Offload IP checksum, Offload UDP checksum and Offload TCP checksum settings in the Network Adapter's Advanced Properties Page.

Large Send Offload (LSO)

Large Send offload (LSO; also known as TCP Segmentation Offload/TSO) offloads the splitting of outgoing TCP data into packets to the adapter. LSO benefits applications using TCP. Applications using protocols other than TCP will not be affected by LSO.

Enabling LSO will reduce CPU utilization on the transmit side of a TCP connection and improve peak throughput, if the CPU is fully utilized. Since LSO has no affect on latency, it can be enabled at all times. The driver has LSO enabled by default on Windows Server 2008, 2008 R2 and Windows 7.

LSO is changed by changing the Large Send Offload setting in the Network Adapter's Advanced Properties Page. TCP and IP checksum offloads must be enabled for LSO to work.

NOTE: Solarflare recommend that you do not disable this setting.

Large Receive Offload (LRO)

Windows XP, Windows 2003, Windows Server 2008, Windows Server 2008 R2, Windows 7, Windows Server 2012.

TCP Large Receive Offload (LRO) is a feature whereby the adapter coalesces multiple packets received on a TCP connection into a single larger packet before passing this onto the network stack for receive processing. This reduces CPU utilization and improves peak throughput when the CPU is fully utilized. The effectiveness of LRO is bounded by the interrupt moderation delay and in itself, enabling LRO does not negatively impact latency. LRO is a Solarflare proprietary implementation of the Windows Receive Side Coalescing feature. LRO is disabled by default and should not be enabled if the host is forwarding received packets from one interface to another.

LRO is set by changing the Large Receive Offload settings in the Network Adapter's Advanced Properties Page. TCP /IP checksum offloads must be enabled for LRO to work. The Solarflare network adapter driver does not enable LRO by default..

NOTE: LRO should **NOT** be enabled when using the host to forward packets from one interface to another. For example, if the host is performing IP routing.

Receive Side Scaling (RSS)

Receive Side Scaling (RSS) was first supported as part of the scalable networking pack for Windows Server 2003 and has been improved with each subsequent operating system release. RSS is enabled by default and will be used on network adapters that support it. Solarflare recommend that RSS is enabled for best networking performance.

For further information about using RSS on Windows platforms see the Microsoft white paper *"Scalable Networking: Eliminating the Receive Processing Bottleneck—Introducing RSS"*

This is available from:

http://download.microsoft.com/download/5/D/6/5D6EAF2B-7DDF-476B-93DC-7CF0072878E6/NDIS_RSS.doc

By default RSS supports spreading the network receive processing workload across 4 CPU cores. Solarflare recommend this value is increased to 8 CPU cores.

On Windows Server 2003, the value is increased by editing the Windows registry: "HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Tcpip\Parameters"

and adding or modifying the following values:

- **Name:** MaxNumRssCpus
  - **Type:** DWORD (32-bit) value
  - **Data (Decimal):** 8

On Windows Server 2008 and later, the same value is added or modified but under the "HKLM\System\CurrentControlSet\Services\NDIS\Parameters" .

The Solarflare driver package installer makes these changes automatically if the "Optimize Windows TCP/IP protocol settings for 10G networking" is selected during the setup wizard.

On Windows Server 2008 R2 and Windows 7, specific RSS parameters can be tuned on a per-adapter basis. For details see the Microsoft white paper *"Networking Deployment Guide: Deploying High-Speed Networking Features"* available from:

http://download.microsoft.com/download/8/E/D/8EDE21BC-0E3B-4E14-AAEA-9E2B03917A09/HSN_Deployment_Guide.doc

Solarflare network adapters optimize RSS settings by default on Windows operating systems (not Windows XP) and offer a number of RSS interrupt balancing modes via the network adapter's advanced property page in Device Manager and Solarflare's adapter management tools.

RSS NUMA Node

The adapter driver chooses a subset of the available CPU cores to handle transmit and receive processing. The RSS NUMA Node setting can be used to constrain the set of CPU cores considered for processing to those on the given NUMA Node.

To force processing onto a particular NUMA Node, change the RSS NUMA Node setting on the Network Adapter's Advanced Properties Page.

NOTE: Solarflare recommend that you do not change this setting.

Other Considerations

PCI Express Lane Configurations

The PCI Express (PCIe) interface used to connect the adapter to the server can function at different speeds and widths. This is independent of the physical slot size used to connect the adapter. The possible widths are multiples x1, x2, x4, x8 and x16 lanes of (2.5Gbps for PCIe Gen 1, 5.0 Gbps for PCIe Gen 2) in each direction. **Solarflare adapters are designed for x8 lane operation**.

On some server motherboards, choice of PCIe slot is important. This is because some slots (including those that are physically x8 or x16 lanes) may only electrically support x4 lanes. In x4 lane slots, Solarflare PCIe adapters will continue to operate, but not at full speed. The Solarflare driver will insert a warning in the Windows Event Log if it detects that the adapter is plugged into a PCIe slot which electrically has fewer than x8 lanes.

For SFN5xxx and SFN6xxx Solarflare adapters, which require a PCIe Gen 2 x8 slot for optimal operation, a warning will also be inserted into the Windows Event Log if the adapter is installed in a PCIe Gen 1 slot.

In addition, the latency of communications between the host CPUs, system memory and the Solarflare PCIe adapter may be PCIe slot dependant. Some slots may be “closer” to the CPU, and therefore have lower latency and higher throughput. Please consult your server user guide for more information.

Memory bandwidth

Many chipsets use multiple channels to access main system memory. Maximum memory performance is only achieved when the chipset can make use of all channels simultaneously. This should be taken into account when selecting the number of memory modules (DIMMs) to populate in the server. Consult the motherboard documentation for details, however it's likely that populating all DIMM slots will be needed for optimal memory bandwidth in the system.

BIOS Settings

DELL Systems

Refer to the BIOS configuration guidelines recommended by Dell's white paper *"Configuring Low-Latency Environments on Dell PowerEdge Servers"* available from:

http://i.dell.com/sites/content/business/solutions/whitepapers/en/Documents/configuring-dell-poweredge-servers-for-low-latency-12132010-final.pdf

HP Systems

Refer to the BIOS configuration guidelines recommended by HP's white paper *"Configuring the HP ProLiant Server BIOS for Low-Latency Applications"* available from:

http://h20000.www2.hp.com/bc/docs/support/SupportManual/c01804533/c01804533.pdf

Although targeted at tuning for real-time operating systems, the recommendations equally apply to Windows Server platforms.

Other system vendors may publish similar recommendations. In general any BIOS settings guidelines that are targeted at increasing network performance whilst minimizing latency and jitter are applicable to all operating systems.

Intel® QuickData / NetDMA

On systems that support Intel I/OAT (I/O Acceleration Technology) features such as QuickData (a.k.a NetDMA), Solarflare recommend that these are enabled as they are rarely detrimental to performance.

Using Intel® QuickData Technology allows data copies to be performed by the system and not the operating system. This enables data to move more efficiently through the server and provide fast, scalable, and reliable throughput.

Windows Server 2003 and Windows XP

With Microsoft's Scalable Networking Pack, NetDMA is enabled as follows:

- I/OAT must first be enabled in the BIOS
- Download the Intel I/OAT drivers for example refer to:

  http://downloadcenter.intel.com/detail_desc.aspx?agr=Y&DwnldID=12193).
- Run IOATDMA.exe to unpack the I/OAT device drivers.

- In Device Manager look for an unrecognized device named “Base System Device” in “Other devices”. If there is more than one such device the I/OAT controller is the one with PCI vendor id of 0x8086 and device id of 0x1a38.
- Right click on the I/OAT device and select 'Update driver software' and navigate to the directory where the IOATDMA.exe unpacked the drivers.

Windows Server 2008, Windows Server 2008 R2,Windows 7 and Windows Server 2012

To enable NetDMA the `EnableTCPA` variable must be set to 1 in the `Tcpip\Parameters` registry key. Locate the following key in the registry:

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters
```

The `EnableTCPA` value must be created if it is not present and set to 1:

```
EnableTCPA = 1
```

Intel Hyper-Threading Technology

On systems that support Intel Hyper-Threading Technology users should consider benchmarking or application performance data when deciding whether to adopt hyper-threading on a particular system and for a particular application. Solarflare have identified that hyper-threading is generally beneficial on systems fitted with Core i5, Core i7 and Xeon (Nehalem or later) CPUs when used in conjunction with Windows Server 2008 or later.

TCP/IP Options

Solarflare recommend the following settings to ensure that TCP operation on Windows Server 2003 and Windows XP is optimized for 10Gbit networking. The values can be changed in the windows registry:

"HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Tcpip\Parameters"

- Name: SackOpts - to enable TCP SACK
  - Type: DWORD (32-bit) value
  - Data (Decimal): 1
- Name: Tcp1323Opts - to enable TCP time-stamp and window scaling option
  - Type: DWORD (32-bit) value
  - Data (Decimal): 3
- Name: TcpWindowSize - increase TCP windows size
  - Type: DWORD (32-bit) value
  - Data (Decimal): 524288

This increases the TCP window size from its default of 64 Kbytes to 512 Kbytes, which is much more suitable for the bandwidth delay product of 10 gigabit connections

The Solarflare driver package installer automatically configures these settings if the "Optimize Windows TCP/IP protocol settings for 10G networking" is selected during the setup wizard.

On Windows Server 2008 and later platforms, TCP timestamps, window scaling and selective acknowledgments are enabled by default and include receive window tuning and congestion control algorithms that automatically adapt to 10 gigabit connections.

Server Power Saving Mode

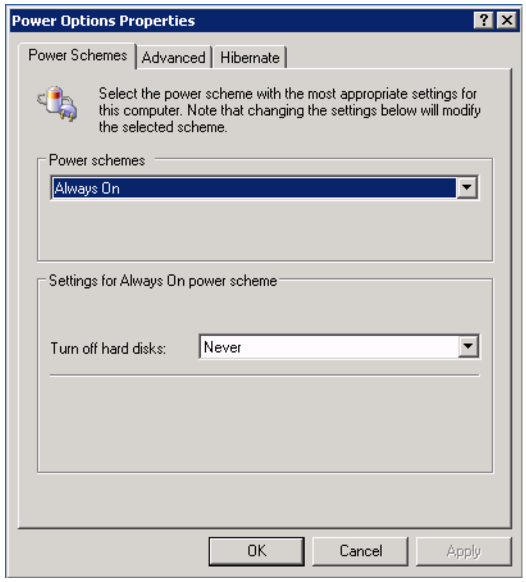
Modern processors utilize design features that enable a CPU core to drop into low power states when instructed by the operating system that the CPU core is idle. When the OS schedules work on the idle CPU core (or when other CPU cores or devices need to access data currently in the idle CPU core's data cache) the CPU core is signaled to return to the fully on power state. These changes in CPU core power states create additional network latency and jitter. Solarflare recommend to achieve the lowest latency and lowest jitter that the "C1E power state" or "CPU power saving mode" is disabled within the system BIOS.

In general the user should examine the system BIOS settings and identify settings that favor performance over power saving. In particular look for settings to disable:

- C states / Processor sleep/idle states
- C1E
- Any deeper C states (C3 through to C6)
- P states / Processor throttling
- Ultra Low Power State
- PCIe Active State Power Management
- ASPM
- Processor Turbo mode
- Unnecessary SMM/SMI features

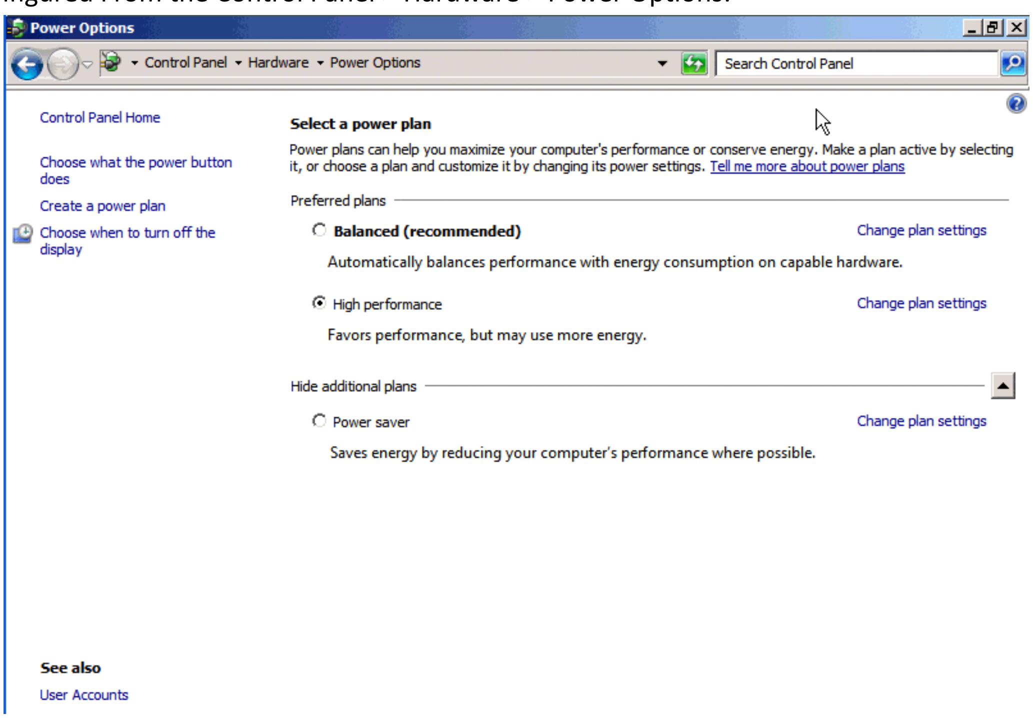
Windows Server 2003, Windows Server 2003 R2 and Windows XP

On Windows 2003, the default “Always On” power mode is the best setting for best latency. The power mode is configured via the Control Panel's Power Options. The “Server Balanced Power and Server Performance” power mode can be used if latency is not critical.



Windows Server 2008, Windows Server 2008 R2,Windows 7 and Windows Server 2012

The latency can be improved by selecting the “Optimum Performance” power plan. This is configured From the Control Panel > Hardware > Power Options:



Windows Firewall

Depending on the system configuration, the built-in Windows (or any third-party) Firewall may have a significant impact on throughput and CPU utilization. Where high throughput is required on a particular port, the performance will be improved by disabling the firewall on that port.

NOTE: The Windows (or any third party) Firewall should be disabled with caution. The network administrator should be consulted before making any changes.

Benchmarks

Throughput Benchmark using Ntttcp

The following example shows results from running Microsoft's ntttcp. On Windows Server 2008, 2008 R2 and Windows 7 it is suggested that first, **Large Receive Offload** (LRO) is enabled via the Network Adapter's Advanced Properties Page.

1. On client and server install drivers via the MSI installer.
2. On Windows Server 2008, 2008 R2 and Windows 7 enable "Large Receive Offload" in advanced driver properties
3. On server run ntttcpr:

```
ntttcpr.exe -rb 500000 -a 24 -n 100000 -l 524288 -m
1,1,<server_adapter_IP_interface>
```

4. On client run ntttcps test:

```
ntttcps.exe -rb 500000 -a 24 -n 100000 -l 524288 -m
1,1,<server_adapter_IP_interface>
```

```
C:\ > ntttcps.exe -rb 500000 -a 24 -n 100000 -l 524288 -m 1,1,<server
adapter IP interface>
Copyright Version 2.4
Network activity progressing...
Thread Realtime(s) Throughput(KB/s) Throughput(Mbit/s)
====== =========== ================
0 44.767 1170961.007 9367.688
Total Bytes(MEG) Realtime(s) Average Frame Size Total Throughput(Mbit/s)
================ =========== ==================
52420.411392 44.767 1459.846 9367.688
Total Buffers Throughput(Buffers/s) Pkts(sent/intr) Intr(count/s) Cycles/
Byte
============= =====================
99984.000 2233.431 27 29187.48 0.8
Packets Sent Packets Received Total Retransmits Total Errors Avg. CPU %
============ ================ =================
```

Tuning Recommendations

The following tables provide recommendations for tuning settings for different application characteristics.

Throughput - Table 52

Latency - Table 53

Table 52: Throughput Tuning Settings

Tuning Parameter	How?
Adaptive Interrupt Moderation	Leave at default (Enabled).
Interrupt Moderation	Leave at default (Enabled).
Interrupt Moderation Time	Leave at default (Enabled 60µs).
Large Receive Offloads	**Enable** in Network Adapter Advanced Properties.
Large Send Offloads	Leave at default (Enabled).
Max Frame Size	Configure to maximum supported by network in Network Adapter's Advanced Properties.
Offload Checksums	Leave at default.
Receive Side Scaling (RSS)	Leave at default.
RSS Interrupt Balancing	Leave at default (Optimized).
RSS NUMA Node	Leave at default (All).
TCP Protocol Tuning	Leave at default (install with “Optimize Windows TCP/IP protocol settings for 10G networking” option selected).
PCI Express Lane Configuration	Ensure current speed (not the supported speed) reads back as “x8 and 5Gb/s” Or “x8 and Unknown”.
Power Saving Mode	Leave at default.
Memory bandwidth	Ensure Memory utilizes all memory channels on system motherboard.
Intel QuickData (Intel chipsets only)	Enable in BIOS and configure as described in guide.

Table 53: Latency Tuning Settings

Tuning Parameter	How?
Adaptive Interrupt Moderation	Leave at default (Enabled).
Interrupt Moderation	**Disable** in Network Adapter’s Advanced Properties.
Interrupt Moderation Time	Set to 0uS in Network Adapter’s Advanced Properties.
Large Receive Offloads	Disable in Network Adapter’s Advanced Properties.
Large Send Offloads	Leave at default (Enabled).
Max Frame Size	Configure to maximum supported by network in Network Adapter's Advanced Properties.
Offload Checksums	Leave at default (Enabled).
TCP/IP Checksum Offload	Leave at default
Receive Side Scaling	Application dependent
RSS Interrupt Balancing	Leave at default (Optimized).
RSS NUMA Node	Leave at default (All).
TCP Protocol Tuning	Leave at default (install with “Optimize Windows TCP/IP protocol settings for 10G networking” option selected).
PCI Express Lane Configuration	Ensure the adapter is in x8 Gen 2 slot.
Power Saving Mode	Disable C1E and other CPU sleep modes to prevent OS from putting CPUs into lowering power modes when idle.
Memory bandwidth	Ensure Memory utilizes all memory channels on system motherboard.
Intel QuickData (Intel chipsets only)	Enable in BIOS and configure as described in guide.

4.29 Windows Event Log Error Messages

The following tables list the various error messages that can be added to the event log, along with a description and action that should be taken.

Driver Status Codes

Table 54: Driver Status Codes

Value	Error Message	Severity	Description	Notes
0x60000001L	BUS_STATUS_DRIVER_VERSION	Informational	The driver version information.	No action required.
0x60000002L	BUS_STATUS_DRIVER_LOAD_FAILURE	Informational	The driver failed to load.	
0xA0000004L	BUS_STATUS_DRIVER_NOT_ADDING_DEVICE	Warning	The driver can't add a device due to the system being started in safe mode (SAFEMODE_MINIMAL).	
0xA0000005L	BUS_STATUS_DRIVER_NUMA_ALLOCATION_FAILED	Warning	The driver could not allocate memory on a specific NUMA node.	For maximum performance all NUMA nodes should be populated. Install additional memory.

Device Status Codes

Table 55: Device Status Codes

Value	Error Message	Severity	Description	Action
0xE0010002L	BUS_STATUS_DEVICE_PHY_ZOMBIE	Error	PHY firmware has failed to start.	Possible PHY firmware corruption. Run sfupdate or SAM to update.
0xA0010004L	BUS_STATUS_DEVICE_LINK_WIDTH	Warning	The device does not have sufficient PCIe lanes to reach full bandwidth.	Move the adapter into a PCIe slot with more lanes. See PCI Express Lane Configurations on page 241.
0xE0010005L	BUS_STATUS_DEVICE_ADD_FAILUR E	Error	The device could not be added to the system.	
0xE0010006L	BUS_STATUS_DEVICE_INIT_INTERR UPTS_DISABLED_FAILURE	Error	The device could not be initialized with interrupts disabled.	
0xE0010007L	BUS_STATUS_DEVICE_INIT_INTERR UPTS_ENABLED_FAILURE	Error	The device could not be initialized with interrupts enabled.	
0xE0010008L	BUS_STATUS_DEVICE_START_FAILU RE	Error	The device could not be started.	
0xE0010009L	BUS_STATUS_DEVICE_RESET_FAILU RE	Error	The device could not be reset.	
0xE001000AL	BUS_STATUS_DEVICE_EFX_FAILURE	Error	There was an EFX API failure.	
0x6001000BL	BUS_STATUS_DEVICE_MTU_CHANG E	Informational	The MTU on the device was changed.	No action required.
0xA001000CL	BUS_STATUS_DEVICE_TX_WATCHD OG	Warning	The transmit watchdog fired	
0xA001000D L	BUS_STATUS_DEVICE_UNEXPECTED _EVENT	Warning	An unexpected event was received from the device.	No action required.
0xA0010010L	BUS_STATUS_DEVICE_WRONG_RX_ EVENT	Warning	A non-contiguous RX event was received from the device.	

Table 55: Device Status Codes

Value	Error Message	Severity	Description	Action
0xA0010011L	BUS_STATUS_DEVICE_TEMPERATURE_WARNING	Warning	The device has exceeded the maximum supported temperature limit.	Improve the server cooling.
0xE0010012L	BUS_STATUS_DEVICE_TEMPERATURE_ERROR	Error	The device has exceeded the critical temperature limit.	Improve the server cooling.
0xA0010013L	BUS_STATUS_DEVICE_COOLING_ERROR	Warning	The device cooling has failed.	
0xA0010014L	BUS_STATUS_DEVICE_VOLTAGE_WARNING	Warning	One of the device voltage supplies is outside of the supported voltage range.	The adapter or server maybe faulty.
0xE0010015L	BUS_STATUS_DEVICE_VOLTAGE_ERROR	Error	One of the device voltage supplies is outside of the critical voltage range.	The adapter or server maybe faulty.
0xE0010016L	BUS_STATUS_DEVICE_UNKNOWN_SENSOREVT	Error	A non-specified hardware monitor device has reported an error condition.	
0xA0010017L	BUS_STATUS_DEVICE_MCDI_ERR	Warning	Hardware MCDI communication suffered an error.	None required.
0xE0010018L	BUS_STATUS_DEVICE_MCDI_TIMEOUT	Error	Hardware MCDI communication timed out.	None required.
0xA0010019L	BUS_STATUS_DEVICE_MCDI_BOOT_ERROR	Warning	Hardware MCDI boot from non-primary flash. Possible flash corruption.	Run sfupdate or update via SAM.
0x6001001BL	BUS_STATUS_DEVICE_MCDI_VERSION	Informational	Hardware MCDI version	None required.

Chapter 5: Solarflare Adapters on VMware

This chapter covers the following topics on the VMware® platform:

5.1 System Requirements

Refer to Software Driver Support on page 13 for supported VMware host platforms.

5.2 VMware Feature Set

Table 56 lists the features available from the VMware host. The following options can also be configured on the guest operating system:

- Jumbo Frames
- Task Offloads
- Virtual LANs (VLANs)

Table 56: VMware Host Feature Set

Jumbo frames	Support for MTUs (Maximum Transmission Units) from 1500 bytes to 9000 bytes. • See Adapter MTU (Maximum Transmission Unit) on page 274
Task offloads	Support for TCP Segmentation Offload (TSO), Large Receive Offload (LRO), and TCP/UDP/IP checksum offload for improved adapter performance and reduced CPU processing requirements. • See TCP/IP Checksum Offload on page 276 • See TCP Segmentation Offload (TSO) on page 276
NetQueue	Support for NetQueue, a performance technology that significantly improves performance in 10 Gigabit Ethernet virtualized environments. • See VMware ESX NetQueue on page 272
Teaming	Improve server reliability by creating teams on either the host vSwitch, Guest OS or physical switch to act as a single adapter, providing redundancy against single adapter failure. • See Configuring Teams on page 255
Virtual LANs (VLANs)	Support for VLANs on the host, guest OS and virtual switch. • See Configuring VLANs on page 255
PXE booting	Support for diskless booting to a target operating system via PXE boot. • See Sfboot: Command Line Options on page 258 • See Solarflare Boot ROM Agent on page 360
Fault diagnostics	Support for comprehensive adapter and cable fault diagnostics and system reports. • See Running Adapter Diagnostics on page 257

Table 56: VMware Host Feature Set

Firmware updates	Support for Boot ROM and Phy transceiver firmware upgrades for in-field upgradable adapters. • See Upgrading Adapter Firmware with Sfupdate on page 268

5.3 Installing Solarflare Drivers and Utilities on VMware

Using the VMware ESX Service Console

The service console is the VMware ESX Server command-line interface. It provides access to the VMware ESX Server management tools, includes a command prompt for direct management of the Server, and keeps track of all the virtual machines on the server as well as their configurations.

Installing on VMware vSphere 4.0 and 4.1

The Solarflare adapter drivers are provided as an iso image file. Copy the .iso image to a CD-ROM and refer to the VMware install instructions in the VMware NIC Device Driver Configuration Guide available from http://www.vmware.com/support/pubs/.

Installing on VMware ESXi 5.0 and 5.1

To install or update the .VIB through the CLI:

```
esxcli software vib install -v <absolute PATH to the .vib>
```

To install or update the offline bundle

```
esxcli software vib install -d <absolute PATH to the .zip>
```

To install through the Update Manager

Import the package in to the Update Manager and add to a baseline, then follow the normal update process. To install a new package on to a host deploy the package as part of a Host Extension type baseline rather than a Host Upgrade type.

Granting access to the NIC from the Virtual Machine

To allow guest operating systems access to the Solarflare NIC, you will need to connect the device to a vSwitch to which the guest also has a connection. You can either connect to an existing vSwitch, or create a new vSwitch for this purpose. To create a new vSwitch:

1 Log in to the **VMware Infrastructure Client**.

2 Select the host from the inventory panel.

3 Select the **Configuration** tab.

4 Choose **Networking** from the **Hardware** box on the left of the resulting panel.

5 Click **Add Networking** on the top right.

6 Select **Virtual Machine** connection type and click **Next**.

7 Choose **Create a Virtual Switch** or **Use vSwitchX** as desired.

8 Follow the remaining on-screen instructions.

5.4 Configuring Teams

A team allows two or more network adapters to be connected to a virtual switch (vSwitch). The main benefits of creating a team are:

- Increased network capacity for the virtual switch hosting the team.
- Passive failover in the event one of the adapters in the team fails.

NOTE: The VMware ESX host only supports NIC teaming on a single physical switch or stacked switches.

To create a team

1 From the host, select the **Configuration** tab.

2 Select **Networking** from the **Hardware** section.

3 Select **Properties** for the Virtual Switch you want to create the team for.

4 Select the **vSwitch** from the dialog box and click **Edit**.

5 Select **NIC Teaming**.

You can configure the following settings:

- Load Balancing
- Network Failover Detection
- Notify Switches
- Failover
- Failover Order

5.5 Configuring VLANs

There are three methods for creating VLANs on VMware ESX:

1 Virtual Switch Tagging (VST)

2 External Switch Tagging (EST)

3 Virtual Guest Tagging (VGT)

For EST and VGT tagging, consult the documentation for the switch or for the guest OS.

To Configure Virtual Switch Tagging (VST)

With vSwitch tagging:

- All VLAN tagging of packets is performed by the virtual switch, before leaving the VMware ESX host.
- The host network adapters must be connected to trunk ports on the physical switch.
- The port groups connected to the virtual switch must have an appropriate VLAN ID specified.

NOTE: VMware recommend that you create or amend VLAN details from the physical console of the server, not via the Infrastructure Client, to prevent potential disconnections.

1 From the host, select the **Configuration** tab.

2 Select **Networking** from the **Hardware** section.

3 Select **Properties** for the Virtual Switch you want to create the team for.

4 Select a **Port Group** and click **Edit**.

5 Enter a valid VLAN ID (0 equals no VLAN).

6 Click **OK**.

Further Reading

- NIC teaming in VMware ESX Server:

http://kb.vmware.com/selfservice/microsites/search.do?cmd=displayKC&docType=kc&externalId=1004088&sliceId=1&docTypeID=DT_KB_1_1&dialogID=40304190&stateId=0%200%2037866989

- VMware ESX Server host requirements for link aggregation:

http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1001938

- VLAN Configuration on Virtual Switch, Physical Switch, and virtual machines:

http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1003806

5.6 Running Adapter Diagnostics

You can use Ethtool to run adapter diagnostic tests. Tests can be run offline (default) or online. Offline runs the full set of tests, possibly causing normal operation interruption during testing. Online performs a limited set of tests without affecting normal adapter operation.

As root user, enter the following command:

```
ethtool --test vmnicX offline|online
```

The tests run by the command are as follows:

Table 57: Adapter Diagnostic Tests

Diagnostic Test	Purpose
core.nvram	Verifies the flash memory 'board configuration' area by parsing and examining checksums.
core.registers	Verifies the adapter registers by attempting to modify the writable bits in a selection of registers.
core.interrupt	Examines the available hardware interrupts by forcing the controller to generate an interrupt and verifying that the interrupt has been processed by the network driver.
tx/rx.loopback	Verifies that the network driver is able to pass packets to and from the network adapter using the MAC and Phy loopback layers.
core.memory	Verifies SRAM memory by writing various data patterns (incrementing bytes, all bit on and off, alternating bits on and off) to each memory location, reading back the data and comparing it to the written value.
core.mdio	Verifies the MII registers by reading from PHY ID registers and checking the data is valid (not all zeros or all ones). Verifies the MMD response bits by checking each of the MMDs in the Phy is present and responding.
chanX eventq.poll	Verifies the adapter’s event handling capabilities by posting a software event on each event queue created by the driver and checking it is delivered correctly. The driver utilizes multiple event queues to spread the load over multiple CPU cores (RSS).
phy.bist	Examines the PHY by initializing it and causing any available built-in self tests to run.

5.7 Configuring the Boot ROM with Sfboot

Sfboot is a command line utility for configuring the Solarflare adapter Boot ROM for PXE and iSCSI booting. Using sfboot is an alternative to using **Ctrl+B** to access the Boot Rom agent during server startup.

See Configuring the Solarflare Boot ROM Agent on page 360 for more information on the Boot Rom agent.

Sfboot: Command Usage

Log in to the VMware Service Console as root, and enter the following command:

```
sfboot [--adapter=vmnicX] [options] [parameters]
```

Note that without `--adapter`, the `sfboot` command applies to all adapters that are present in the target host.

The format for the parameters are:

`<parameter>=<value>`

Sfboot: Command Line Options

Table 58 lists the options for `sfboot.exe` and Table 59 lists the available parameters.

Table 58: Sfboot Options

Option	Description
`-?-h, --help`	Displays command line syntax and provides a description of each sfboot option.
`-V, --version`	Shows detailed version information and exits.
`--nologo`	Hide the version and copyright message at startup.
`-v, --verbose`	Shows extended output information for the command entered.
`-s, --quiet` `Aliases: --silent`	Suppresses all output, including warnings and errors; no user interaction. You should query the completion code to determine the outcome of commands when operating silently (see Performance Tuning on Windows on page 236).

Table 58: Sfboot Options

Option	Description
`--log <filename>`	Logs output to the specified file in the current folder or an existing folder. Specify `--silent` to suppress simultaneous output to screen, if required.
`--computer <computer_name>`	Performs the operation on a specified remote computer. Administrator rights on the remote computer is required.
`--list`	Lists all available Solarflare adapters. This option shows the ifname and MAC address. Note: this option may not be used in conjunction with the any other option. If this option is used with configuration parameters, those parameters will be silently ignored.
`-i, --adapter =<vmnicX>`	Performs the action on the identified Solarflare network adapter. The adapter identifier `vmnicX` can be the name or MAC address, as output by the `--list` option. If `--adapter` is not included, the action will apply to all installed Solarflare adapters.
`--clear`	Resets all adapter options except `boot-image` to their default values. Note that `--clear` can also be used with parameters, allowing you to reset to default values, and then apply the parameters specified.

The following parameters in Table 59 are used to control the options for the Boot ROM driver when running prior to the operating system booting.

Table 59: Sfboot Parameters

Parameter	Description
`boot-image=<all|optionrom|uefi|disabled>`	Specifies which boot firmware images are served-up to the BIOS during start-up. This parameter can not be used if the `--adapter` option has been specified. This option is not reset if `--clear` is used.

Table 59: Sfboot Parameters

Parameter	Description
`link-speed=<auto|10g|1g|100m>`	Specifies the network link speed of the adapter used by the Boot ROM the default is `auto.` On the 10GBASE-T adapters "auto" instructs the adapter to negotiate the highest speed supported in common with it's link partner . On SFP+ adapters, "auto" instructs the adapter to use the highest link speed supported by the inserted SFP+ module. On 10GBASE-T and SFP+ adapters, any other value specified will fix the link at that speed, regardless of the capabilities of the link partner, which may result in an inability to establish the link `auto` Auto-negotiate link speed (default) `10G` 10G bit/sec `1G` 1G bit/sec `100M` 100M bit/sec
`linkup-delay=<seconds>`	Specifies the delay (in seconds) the adapter defers its first connection attempt after booting, allowing time for the network to come up following a power failure or other restart. This can be used to wait for spanning tree protocol on a connected switch to unblock the switch port after the physical network link is established. The default is 5 seconds.
`banner-delay=<seconds>`	Specifies the wait period for **Ctrl-B** to be pressed to enter adapter configuration tool. `seconds` = 0-256
`bootskip-delay=<seconds>`	Specifies the time allowed for **Esc** to be pressed to skip adapter booting. `seconds` = 0-256
`boot-type=<pxe|iscsi|disabled>`	Sets the adapter boot type. `pxe` – PXE (Preboot eXecution Environment) booting `iscsi` – iSCSI (Internet Small Computer System Interface) booting `disabled` – Disable adapter booting

Table 59: Sfboot Parameters

Parameter	Description

`initiator-dhcp=<enabled|disabled>`	Enables or disables DHCP address discovery for the adapter by the Boot ROM except for the Initiator IQN (see `initiator-iqn-dhcp`). This option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).
	If initiator-DHCP is set to disabled, the following options will need to be specified:
	`initiator-ip=<ip_address>`
	`netmask=<subnet>`
	The following options may also be needed:
	`gateway=<ip_address>`
	`primary-dns=<ip_address>`

`initiator-ip=<ipv4 address>`	Specifies the IPv4 address (in standard “.” notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled initiator-ip=<192.168.1.3>`
`netmask=<ipv4 subnet>`	Specifies the IPv4 subnet mask (in standard “.” notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled netmask=255.255.255.0`
`gateway=<ipv4 address>`	Specifies the IPv4 subnet mask (in standard “.” notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled gateway=192.168.0.10`

Table 59: Sfboot Parameters

Parameter	Description
`primary-dns=<ipv4 address>`	Specifies the IPv4 address (in standard "." notation form) of the Primary DNS to be used by the adapter when `initiator-dhcp` is disabled. This option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled primary-dns=192.168.0.3`
`initiator-iqn-dhcp=<enabled|disabled>`	Enables or disables use of DHCP for the initiator IQN only.
`initiator-iqn=<IQN>`	Specifies the IQN (iSCSI Qualified Name) to be used by the adapter when `initiator-iqn-dhcp` is disabled. The IQN is a symbolic name in the "." notation form; for example: iqn.2009.01.com.solarflare, and is a maximum of 223 characters long. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot initiator-iqn-dhcp=disabled initiator-iqn=iqn.2009.01.com.solarflare adapter=2`
`lun-retry-count=<count>`	Specifies the number of times the adapter attempts to access and login to the Logical Unit Number (LUN) on the iSCSI Target before failing. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot lun-retry-count=3`

Table 59: Sfboot Parameters

Parameter	Description

`target-dhcp=<enabled|disabled>`	Enables or disables the use of DHCP to discover iSCSI target parameters on the adapter.
	
	If `target-dhcp` is disabled, you must specify the following options:
	
	`target-server=<address>`
	`target-iqn=<iqn>`
	`target-port=<port>`
	`target-lun=<LUN>`
	
	Example - Enable the use of DHCP to configure iSCSI Target settings:
	
	`sfboot boot-type=iscsi target-dhcp=enabled`

`target-server=<DNS name or ipv4 address>`	Specifies the iSCSI target's DNS name or IPv4 address to be used by the adapter when `target-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi target-dhcp=disabled target-server=192.168.2.2`
`target-port=<port_number>`	Specifies the Port number to be used by the iSCSI target when `target-dhcp` is disabled. The default Port number is Port 3260. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi target-dhcp=disabled target-port=3262` This option should only be used if your target is using a non-standard TCP Port.
`target-lun=<LUN>`	Specifies the Logical Unit Number (LUN) to be used by the iSCSI target when `target-dhcp` is disabled. The default LUN is 0. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).

Table 59: Sfboot Parameters

Parameter	Description
`target-iqn=<IQN>`	Specifies the IQN of the iSCSI target when `target-dhcp` is disabled. Maximum of 223 characters. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Note that if there are spaces contained in `<IQN>`, then the IQN must be wrapped in double quotes (“”). Example: `sfboot target-dhcp=disabled target-iqn=iqn.2009.01.com.solarflare adapter=2`
`vendor-id=<dhcp_id>`	Specifies the device vendor ID to be advertised to the DHCP server. This must match the vendor id configured at the DHCP server when using DHCP option 43 to obtain the iSCSI target .

`chap=<enabled|disabled>`	Enables or disables the use of Challenge Handshake Protocol (CHAP) to authenticate the iSCSI connection.
	
	Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).
	
	To be valid, this option also requires the following sub-options to be specified:
	
	`username=<initiator username>`
	
	`secret=<initiator password>`
	
	Example:
	
	`sfboot boot-type=iscsi chap=enabled username=initiatorusername secret=initiatorsecret`

Table 59: Sfboot Parameters

Parameter	Description
`username=<username>`	Specifies the CHAP initiator username (maximum 64 characters). Note that this option is required if either CHAP or Mutual CHAP is enabled (`chap=enabled`, `mutual-chap=enabled`). Note that if there are spaces contained in `<username>`, then it must be wrapped in double quotes (“”). Example: `sfboot boot-type=iscsi chap=enabled username=username`
`secret=<secret>`	Specifies the CHAP initiator secret (minimum 12 characters, maximum 20 characters). Note that this option is valid if either CHAP or Mutual CHAP is enabled (chap=enabled, `mutual-chap=enabled`). Note that if there are spaces contained in `<secret>`, then it must be wrapped in double quotes (“”). Example: `sfboot boot-type=iscsi chap=enabled username=username secret=veryverysecret`

`mutual-chap=<enabled|disabled>`	Enables/disables Mutual CHAP authentication when iSCSI booting is enabled.
	
	This option also requires the following sub-options to be specified:
	
	`target-username=<username>`
	
	`target-secret=<password>`
	
	`username=<username>`
	
	`secret=<password>`
	
	Example:
	
	`sfboot boot-type=iscsi mutual-chap=enabled username=username secret=veryverysecret target-username=targetusername target-secret=anothersecret`

Table 59: Sfboot Parameters

Parameter	Description
`target-username=<username>`	Specifies the username that has been configured on the iSCSI target (maximum 64 characters). Note that this option is necessary if Mutual CHAP is enabled on the adapter (`mutual-chap=enabled`). Note that if there are spaces contained in `<username>`, then it must be wrapped in double quotes (“”).
`target-secret=<secret>`	Specifies the secret that has been configured on the iSCSi target (minimum 12 characters; maximum 20 characters). Note: This option is necessary if Mutual CHAP is enabled on the adapter (`mutual-chap=enabled`). Note that if there are spaces contained in `<secret>`, then it must be wrapped in double quotes (“”).
`mpio-priority=<MPIO priority>`	Specifies the Multipath I/O (MPIO) priority for the adapter. This option is only valid for iSCSI booting over multi-port adapters, where it can be used to establish adapter port priority. The range is 1- 255, with 1 being the highest priority.
`mpio-attempts=<attempt count>`	Specifies the number of times MPIO will try and use each port in turn to login to the iSCSI target before failing.
`msix-limit=<32|1024>`	Specifies the maximum number of MSI-X interrupts the specified adapter will use. The default is 32. Note: Using the incorrect setting can impact the performance of the adapter. Contact Solarflare technical support before changing this setting.

Sfboot: Examples

- Show the current boot configuration for all adapters:

Sfboot

```
Solarflare boot configuration utility [v3.0.3]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

eth1:
  Boot image                      Option ROM and UEFI
    Link speed                    Negotiated automatically
    Link-up delay time            5 seconds
    Banner delay time             2 seconds
    Boot skip delay time          5 seconds
    Boot type                     Disabled
  MSI-X interrupt limit           32

eth2:
  Boot image                      Option ROM and UEFI
    Link speed                    Negotiated automatically
    Link-up delay time            5 seconds
    Banner delay time             2 seconds
    Boot skip delay time          5 seconds
    Boot type                     Disabled
  MSI-X interrupt limit           32
```

5.8 Upgrading Adapter Firmware with Sfupdate

Sfupdate is a command line utility used to manage and upgrade the Solarflare adapter Boot ROM, Phy and adapter firmware. Embedded within the sfupdate executable is firmware images for various Solarflare adapters - the exact updates available via sfupdate are therefore depend on your adapter.

Sfupdate: Command Usage

Log in to the VMware Service Console as root, and enter the following command:

```
sfupdate [--adapter=vmnicX] [options]
```

where:

`vmnicX` is the interface name of the Solarflare adapter you want to upgrade. Specifing the adapter is optional - if it is not included the command is applied to all Solarflare adapters in the machine.

`option` is one of the command options listed in Table 60.

The format for the options are:

```
<option>=<parameter>
```

Running the command `sfupdate` with no additional parameters will show the current firmware version for all Solarflare adapters and whether the firmware within sfupdate is more up to date. To update the firmware for all Solarflare adapters run the command `sfupdate --write`

Solarflare recommend that you use sfupdate in the following way:

1. Run `sfupdate` to check that the firmware on all your adapters are up to date.
2. Run `sfupdate --write` to update the firmware on all adapters.

Sfupdate: Command Line Options

Table 60 lists the options for `sfupdate`.

Table 60: Sfupdate Options

Option	Description
`-h, --help`	Shows help for the available options and command line syntax.
`-v, --verbose`	Verbose output mode.
`-s, --silent`	Suppress all output except errors. Useful for scripting.
`-V, --version`	DIsplay version number information and exit.

Table 60: Sfupdate Options

Option	Description
`-i, --adapter=vmnicX`	Specifies the target adapter when more than one adapter is installed in the local host. vmnicX = Adapter interface name or MAC address (as obtained with `--list`).
`--list`	Shows the adapter ID, adapter name and MAC address of each adapter installed in the local host, or on the target when `--computer` is specified.
`--write`	Writes the firmware from the images embedded in `sfupdate`. To use an external image, specify `--image=<filename>` in the command. `--write` fails if the embedded image is the same or a previous version to that in the adapter. To force a write in this case, specify `--force` in the command.
`--force`	Force update of all firmware, even if the installed firmware version is the same or more recent. If required, use this option with `--write`.
`--image=<filename>`	Specifies a specific firmware image. This option is not normally required and is only necessary if you need to provide writing the `sfupdate` embedded image file.
`-y, --yes`	Prompts for user confirmation before writing the firmware.

Sfupdate: Examples

- List all Solarflare adapters installed on the host with the installed firmware:

```
sfupdate
```

```
Solarflare firmware update utility [v3.0.3]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

eth1 - MAC: 00-0F-53-01-39-70
    Firmware version:   v3.0.3
    PHY type:           QT2025C
    PHY version:        v2.0.2.5
    Controller type:    Solarflare SFC4000
    Controller version: v3.0.3.2127
    BootROM version:    v3.0.3.2127

The PHY firmware is up to date
The BootROM firmware is up to date
The controller firmware is up to date

eth2 - MAC: 00-0F-53-01-39-71
    Firmware version:   v3.0.2
    PHY type:           QT2025C
    PHY version:        v2.0.2.5

The PHY firmware is up to date
```


5.9 Performance Tuning on VMware

Introduction

The Solarflare family of network adapters are designed for high-performance network applications. The adapter driver is pre-configured with default performance settings that have been designed to give good performance across a broad class of applications. In many cases, application performance can be improved by tuning these settings to best suit the application.

There are three metrics that should be considered when tuning an adapter:

- Throughput
- Latency
- CPU utilization

Different applications may be more or less affected by improvements in these three metrics. For example, transactional (request-response) network applications can be very sensitive to latency whereas bulk data transfer applications are likely to be more dependent on throughput.

The purpose of this section is to highlight adapter driver settings that affect the performance metrics described. This guide covers the tuning of all members of the Solarflare family of adapters. Performance between adapters should be identical, with the exception of latency measurements.

Latency will be affected by the type of physical medium used: CX4, XFP, 10GBase-T or SFP+. This is because the physical media interface chip (PHY) used on the adapter can introduce additional latency.

Tuning Settings

Install VMware Tools in the Guest Platform

Installing VMware tools will give greatly improved networking performance in the guest. If VMware Tools are not installed, ESX emulates a PC-Lance device in the guest. If VMware Tools are installed, the guest will see a virtual adapter of type vmxnet.

To check that VMware Tools are installed:

1. From the **VMware Infrastructure Client,** power on the virtual machine and click the **Summary** tab.
2. In the **General** panel, check the status of **VMware Tools**.

To install VMware Tools:

1. Power on the virtual machine
2. From the **Inventory > Virtual Machine** menu, select **Install/Upgrade VMware Tools**.

This will mount a virtual CD-ROM in the guest OS. If the guest OS is Windows, it can autorun the CD and install tools (if not, navigate to the CD-ROM device and run the setup program yourself). If the guest is a Linux OS, you must mount the CD, install the tools, and configure them. For example, if the guest is Red Hat:

```
# mount /dev/cdrom /mnt
# rpm –i /mnt/VMwareTools*.rpm
# vmware-tools-config.pl
```

VMware ESX NetQueue

Solarflare adapters supports VMware's NetQueue technology, which accelerates network performance in 10 Gigabit Ethernet virtualized environments. NetQueue is enabled by default in VMware versions. There is usually no reason not to enable NetQueue.

NOTE: VMware NetQueue accelerates both receive and transmit traffic.

Binding NetQueue queues and Virtual Machines to CPUs

Depending on the workload, NetQueue can show improved performance if each of the queues' associated interrupt and the virtual machine are pinned to the same CPU. This is particularly true of workloads where sustained high bandwidth is evenly distributed across multiple virtual machines (such as you might do when benchmarking). To pin a Virtual Machine to one or more CPUs:

1. Log in to the VMware Infrastructure Client.
2. Expand the host and select the virtual machine to pin from the inventory panel.
3. Select the **Summary** tab for that virtual machine.
4. Click **Edit Settings**.
5. From the resulting dialog box select the **Resources** tab
6. Click **Advanced CPU** on the left.
7. Select the CPU(s) to which the virtual machine is to be bound (on the right hand side of the dialog box).

To bind a queue's interrupt to a CPU, from the VMware ESX console OS enter:

```
# echo move $IRQVEC $CPU > /proc/vmware/intr-tracker
```

(Where `$IRQVEC` is the interrupt vector in hex, and `$CPU` is the CPU number in decimal.)

To determine the value for `$IRQVEC` enter:

```
# cat /proc/vmware/interrupts
```

Locate the interrupts associated with the Solarflare adapter (e.g. vmnic2). Interrupts are listed in order: the first interrupt will be for the **default** queue, the second interrupt for the queue dedicated to the first virtual machine to have been started, the third interrupt for the queue dedicated to the second virtual machine to have been started, and so on.

If there are more virtual machine's than CPUs on the host, optimal performance is obtained by pinning each virtual machine and associated interrupt to the same CPU. If there are fewer virtual machines than CPUs, optimal results are obtained by pinning the virtual machine and associated interrupt respectively to two cores which share an L2 cache.

Adapter MTU (Maximum Transmission Unit)

The default MTU of 1500 bytes ensures that the adapter is compatible with legacy 10/100Mbps Ethernet endpoints. However if a larger MTU is used, adapter throughput and CPU utilization can be improved. CPU utilization is improved because it takes fewer packets to send and receive the same amount of data. Solarflare adapters support frame sizes up to 9216 bytes (this does not include the Ethernet preamble or frame-CRC).

Since the MTU should ideally be matched across all endpoints in the same LAN (VLAN), and since the LAN switch infrastructure must be able to forward such packets, the decision to deploy a larger than default MTU requires careful consideration. It is recommended that experimentation with MTU be done in a controlled test environment.

To change the MTU of the vSwitch, from the VMware Console OS enter:

```
# esxcfg-vswitch --mtu <size> <vSwitch>
```

To verify the MTU settings, as well as obtaining a list of vSwitches installed on the host, enter:

```
# esxcfg-vswitch --list
```

The change in MTU size of the vSwitch will persist across reboots of the VMware ESX host.

Interrupt Moderation (Interrupt Coalescing)

Interrupt moderation controls the number of interrupts generated by the adapter by adjusting the extent to which receive packet processing events are coalesced. Interrupt moderation may coalesce more than one packet-reception or transmit-completion event into a single interrupt.

By default, adaptive moderation is enabled. Adaptive moderation means that the network driver software adapts the interrupt moderation setting according to the traffic and workloads it sees.

Alternatively, you can set the moderation interval manually. You would normally only do this if you are interested in reducing latency. To do this you must first disable adaptive moderation with the following command, where `vmnicX` is the interface name.

```
ethtool -C <vmnicX> adaptive-rx off
```

> **NOTE:** `adaptive-rx` may already have been disabled. Consult your VMware documentation for details.

Interrupt moderation can be changed using ethtool, where vmnicX is the interface name and interval is the moderation setting in microseconds (µs). Specifying 0 as the interval parameter will turn interrupt moderation off:

```
ethtool –C <vmnicX> rx-usecs-irq <interval>
```

Verification of the moderation settings may be performed by running `ethtool –c`

This parameter is critical for tuning adapter latency. Increasing the moderation value will increase latency, but reduce CPU utilization and improve peak throughput, if the CPU is fully utilized. Decreasing the moderation value or turning it off will decrease latency at the expense of CPU utilization and peak throughput. However, for many transaction request-response type network applications, the benefit of reduced latency to overall application performance can be considerable. Such benefits may outweigh the cost of increased CPU utilization.

> **NOTE:** The interrupt moderation time dictates the minimum gap between two consecutive interrupts. It does not mandate a delay on the triggering of an interrupt on the reception of every packet. For example, an interrupt moderation setting of 30µs will not delay the reception of the first packet received, but the interrupt for any following packets will be delayed until 30µs after the reception of that first packet.

TCP/IP Checksum Offload

Checksum offload moves calculation and verification of IP Header, TCP and UDP packet checksums to the adapter. The driver by default has all checksum offload features enabled. Therefore, there is no opportunity to improve performance from the default.

Checksum offload is controlled using ethtool:

Receive Checksum:

```
# /sbin/ethtool –K <vmnicX> rx <on|off>
```

Transmit Checksum:

```
# /sbin/ethtool –K <vmnicX> tx <on|off>
```

Verification of the checksum settings may be performed by running ethtool with the –k option. Solarflare recommend you do not disable checksum offload.

For advice on configuring checksum offload in the guest, consult the relevant Solarflare section for that guest, or the documentation for the guest operating system.

TCP Segmentation Offload (TSO)

TCP Segmentation offload (TSO) offloads the splitting of outgoing TCP data into packets to the adapter. TCP segmentation offload benefits applications using TCP. Non TCP protocol applications will not benefit (but will not suffer) from TSO.

Enabling TCP segmentation offload will reduce CPU utilization on the transmit side of a TCP connection, and so improve peak throughput, if the CPU is fully utilized. Since TSO has no effect on latency, it can be enabled at all times. The driver has TSO enabled by default. Therefore, there is no opportunity to improve performance from the default.

NOTE: TSO cannot be controlled via the host on VMware ESX. It can only be controlled via the guest Operating System.

TCP Large Receive Offload (LRO)

TCP Large Receive Offload (LRO) is a feature whereby the adapter coalesces multiple packets received on a TCP connection into a single call to the operating system TCP Stack. This reduces CPU utilization, and so improves peak throughput when the CPU is fully utilized.

LRO should not be enabled if you are using the host to forward packets from one interface to another; for example if the host is performing IP routing or acting as a layer2 bridge.

LRO is supported, and enabled by default, on VMware versions later than ESX 3.5.

TCP Protocol Tuning

TCP Performance can also be improved by tuning kernel TCP settings. Settings include adjusting send and receive buffer sizes, connection backlog, congestion control, etc.

Typically it is sufficient to tune just the max buffer value. It defines the largest size the buffer can grow to. Suggested alternate values are max=500000 (1/2 Mbyte). Factors such as link latency, packet loss and CPU cache size all influence the affect of the max buffer size values. The minimum and default values can be left at their defaults minimum=4096 and default=87380.

For advice on tuning the guest TCP stack consult the documentation for the guest operating system.

Receive Side Scaling (RSS)

Solarflare adapters support Receive Side Scaling (RSS). RSS enables packet receive-processing to scale with the number of available CPU cores. RSS requires a platform that supports MSI-X interrupts. RSS is enabled by default.

When RSS is enabled the controller uses multiple receive queues into which to deliver incoming packets. The receive queue selected for an incoming packet is chosen in such a way as to ensure that packets within a TCP stream are all sent to the same receive queue – this ensures that packet-ordering within each stream is maintained. Each receive queue has its own dedicated MSI-X interrupt which ideally should be tied to a dedicated CPU core. This allows the receive side TCP processing to be distributed amongst the available CPU cores, providing a considerable performance advantage over a conventional adapter architecture in which all received packets for a given interface are processed by just one CPU core.

RSS will be enabled whenever NetQueue is not and Solarflare recommend using NetQueue on VMware ESX hosts.

Other Considerations

PCI Express Lane Configurations

The PCI Express (PCIe) interface used to connect the adapter to the server can function at different widths. This is independent of the physical slot size used to connect the adapter. The possible widths are multiples x1, x2, x4, x8 and x16 lanes of (2.5Gbps for PCIe Gen. 1, 5.0 Gbps for PCIe Gen. 2) in each direction. Solarflare Adapters are designed for x8 lane operation.

On some server motherboards, choice of PCIe slot is important. This is because some slots (including ones that are physically x8 or x16 lanes) may only electrically support x4 lanes. In x4 lane slots, Solarflare PCIe adapters will continue to operate, but not at full speed. The Solarflare driver will warn you if it detects the adapter is plugged into a PCIe slot which electrically has fewer than x8 lanes.

For SFN5xxxx adapters, which require a PCIe Gen. 2 slot for optimal operation, a warning will be given if they are installed in a PCIe Gen. 1 slot. Warning messages can be viewed in `dmesg` from `/var/log/messages`.

Memory bandwidth

Many chipsets/CPUs use multiple channels to access main system memory. Maximum memory performance is only achieved when the server can make use of all channels simultaneously. This should be taken into account when selecting the number of DIMMs to populate in the server. Consult your motherboard documentation for details.

Intel® QuickData

Intel® QuickData Technology allows VMware ESX to data copy by the chipset instead of the CPU, to move data more efficiently through the server and provide fast, scalable, and reliable throughput.

I/O AT can be enabled on the host and on guest operating systems. For advice on enabling I/OAT in the guest, consult the relevant Solarflare section for that guest, or the documentation for the guest operating system. I/OAT must be enabled on the host if it is to be used in the guests.

To enable I/OAT on the VMware ESX host:

On some systems the hardware associated with I/OAT must first be enabled in the BIOS

Log in to the ConsoleOS on the VMware ESX host, and enter:

```
# esxcfg-advcfg -s 1 /Net/TcpipUseIoat
```

Reboot the VMware ESX host

To verify I/OAT is enabled, from the ConsoleOS enter:

```
# vmkload_mod -l | grep -i ioat
```

NOTE: The following VMware KB article should be read when enabling I/OAT.

http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1003712

Server Motherboard, Server BIOS, Chipset Drivers

Tuning or enabling other system capabilities may further enhance adapter performance. Readers should consult their server user guide. Possible opportunities include tuning PCIe memory controller (PCIe Latency Timer setting available in some BIOS versions).

Chapter 6: Solarflare Adapters on Solaris

This chapter covers the following topics on the Solaris platform:

6.1 System Requirements

Refer to Software Driver Support on page 13 for details of supported Solaris distributions.

Solarflare drivers for Solaris support the GLDv3 API, but do not support the Crossbow API framework.

6.2 Solaris Platform Feature Set

Table 61 lists the features supported by Solarflare adapters on Solaris.

Table 61: Solaris Feature Set

Jumbo frames	Support for MTUs (Maximum Transmission Units) to 9000 bytes. • See Configuring Jumbo Frames on page 285
Task offloads	Support for TCP Segmentation Offload (TSO), Large Receive Offload (LRO), and TCP/UDP/IP checksum offload for improved adapter performance and reduced CPU processing requirements. • See Configuring Task Offloading on page 285
Receive Side Scaling (RSS)	Support for RSS multi-core load distribution technology. • See Receive Side Scaling (RSS) on page 303
Virtual LANs (VLANs)	Support for multiple VLANs per adapter. • See Setting Up VLANs on page 286
PXE and booting	Support for diskless booting to a target operating system via PXE or iSCSI boot. • See Configuring the Boot ROM with sfboot on page 286 • See Solarflare Boot ROM Agent on page 360
Firmware updates	Support for Boot ROM, PHY transceiver and adapter firmware upgrades. • See Upgrading Adapter Firmware with Sfupdate on page 297

6.3 Installing Solarflare Drivers

The Solaris drivers for Solarflare are available in a binary package for both 32 and 64 bit platforms.

- A driver package (pkg format) is available for Solaris 10.8, 10.9 and 10.10.
- A driver package (pkg format) is available for Solaris 11.0.

> **NOTE:** The Solarflare adapter should be physically installed in the host computer before you attempt to install drivers. You must have root permissions to install the adapter drivers.

1 As a root user enter:

```
pkgadd -d SFCsfxge_sol10_i386_<version>.pkg SFCsfxge
```

or

```
pkgadd -d SFCsfxge_sol11_i386_<version>.pkg SFCsfxge
```

Output similar to the following will be displayed:

```
Solarflare 10GE NIC Driver(i386) <DRIVER VERSION>
<LICENSE INFO>
This package contains scripts which will be executed with super-user
permission during the process of installing this package.
Do you want to continue with the installation of <SFCsfxge> [y,n,?]
```

2 Enter 'y'. The installation will continue.

3 The following information will be displayed:

```
Installing Solarflare 10GE NIC Driver as <SFCsfxge>
## Installing part 1 of 1.
/kernel/drv/amd64/sfxge
/kernel/drv/sfxge
[ verifying class <none> ]
## Executing postinstall script.
Installation of <SFCsfxge> was successful.
```


6.4 Unattended Installation Solaris 10

Unattended installations of Solaris 10 are done via JumpStart. For general information on JumpStart see:

http://www.oracle.com/technetwork/articles/servers-storage-admin/installjumpstartons11ex-219229.html

The process for using JumpStart is as follows:

- Create a JumpStart installation server
- Create the client configuration files
- Share the client tftpboot files
- Configure and run the DHCP Server
- Perform a hands-off JumpStart installation

These processes are documented here:

http://docs.oracle.com/cd/E19253-01/819-6397/819-6397.pdf

NOTE: The Solarflare server adapter can be used to PXE boot the installer, but as there is no driver, the adapter can not be used during installation.

To install the Solarflare Solaris package as part of an unattended installation, it must be added using the **package** command to the JumpStart machine profile. The package can reside on a local disk or on a HTTP or NFS server. For more information, see:

http://search.oracle.com/sear ch/
search?start=1&search_p_main_operator=all&q=package+command&group=Technology+Networ

The following are example lines for a JumpStart profile:

```
package SFCsfxge add local_device <device> <path> <file_system_type>
package SFCsfxge add http://<server_name>[:<port>] <path> [<options>]
package SFCsfxge add nfs://<server_name>:/<path> [retry <n>]
```


Table 62 shows an example time line for an unattended installation.

Table 62: Installation Stages

In Control	Stages of Boot	Setup needed
BIOS	PXE code on the adapter runs.	Adapter must be in PXE boot mode. See PXE Support on page 361.
SF Boot ROM (PXE)	DHCP request from PXE (SF Boot ROM).	Jumpstart server must be installed and configured.
SF Boot ROM (PXE)	TFTP request for filename to next-server, e.g. pxegrub.0	
pxegrub	TFTP retrieval of grub configuration.	
pxegrub	TFTP menu retrieval of Solaris kernel image.	
Solaris kernel/installer	Installer retrieves configuration.	
Installation occurs	Machine reboots	
Target Solaris kernel	kernel reconfigures network adapters.	DHCP server.

6.5 Unattended Installation Solaris 11

Please refer to the Oracle Solaris 11 documentation for details of transitioning from Solaris 10 to 11 or for details of the Automated Installer feature for Solaris 11.

https://blogs.oracle.com/unixman/entry/how_to_get_started_with

https://blogs.oracle.com/unixman/entry/migrating_from_jumpstart_to_automated

6.6 Configuring the Solarflare Adapter

> **NOTE:** The examples below demonstrate the **Solaris 10.x** configuration command. **Solaris 11** users should refer to Solaris documentation for the equivalent Solaris 11 configuration commands.

The drivers will be loaded as part of the as part of the installation. However the adapter will not be plumbed (implement the TCP/IP stack) or configured (adding IP address and netmask).

Each Solarflare network adapter interface will be named `sfxge<x>` where <x> is a unique identifier. There will be one interface per physical port on the Solarflare adapter.

To plumb an interface enter the following:

```
ifconfig sfxge<x> plumb
```

You then need to configure the interface and bring it up to allow data to pass. Enter the following:

```
ifconfig sfxge<x> <IPv4 address> netmask <netmask> up
```

This configures the interface and initializes it with the up command.

> **NOTE:** This method of plumbing and configuring is temporary. If you reboot your computer the settings will be lost. To make these settings permanent, create the configuration files as described below.

Using IPv6

To plumb and configure using IPv6, enter the following:

```
ifconfig sfxge<x> inet6 plumb
ifconfig sfxge<x> inet6 up
```

Then create an IPv6 interface sfxge<x> interface with a link local IPv6 address by entering:

```
ifconfig sfxge<x> inet6 addif <IPv6 address>/<ipv6 prefix length> up
```

This will give an IPv6 interface name of sfxge<x>:1

Using Configuration Files with IPv4

There are three options when using a configuration file with IPv4:

1 Using a static IPv4 address. To use this option, add `<IPv4 address> <netmask>` to:

`/etc/hostname.sfxge<x>`

2 Using a static IPv4 hostname. To use this option, add `<hostname>` to:

`/etc/hostname.sfxge<x>`

And modify `/etc/hosts` and `/etc/netmasks`

3 Using DHCP. To use this option, enter:

`touch /etc/hostname.sfxge<4>` and


```
touch /etc/dhcp.sfxge<4>
```

Using Configuration files with IPv6

To make the interface settings permanent, you need to create the following file per interface:

`/etc/hostname6.sfxge<x>`

This enables the interface to be plumbed and configured when the computer is booted. For example:

```
touch /hostname6.sfxge<x>
```

For a static IP address, add your IPv6 address to `/etc/hostname6.sfxge<x>`.

Or add your hostname to `/etc/hostname6.sfxge<x>` and edit the following:

`/etc/hosts`

DHCP and IPv6

Unlike for IPv4, no file is required for DHCP in. The DHCP Daemons are automatically started. Consult the `man dhcp` pages for more details.

Configuring Task Offloading

Solarflare adapters support IPv4 TCP and UDP transmit (Tx) and receive (Rx) checksum offload, as well as TCP segmentation offload. To ensure maximum performance from the adapter, all task offloads should be enabled, which is the default setting on the adapter. For more information, see Performance Tuning on Solaris on page 300.

Configuring Jumbo Frames

The maximum driver MTU size can be set in `sfxge.conf`. This setting is applied across all Solarflare adapters. The default setting in `sfxge.conf` is 1500.

Solarflare adapters support frame sizes from 1500 bytes to 9000 bytes. For example, to set a new frame size (MTU) of 9000 bytes, enter the following command:

```
$ ifconfig sfxge<x> mtu 9000
```

To view the current MTU, enter:

```
$ ifconfig sfxge<x>

sfxge0: flags=1001000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4> mtu 9000
```

If you want to have an MTU configure when the interface is brought up add `mtu` to the single line of configuration data in `/etc/hostname.sfxge<X>`. For example:

```
[<IP address>] mtu <size>
```


6.7 Setting Up VLANs

VLANs offer a method of dividing one physical network into multiple broadcast domains. In enterprise networks, these broadcast domains usually match with IP subnet boundaries, so that each subnet has its own VLAN. The advantages of VLANs include:

- Performance
- Ease of management
- Security
- Trunks
- You don't have to configure any hardware device, when physically moving your server to another location.

To have a single interface exist on multiple VLANs (if the port on the connected switch is set to "trunked" mode) see the "How to Configure a VLAN" section in the following documentation:

http://docs.oracle.com/cd/E19253-01/816-4554/fpdga/index.html

6.8 Solaris Utilities Package

The Solarflare Solaris Utilities package, supplied as a 32 bit SVR package and available from https://support.solarflare.com/ contains the following utilities:

Table 63: Utilities Package

Utility File	Description
`sfupdate`	A command line utility that contains an adapter firmware version which can update Solarflare adapter firmware.
`sfboot`	A command line utility to configure the Solarflare adapter Boot ROM for PXE and iSCSI booting.
`sfreport`	A command line utility that generates a diagnostic log file providing diagnostic data about the server and Solarflare adapters.

Once installed (`pkgadd -d SFCutils_i386_v<version>.pkg`), by default, utility files are located in the `/opt/SFCutils/bin` directory.

6.9 Configuring the Boot ROM with sfboot

Sfboot is a command line utility for configuring the Solarflare adapter Boot ROM for PXE and iSCSI booting. Using sfboot is an alternative to using **Ctrl + B** to access the Boot Rom agent during server startup.

See Configuring the Solarflare Boot ROM Agent on page 360 for more information on the Boot Rom agent.

Sfboot: Command Usage

The general usage for sfboot is as follows (as root):

```
sfboot [--adapter=sfxge<x>] [options] [parameters]
```

Note that without `--adapter`, the `sfboot` command applies to all adapters that are present in the target host.

The format for the parameters are:

```
<parameter>=<value>
```


Sfboot: Command Line Options

Table 64 lists the options for `sfboot` and Table 65 lists the available parameters.

Table 64: Sfboot Options

Option	Description
`-h, --help`	Displays command line syntax and provides a description of each sfboot option.
`-V, --version`	Shows detailed version information and exits.
`-v, --verbose`	Shows extended output information for the command entered.
`-s, --silent`	Suppresses all output, including warnings and errors; no user interaction. You should query the completion code to determine the outcome of commands when operating silently (see Performance Tuning on Windows on page 236).
`--log <filename>`	Logs output to the specified file in the current folder or an existing folder. Specify `--silent` to suppress simultaneous output to screen, if required.
`--computer <computer_name>`	Performs the operation on a specified remote computer. Administrator rights on the remote computer is required.
`--list`	Lists all available Solarflare adapters. This option shows the adapter's ID number, ifname and MAC address. Note: this option may not be used in conjunction with the any other option. If this option is used with configuration parameters, those parameters will be silently ignored.
`-d, --adapter =<sfxge<N>>`	Performs the action on the identified Solarflare network adapter. The adapter identifier `sfxge` can be the adapter ID number, ifname or MAC address, as output by the --`list` option. If `--adapter` is not included, the action will apply to all installed Solarstorm adapters.
`--clear`	Resets all adapter options except `boot-image` to their default values. Note that `--clear` can also be used with parameters, allowing you to reset to default values, and then apply the parameters specified.

The following parameters in Table 65 are used to control the options for the Boot ROM driver when running prior to the operating system booting.

Table 65: Sfboot Parameters

Parameter	Description
`boot-image =<all|optionrom|uefi|disabled>`	Specifies which boot firmware images are served-up to the BIOS during start-up. This parameter can not be used if the `--adapter` option has been specified. This option is not reset if `--clear` is used.
`link-speed=` `<auto|10g|1g|100m>`	Specifies the network link speed of the adapter used by the Boot ROM the default is `auto.` On the 10GBASE-T adapters "auto" instructs the adapter to negotiate the highest speed supported in common with it's link partner . On SFP+ adapters, "auto" instructs the adapter to use the highest link speed supported by the inserted SFP+ module. On 10GBASE-T and SFP+ adapters, any other value specified will fix the link at that speed, regardless of the capabilities of the link partner, which may result in an inability to establish the link `auto` Auto-negotiate link speed (default) `10G` 10G bit/sec `1G` 1G bit/sec `100M` 100M bit/sec
`linkup-delay=<seconds>`	Specifies the delay (in seconds) the adapter defers its first connection attempt after booting, allowing time for the network to come up following a power failure or other restart. This can be used to wait for spanning tree protocol on a connected switch to unblock the switch port after the physical network link is established. The default is 5 seconds.
`banner-delay=<seconds>`	Specifies the wait period for **Ctrl-B** to be pressed to enter adapter configuration tool. `seconds` = 0-256
`bootskip-delay=<seconds>`	Specifies the time allowed for **Esc** to be pressed to skip adapter booting. `seconds` = 0-256

Table 65: Sfboot Parameters

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>boot-type=<pxe|iscsi|disabled></td><td>Sets the adapter boot type.
pxe – PXE (Preboot eXecution Environment) booting
iscsi – iSCSI (Internet Small Computer System Interface) booting
disabled – Disable adapter booting</td></tr>
<tr><td>initiator-dhcp=<enabled|disabled></td><td>Enables or disables DHCP address discovery for the adapter by the Boot ROM except for the Initiator IQN (see initiator-iqn-dhcp). This option is only valid if iSCSI booting is enabled (boot-type=iscsi).
If initiator-DHCP is set to disabled, the following options will need to be specified:
initiator-ip=<ip_address>
netmask=<subnet>
The following options may also be needed:
gateway=<ip_address>
primary-dns=<ip_address></td></tr>
<tr><td>initiator-ip=<ipv4 address></td><td>Specifies the IPv4 address (in standard “.” notation form) to be used by the adapter when initiator-dhcp is disabled.
Note that this option is only valid if iSCSI booting is enabled (boot-type=iscsi).
Example:
sfboot boot-type=iscsi initiator-dhcp=disabled initiator-ip=<192.168.1.3></td></tr>
<tr><td>netmask=<ipv4 subnet></td><td>Specifies the IPv4 subnet mask (in standard “.” notation form) to be used by the adapter when initiator-dhcp is disabled. Note that this option is only valid if iSCSI booting is enabled (boot-type=iscsi).
Example:
sfboot boot-type=iscsi initiator-dhcp=disabled netmask=255.255.255.0</td></tr>
</table>

Table 65: Sfboot Parameters

Parameter	Description
`gateway=<ipv4 address>`	Specifies the IPv4 subnet mask (in standard "." notation form) to be used by the adapter when `initiator-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled gateway=192.168.0.10`
`primary-dns=<ipv4 address>`	Specifies the IPv4 address (in standard "." notation form) of the Primary DNS to be used by the adapter when `initiator-dhcp` is disabled. This option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi initiator-dhcp=disabled primary-dns=192.168.0.3`
`initiator-iqn-dhcp=<enabled|disabled>`	Enables or disables use of DHCP for the initiator IQN only.
`initiator-iqn=<IQN>`	Specifies the IQN (iSCSI Qualified Name) to be used by the adapter when `initiator-iqn-dhcp` is disabled. The IQN is a symbolic name in the "." notation form; for example: iqn.2009.01.com.solarflare, and is a maximum of 223 characters long. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot initiator-iqn-dhcp=disabled initiator-iqn=iqn.2009.01.com.solarflare adapter=2`
`lun-retry-count=<count>`	Specifies the number of times the adapter attempts to access and login to the Logical Unit Number (LUN) on the iSCSI Target before failing. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot lun-retry-count=3`

Table 65: Sfboot Parameters

Parameter	Description

`target-dhcp=<enabled|disabled>`	Enables or disables the use of DHCP to discover iSCSI target parameters on the adapter.
	
	If `target-dhcp` is disabled, you must specify the following options:
	
	`target-server=<address>`
	`target-iqn=<iqn>`
	`target-port=<port>`
	`target-lun=<LUN>`
	
	Example - Enable the use of DHCP to configure iSCSI Target settings:
	
	`sfboot boot-type=iscsi target-dhcp=enabled`

`target-server=<DNS name or ipv4 address>`	Specifies the iSCSI target's DNS name or IPv4 address to be used by the adapter when `target-dhcp` is disabled. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi target-dhcp=disabled target-server=192.168.2.2`
`target-port=<port_number>`	Specifies the Port number to be used by the iSCSI target when `target-dhcp` is disabled. The default Port number is Port 3260. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Example: `sfboot boot-type=iscsi target-dhcp=disabled target-port=3262` This option should only be used if your target is using a non-standard TCP Port.
`target-lun=<LUN>`	Specifies the Logical Unit Number (LUN) to be used by the iSCSI target when `target-dhcp` is disabled. The default LUN is 0. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).

Table 65: Sfboot Parameters

Parameter	Description
`target-iqn=<IQN>`	Specifies the IQN of the iSCSI target when `target-dhcp` is disabled. Maximum of 223 characters. Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`). Note that if there are spaces contained in `<IQN>`, then the IQN must be wrapped in double quotes (“”). Example: `sfboot target-dhcp=disabled target-iqn=iqn.2009.01.com.solarflare adapter=2`
`vendor-id=<dhcp_id>`	Specifies the device vendor ID to be advertised to the DHCP server. This must match the vendor id configured at the DHCP server when using DHCP option 43 to obtain the iSCSI target .

`chap=<enabled|disabled>`	Enables or disables the use of Challenge Handshake Protocol (CHAP) to authenticate the iSCSI connection.
	
	Note that this option is only valid if iSCSI booting is enabled (`boot-type=iscsi`).
	
	To be valid, this option also requires the following sub-options to be specified:
	
	`username=<initiator username>`
	
	`secret=<initiator password>`
	
	Example:
	
	`sfboot boot-type=iscsi chap=enabled username=initiatorusername secret=initiatorsecret`

Table 65: Sfboot Parameters

Parameter	Description
`username=<username>`	Specifies the CHAP initiator username (maximum 64 characters). Note that this option is required if either CHAP or Mutual CHAP is enabled (`chap=enabled`, `mutual-chap=enabled`). Note that if there are spaces contained in `<username>`, then it must be wrapped in double quotes (“”). Example: `sfboot boot-type=iscsi chap=enabled username=username`
`secret=<secret>`	Specifies the CHAP initiator secret (minimum 12 characters, maximum 20 characters). Note that this option is valid if either CHAP or Mutual CHAP is enabled (chap=enabled, `mutual-chap=enabled`). Note that if there are spaces contained in `<secret>`, then it must be wrapped in double quotes (“”). Example: `sfboot boot-type=iscsi chap=enabled username=username secret=veryverysecret`

`mutual-chap=<enabled|disabled>`	Enables/disables Mutual CHAP authentication when iSCSI booting is enabled.
	
	This option also requires the following sub-options to be specified:
	
	`target-username=<username>`
	
	`target-secret=<password>`
	
	`username=<username>`
	
	`secret=<password>`
	
	Example:
	
	`sfboot boot-type=iscsi mutual-chap=enabled username=username secret=veryverysecret target-username=targetusername target-secret=anothersecret`

Table 65: Sfboot Parameters

Parameter	Description
`target-username=<username>`	Specifies the username that has been configured on the iSCSI target (maximum 64 characters). Note that this option is necessary if Mutual CHAP is enabled on the adapter (`mutual-chap=enabled`). Note that if there are spaces contained in `<username>`, then it must be wrapped in double quotes (“”).
`target-secret=<secret>`	Specifies the secret that has been configured on the iSCSi target (minimum 12 characters; maximum 20 characters). Note: This option is necessary if Mutual CHAP is enabled on the adapter (`mutual-chap=enabled`). Note that if there are spaces contained in `<secret>`, then it must be wrapped in double quotes (“”).
`mpio-priority=<MPIO priority>`	Specifies the Multipath I/O (MPIO) priority for the adapter. This option is only valid for iSCSI booting over multi-port adapters, where it can be used to establish adapter port priority. The range is 1- 255, with 1 being the highest priority.
`mpio-attempts=<attempt count>`	Specifies the number of times MPIO will tryand use each port in turn to login to the iSCSI target before failing.
`msix-limit=<8|16|32|64|128|256|512|1024>`	Specifies the maximum number of MSI-X interrupts the specified adapter will use. The default is 32. Note: Using the incorrect setting can impact the performance of the adapter. Contact Solarflare technical support before changing this setting.
`sriov=<enabled|disabled>`	Enable SR-IOV support for OS system that support it.
`vf-count=<vf_count>`	Number of Virtual Functions advertised to the OS. Solarflare adapters support 1024 interrupts. Depending on the value of msix-limit and vf-msic-limit, some of these Virtual Functions may not be useable.
`vf-msix-limit=<1|2|4|8>`	Maximum number of MSI-X interrupts a Virtual Function can have.

Sfboot: Examples

- Show the current boot configuration for all adapters:

```
sfboot
```

```
Solarflare boot configuration utility [v3.0.5]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005

sfxge0:
  Boot image                        Disabled
  MSI-X interrupt limit             32

sfxge1:
  Boot image                        Disabled
  MSI-X interrupt limit             32
```

- List all Solarflare adapters installed on the localhost:

```
sfboot --list
```

```
Solarflare boot configuration utility [v3.0.5]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005
sfxge0 - 00-0F-53-01-38-40
sfxge1 - 00-0F-53-01-38-41
```


6.10 Upgrading Adapter Firmware with Sfupdate

To Update Adapter Firmware

As a root user enter:

```
pkgadd -d SFCutils_i386_v<version>.pkg
```

Once installed, by default, utility tools are located in the `/opt/SFCutils/bin` directory.

Sfupdate: Command Usage

The general usage for sfupdate is as follows (as root):

```
sfupdate [--adapter=sfxge<x>] [options]
```

where:

`sfgxe<x>` is the interface name of the Solarflare adapter you want to upgrade.

`option` is one of the command options listed in Table 66.

The format for the options are:

```
--<option>=<parameter>
```

Running the command `sfupdate` with no additional parameters will show the current firmware version for all Solarflare adapters and whether the firmware within sfupdate is more up to date. To update the firmware for all Solarflare adapters run the command `sfupdate --write`

Solarflare recommend that you use sfupdate in the following way:

1. Run `sfupdate` to check that the firmware on all your adapters are up to date.
2. Run `sfupdate --write` to update the firmware on all adapters.

Sfupdate: Command Line Options

Table 66 lists the options for `sfupdate`.

Table 66: Sfupdate Options

Option	Description
`-h, --help`	Shows help for the available options and command line syntax.
`-v, --verbose`	Enable verbose output mode.
`-s, --silent`	Suppress all output except for errors. Useful for scripts.
`-V, --version`	Display version information and exit.

Table 66: Sfupdate Options

Option	Description
`-i, --adapter=sfxge<x>`	Specifies the target adapter when more than one adapter is installed in the machine. `sfxge<x>` = Adapter ifname or MAC address (as obtained with `--list`).
`--list`	Shows the adapter ID, adapter name and MAC address of each adapter installed in the machine.
`--write`	Re-writes the firmware from the images embedded in the `sfupdate` tool. To re-write using an external image, specify `--image=<filename>` in the command. `--write` fails if the embedded image is the same or a previous version. To force a write in this case, specify the option `--force`.
`--force`	Force update of all firmware, even if the installed firmware version is the same or more recent than the images embedded in the utility.
`--image=(filename)`	Update the firmware using the image contained in the specified file, rather than the image embedded in the utility. Use with the `--write` and, if needed, `--force` options.
`-y, --yes`	Prompts for user confirmation before re-writing the firmware.

Sfupdate: Examples

- Display firmware versions for all adapters:

sfupdate

```
sfupdate: Solarflare Firmware Update Utility [v3.0.5.2164]
Copyright Solarflare Communications 2006-2010, Level 5 Networks 2002-2005
Network adapter driver version: v3.0.5.2163

sfxge0 - MAC: 00:0F:53:01:38:90
    Firmware   version: v3.0.5
    Boot ROM   version: v3.0.5.2163
    PHY        version: v2.0.2.5
    Controller version: v3.0.5.2161

The Boot ROM firmware is up to date
The PHY firmware is up to date
The image contains a more recent version of the Controller [v3.0.5.2163]
vs [v3.0.5.2161]
Use the -w|--write option to perform an update

sfxge1 - MAC: 00:0F:53:01:38:91
    Firmware   version: v3.0.5
    Boot ROM   version: v3.0.5.2163
    PHY        version: v2.0.2.5
    Controller version: v3.0.5.2161

The Boot ROM firmware is up to date
The PHY firmware is up to date
The image contains a more recent version of the Controller [v3.0.5.2163]
vs [v3.0.5.2161]
Use the -w|--write option to perform an update
```

6.11 Performance Tuning on Solaris

Introduction

The Solarflare family of network adapters are designed for high-performance network applications. The adapter driver is pre-configured with default performance settings that have been chosen to give good performance across a broad class of applications. In many cases, application performance can be improved by tuning these settings to best suit the application.

There are three metrics that should be considered when tuning an adapter:

- Throughput
- Latency
- CPU utilization

Different applications may be more or less affected by improvements in these three metrics. For example, transactional (request-response) network applications can be very sensitive to latency whereas bulk data transfer applications are likely to be more dependent on throughput.

The purpose of this guide is to highlight adapter driver settings that affect the performance metrics described. This guide covers the tuning of all of the Solarflare family of adapters.

In addition to this guide, you may need to consider other issues influencing performance such as application settings, server motherboard chipset, additional software installed on the system, such as a firewall, and the specification and configuration of the LAN. Consideration of such issues is not within the scope of this guide.

Tuning settings

Adapter MTU (Maximum Transmission Unit)

The default MTU of 1500 bytes ensures that the adapter is compatible with legacy 10/100Mbps Ethernet endpoints. However if a larger MTU is used, adapter throughput and CPU utilization can be improved. CPU utilization is improved because it takes fewer packets to send and receive the same amount of data. Solarflare adapters support frame sizes up to 9000 bytes (this does not include the Ethernet preamble or frame-CRC).

Since the MTU should ideally be matched across all endpoints in the same LAN (VLAN), and since the LAN switch infrastructure must be able to forward such packets, the decision to deploy a larger than default MTU requires careful consideration. It is recommended that experimentation with MTU be done in a controlled test environment.

The MTU can be changed dynamically using `ifconfig` if the maximum MTU size has been set in the `sxfge_conf` file (see Configuring Jumbo Frames on page 285), where `sfxge<X>` is the interface name and size is the MTU size in bytes:

```
$ ifconfig sfxge<X> mtu <size>
```

Verification of the MTU setting may be performed by running `$ ifconfig sfxge<X>` with no options and checking the MTU value associated with the interface. If you want to have an MTU configure when the interface is brought up, add `mtu` to the single line of configuration data in:

```
/etc/hostname.sfxge<X>
```

For example:

```
[<IP address>] mtu <size>
```

Interrupt Moderation (Interrupt Coalescing)

Interrupt moderation controls the number of interrupts generated by the adapter by adjusting the extent to which receive packet processing events are coalesced. Interrupt moderation may coalesce more than one packet-reception or transmit-completion event into a single interrupt.

This parameter is critical for tuning adapter latency. Increasing the moderation value will increase latency, but reduce CPU utilization and improve peak throughput, if the CPU is fully utilized. Decreasing the moderation value or turning it off will decrease latency at the expense of CPU utilization and peak throughput. However, for many transaction request-response type network applications, the benefit of reduced latency to overall application performance can be considerable. Such benefits may outweigh the cost of increased CPU utilization.

> **NOTE:** The interrupt moderation time dictates the minimum gap between two consecutive interrupts. It does not mandate a delay on the triggering of an interrupt on the reception of every packet. For example, an interrupt moderation setting of 30µs will not delay the reception of the first packet received, but the interrupt for any following packets will be delayed until 30µs after the reception of that first packet.

TCP/IP Checksum Offload

Checksum offload moves calculation and verification of IP Header, TCP and UDP packet checksums to the adapter. The driver by default has all checksum offload features enabled. Therefore, there is no opportunity to improve performance from the default.

TCP Segmentation Offload (TSO)

TCP Segmentation offload (TSO) offloads the splitting of outgoing TCP data into packets to the adapter. TCP segmentation offload benefits applications using TCP. Non TCP protocol applications will not benefit (but will not suffer) from TSO.

The Solaris TCP/IP stack provides a large TCP segment to the driver, which splits the data into MSS size, each with adjusted sequence space and a hardware calculated checksum.

TCP Large Receive Offload (LRO) / RX Coalescing

LRO (called rx coalescing on Solaris) is a feature whereby the adapter coalesces multiple packets received on a TCP connection into a single call to the operating system TCP Stack. This reduces CPU utilization, and so improves peak throughput when the CPU is fully utilized.

LRO should not be enabled if you are using the host to forward packets from one interface to another; for example if the host is performing IP routing or acting as a layer2 bridge. The driver has LRO disabled by default.

TCP Protocol Tuning

TCP Performance can also be improved by tuning kernel TCP settings. Settings include adjusting send and receive buffer sizes, connection backlog, congestion control, etc.

The transmit and receive buffer sizes may already be explicitly controlled by an application calling `setsockopt()` to set SO_SNDBUF or SO_RCVBUF.

```
ndd -set /dev/tcp tcp_xmit_hiwat 524288
ndd -set /dev/tcp tcp_recv_hiwat 524288
```

The following settings may help if there are a large number of connections being made:

```
ndd -set /dev/tcp tcp_time_wait_interval 1000 # 1 sec for time-wait (min)
ndd -set /dev/tcp tcp_conn_req_max_q 4096 # increase accept queue
ndd -set /dev/tcp tcp_conn_req_max_q0 4096 # increase accept queue
ndd -set /dev/tcp tcp_conn_req_min 1024 # increase minimum accept queue
ndd -set /dev/tcp tcp_rst_sent_rate_enabled 0 # disable rst rate limiting
```

See the Internet Protocol Suite Tunable Parameters chapter of the Tunable Parameters Reference Guide for more details:

http://docs.oracle.com/cd/E19082-01/819-2724/6n50b07lr/index.html

NOTE: You can also add these settings to `/etc/system`

Receive Side Scaling (RSS)

Solarflare adapters support Receive Side Scaling (RSS). RSS enables packet receive-processing to scale with the number of available CPU cores. RSS requires a platform that supports MSI-X interrupts.

When RSS is enabled the controller uses multiple receive queues into which to deliver incoming packets. The receive queue selected for an incoming packet is chosen in such a way as to ensure that packets within a TCP stream are all sent to the same receive queue – this ensures that packet-ordering within each stream is maintained. Each receive queue has its own dedicated MSI-X interrupt which ideally should be tied to a dedicated CPU core. This allows the receive side TCP processing to be distributed amongst the available CPU cores, providing a considerable performance advantage over a conventional adapter architecture in which all received packets for a given interface are processed by just one CPU core.

RSS is enabled by default in the sfxge driver. To limit or disable RSS:

Uncomment the following line in: `/kernel/drv/sfxge.conf`

```
rx_scale_count=<number of MSI-X interrupts requested>
```

Limitations of Solaris MSI-X interrupt allocation are:

1 All network drivers share 32 MSI-X interrupts.

2 A single NIC can only use 2 MSI-X interrupts (this restriction can be lifted with the `ddi_msix_alloc_limit` setting below).

To lift the restriction of 2 MSI-X interrupts, add the following line to `/etc/system` and reboot.

```
set ddi_msix_alloc_limit=8
```

If no MSI/MSI-X interrupts are available then the driver will fall-back to use a single legacy interrupt. RSS will be unavailable for that port.

Other RSS Settings

You should add the following lines to `/etc/system`:

```
set pcplusmp:apic_intr_policy=1
```

This sets the interrupt distribution method to round robin.

```
set ip:ip_squeue_fanout=1
```

This determines the mode for associating TCP/IP connections with queues. For details refer to the following:

http://docs.oracle.com/cd/E19082-01/819-2724/chapter4-7/index.html

> **NOTE:** RSS also works for UDP packets. For UDP traffic the Solarflare adapter will select the Receive CPU based on IP source and destination addresses. SFN5xxx adapters support IPv4 and IPv6 RSS, while SFN4xxx adapters support just IPv4 RSS.

Other Considerations

PCI Express Lane Configurations

The PCI Express (PCIe) interface used to connect the adapter to the server can function at different widths. This is independent of the physical slot size used to connect the adapter. The possible widths are multiples x1, x2, x4, x8 and x16 lanes of (2.5Gbps for PCIe Gen 1, 5.0 Gbps for PCIe Gen 2) in each direction. Solarflare Adapters are designed for x8 lane operation.

On some server motherboards, choice of PCIe slot is important. This is because some slots (including ones that are physically x8 or x16 lanes) may only electrically support x4 lanes. In x4 lane slots, Solarflare PCIe adapters will continue to operate, but not at full speed. The Solarflare driver will warn you if it detects the adapter is plugged into a PCIe slot which electrically has fewer than x8 lanes.

For SFN5xxxx adapters, which require a PCIe Gen 2 slot for optimal operation, a warning will be given if they are installed in a PCIe Gen 1 slot.

CPU Power Management

This feature monitors CPU utilization and lowers the CPU frequency when utilization is low. This reduces the power consumption of the CPU. For latency sensitive applications, where the application switches between having packets to process and having periods of idle time waiting to receive a packet, dynamic clock speed control may increase packet latencies. There therefore can be a benefit to disabling the service.

The service can be disabled temporarily with the configuration in `/etc/power.conf` file and restarting the service. For example:

```
cpupm disable
system-threshold always-on
cpu-threshold always-on
cpu_deep_idle disable
```

The service can be disabled across reboots with:

```
svcadm disable  svc:/system/power:default
```

See http://docs.oracle.com/cd/E19253-01/817-0547/gfgmu/index.html

Memory bandwidth

Many chipsets use multiple channels to access main system memory. Maximum memory performance is only achieved when the chipset can make use of all channels simultaneously. This should be taken into account when selecting the number of DIMMs to populate in the server. Consult the motherboard documentation for details.

Server Motherboard, Server BIOS, Chipset Drivers

Tuning or enabling other system capabilities may further enhance adapter performance. Readers should consult their server user guide. Possible opportunities include tuning PCIe memory controller (PCIe Latency Timer setting available in some BIOS versions).

Tuning Recommendations

The following tables provide recommendations for tuning settings for different applications.

Throughput - Table 67

Latency - Table 68

Forwarding - Table 69

Recommended Throughput Tuning

Table 67: Throughput Tuning Settings

Tuning Parameter	How?
MTU Size to maximum supported by network	`ifconfig sfxge<x> mtu <size>`
Interrupt moderation	Leave at default
TCP/IP Checksum Offload	Leave at default
TCP Segmentation Offload	Leave at default
TCP Large Receive Offload	Leave at default
TCP Protocol Tuning	Leave at default
Receive Side Scaling (RSS)	Application dependent
Buffer Allocation Method	Leave at default. Some applications may benefit from specific setting.
PCI Express Lane Configuration	Ensure current speed (not the supported speed) reads back as “x8 and 5Gb/s” Or “x8 and Unknown”
CPU Power Management	Leave enabled
Memory bandwidth	Ensure Memory utilizes all memory channels on system motherboard

Recommended Latency Tuning

Table 68: Latency Tuning Settings

Tuning Parameter	How?
MTU Size to maximum supported by network	Leave at default
Interrupt moderation	Disable with: `sfxge.conf`
TCP/IP Checksum Offload	Leave at default
TCP Segmentation Offload	Leave at default
TCP Large Receive Offload	Leave at default
TCP Protocol Tuning	Leave at default, but changing does not impact latency
Receive Side Scaling	Application dependent
Buffer Allocation Method	Leave at default
PCI Express Lane Configuration	Ensure current speed (not the supported speed) reads back as “x8 and 5Gb/s” Or “x8 and Unknown”
CPU Power Management	Disable with: `/etc/power.conf`
Memory bandwidth	Ensure Memory utilizes all memory channels on system motherboard

Recommended Forwarding Tuning

Table 69: Forwarding Tuning Settings

Tuning Parameter	How?
MTU Size to maximum supported by network	`ifconfig sfxge<X> mtu <size>`
Interrupt moderation	Leave at default
TCP/IP Checksum Offload	Leave at default
TCP Segmentation Offload	Leave at default
TCP Large Receive Offload	Leave at default
TCP Protocol Tuning	Can leave at default
Receive Side Scaling (RSS)	`sfxge.conf`
Buffer Allocation Method	Leave at default

Table 69: Forwarding Tuning Settings

Tuning Parameter	How?
PCI Express Lane Configuration	Ensure current speed (not the supported speed) reads back as “x8 and 5Gb/s” Or “x8 and Unknown”
CPU Speed service (cpuspeed)	Leave enabled
Memory bandwidth	Ensure Memory utilizes all memory channels on system motherboard

6.12 Module Parameters

The normal syntax when using parameters is `param=<value>`.

Table 70 lists the available parameters in the Solarflare Solaris driver module (`sfxge.conf`):

Table 70: Driver Module Parameters

Parameter	Description	Values	Default
`rx_scale_count`	Maximum number of RSS channels to use per port. The actual number may be lower due to availability of MSI-X interrupts. There is a maximum of 32 MSI-X interrupts across all network devices. To use more than 2 MSI-X interrupts you need to add e.g. `set ddi_msix_alloc_limit=8` in `/etc/system`.		128
`rx_coalesce_mode`	Coalesce RX packets (Large Receive Offload).	0 = off 1 = on 2 = on, respecting TCP PSH boundaries.	0
`intr_moderation`	Interrupt moderation in µs. Decreasing this reduces latency but increases interrupt rate and therefore CPU usage.		30
`mtu`	Maximum MTU of an sfxge interface in bytes (excludes ethernet framing)	1500 - 9000	1500
`rxq_size`	Number of descriptors in the receive queue descriptor ring	512 - 4096 must be a power of 2 value	1024
`rx_pkt_mem_max`	Per port memory limit for receive packet buffers		64Mb

Table 70: Driver Module Parameters

Parameter	Description	Values	Default
`action_on_hw_err`	Controls the action taken on hardware error.	0 - recover adapter to a working state. 1- do not advertise to the kernel that the link is down during the reset. 2. reset the hardware, but do not use it again - useful for failover mechanisms to ensure this adapter does not become the active link again.	0
`rx_prealloc_pkt_buffers`	Number of pkt buffers to allocate at start of a receive queue and maintain a free pkt pool of at least this many buffers.	limited by available system memory.	512

6.13 Kernel and Network Adapter Statistics

Statisitical data originating from the MAC on Solarflare network adapters can be gathered using the Solaris Kernel Statistics command (`kstat`). The following tables identify kernel and adapter statistics returned from the `kstat` command:

```
# kstat -m sfxge
```

To read individual classes use the -c option or by name use the -n option, for example:

```
# kstat -m sfxge -c net
# kstat -m sfxge -n mac
```

The kstats statistics are listed by 'names' in the following tables

Table 71: Name mac

Parameter	Description
adv_cap_1000fdx	Advertise 1000 Mbps full duplex capacity 1 = true, 0 = false.
adv_cap_1000hdx	Advertise 1000 Mbps half duplex capacity 1 = true, 0 = false.
adv_cap_100fdx	Advertise 100 Mbps full duplex capacity 1 = true, 0 = false.
adv_cap_100hdx	Advertise 100 Mbps half duplex capacity 1 = true, 0 = false.
adv_cap_10fdx	Advertise 10 Mbps full duplex capacity 1 = true, 0 = false.
adv_cap_10hdx	Advertise 10 Mbps half duplex capacity 1 = true, 0 = false.
adv_cap_asmpause	Advertise asymmetric pause capability 1 = true, 0 = false.
adv_cap_autoneg	Advertise auto-negotiation capability when auto-negotiation is enabled. When set to zero, the highest priority speed and duplex mode is used for forced mode.

Table 71: Name mac

Parameter	Description
adv_cap_pause	Depends on the value of adv_cap_asmpause. If adv_cap_asmpause = 1 then: 1 = send pause frames when there is receive congestion. 0 = pause transmission when a pause frame is received. If adv_cap_asmpause = 0 then: 1 = send pause frames when there is receive congestion and pause transmission when a pause frame is received. 0 = pause capability is not available in either direction.
align_errors	Number of occurrences of frame alignment error.
brdcstrcv	Number of broadcast packets received.
brdcstxmt	Number of broadcast packets transmitted.
cap_1000fdx	Capable of 1000 Mbps full duplex 1 = true, 0 = false.
cap_1000hdx	Capable of 1000 Mbps half duplex 1 = true, 0 = false.
cap_100fdx	Capable of 100 Mbps full duplex 1 = true, 0 = false.
cap_100hdx	Capable of 100 Mbps half duplex 1 = true, 0 = false.
cap_10fdx	Capable of 10 Mbps full duplex 1 = true, 0 = false.
cap_10hdx	Capable of 10 Mbps half duplex 1 = true, 0 = false.
cap_asmpause	Asymmetric pause capability 1 = true, 0 = false. This determines action taken by the cap_pause parameter - see below.
cap_autoneg	Capable of auto negotiation 1= true, 0 = false.
cap_pause	Direction depends on value of cap_asmpause. If cap_asmpause = 1 then: 0 = pause transmission when a pause frame is received. 1 = send pause frames when there is receive congestion. If cap_asmpause = 0 then: 0 = pause capability is not available in either direction. 1 = send pause frames when there is receive congestion and pause transmission when a pause frame is received.
collisions	Number of collisions detected when attempting to send.
crtime	Timestamp when samples were taken.

Table 71: Name mac

Parameter	Description
defer_xmts	Number of packets successfully transmitted after the network adapter defers transmission at least once when the medium is busy.
ex_collsions	Number of packets not transmitted due to excessive collisions which can occur on networks under heavy load or when too many devices contend for the collision domain. After 15 retransmission attempts plus the original transmission attempt the counter is incremented and the packet is dropped.
fcs_errors	Number of frames received which FCS errors.
first_collisions	0
ierrors	0
ifspeed	Adapter interface speed.
ipackets	Number of packets received (32 bit counter).
ipackets64	Number of packets received (64 bit counter).
link_asmpause	When adv_*pause_cap and lp_*pause_cap are compared following auto-negotiation, the flow control mechanism for the link depends on what is most meaningful: 0 = flow control in both directions when link_pause is set to one. 1 = flow control in one direction.
link_autoneg	Auto-negotiation, 0 = not enabled, 1 = enabled.
link_duplex	0 = down, 1 = half duplex, 2 = full duplex.
link_pause	Depends on link_asmpause. If link_asmpause = 1 then: 1 = flow control in both directions is available. 0 = no flow control on the link. If link_asmpause = 0 then: 1 = the local host will honour received pause frames by temporarily suspending transmission of further frames. 0 = in the event of receive congestion, the local host will transmit pause frames to the peer.
link_state	link status 0 = link down, 1 = link up.
link_up	1 =link is up, 0 = link is down.

Table 71: Name mac

Parameter	Description
lp_cap_1000fdx	Link partner advertises 1000 Mbps full duplex capability.
lp_cap_1000hdx	Link partner advertises 1000 Mbps half duplex capability.
lp_cap_100fdx	Link partner advertises 100 Mbps full duplex capability.
lp_cap_100hdx	Link partner advertises 100 Mbps half duplex capability.
lp_cap_10fdx	Link partner advertises 10 Mbps full duplex capability.
lp_cap_10hdx	Link partner advertises 10 Mbps half duplex capability.
lp_cap_asmpause	Asymmetric pause capability. 1 = true, 0 = false. This determines action taken by the lp_cap_pause parameter - see below.
lp_cap_autoneg	Link partner advertises auto-negotiation capability.
lp_cap_pause	Depends on value of lp_cap_asmpause. If lp_cap_asmpause = 1 then: 1 = send pause frames when there is receive congestion. 0 = pause transmission when a pause frame is received. If lp_cap_asmpause = 0 then: 1 = send pause frames when there is receive congestion and pause transmission when a pause frame is received. 0 = pause capability is not available in either direction.
macrcv_errors	Count the number of frames for which reception on a particular interface fails due to internal MAC error. Does not include too long frames, alignment error frames or FCS errors.
macxmt_errors	Count the number of frames for which transmission fails due to internal MAC error. Does not include failures due to late collisions, excessive collisions or carrier sense errors.
multi_collisions	Count the number of frames for which transmission fails due to multiple collisions.
multircv	Number of multicast packets received.
multixmt	Number of multicast packets transmitted.
norcvbuf	0
noxmtbuf	0
obytes	Number of bytes output (32 bit counter).

Table 71: Name mac

Parameter	Description
obytes64	Number of bytes output (64 bit counter).
oerrors	Number of outbound packets not transmitted due to error.
opackets	Number of outbound packets (32 bit counter).
opackets64	Number of outbound packets (64 bit counter)
promisc	Promiscuous Mode, 0 = not enabled, 1 = enabled
rbytes	Number of bytes received (32 bit counter)
rbytes64	Number of bytes received (64 bit counter)
snaptime	178761.398854604
sqe_errors	Count of number of times the SQE_TEST_ERROR message is generated for an interface.
toolong_errors	Count the number of frames received that exceed the maximum permitted frame size.
tx_late_collsions	A sending device may detect a collision as it attempts to transmit a frame or before it completes sending the entire frame. If a collision is detected after the device has completed sending the entire frame, the device will assume that the collision occurred because of a different frame. Late collisions can occur if the length of the network segment is greater than the standard allowed length. Collision occurred beyond the collision window (512 bit times). This should always be zero as Solarflare adapters operate in full duplex mode.
unknowns	0
xcvr_addr	MII address in the 0-31 range of the physical layer device in use for a given Ethernet device.
xcvr_id	MII transceiver manufacturer and device ID.

Table 71: Name mac

Parameter	Description
xcvr_inuse	MII transceiver type: 0 = undefined 1 = none, MII present but nothing connected 2 = 10 Mbps Manchester encoding 3 = 100BaseT4, 100 Mbps 8B/6T 4 = 100BaseX, 100 Mbps 4B/5B 5 = 100BaseT2 100 Mbps PAM5X5 6 = 1000BaseT, 1000 Mbps 4D-PAM5

Table 72: Name sfxge_cfg

Parameter	Description
crtime	Timestamp when samples were taken.
mac	Adapter hardware address.
version	Solarflare sfxge driver version

Table 73: Name sfxge_mac

Parameter	Description
crtime	Timestamp when samples were taken.
link_duplex	0 = down, 1 = half duplex, 2 = full duplex.
link_speed	10000 (Mbps).
link_up	1 = link is up, 0 = link is down.
rx_1024_to_15xx_pkts	Number of packets received where the length is between 1024 and 15xx bytes. 1518(non VLAN), 1522(VLAN).
rx_128_to_255_pkts	Number of packets received where the length is between 128 and 255 bytes.
rx_256_to_511_pkts	Number of packets received where the length is between 256 and 511 bytes.
rx_512_to_1023_pkts	Number of packets received where the length is between 512 and 1023 bytes.
rx_65_to_127_pkts	Number of packets received where the length is between 65 and 127 bytes.

Table 73: Name sfxge_mac

Parameter	Description
rx_align_errors	Number of occurrences of frame alignment error.
rx_brdcst_pkts	Number of broadcast packets received.
rx_drop_events	Number of packets dropped by adapter driver.
rx_errors	Number of packet received with bad FCS.
rx_false_carrier_errors	Count of the instances of false carrier detected. False carrier is activity on the receive channel that does not result in a packet receive attempt being made.
rx_fcs_errors	Number of packets received with FCS errors - these are dropped by the Solarflare driver.
rx_ge_15xx_pkts	Number of packets received with payload size greater than 1518 bytes (1522 bytes VLAN).
rx_internal_errors	Number of frames that could not be received due to a MAC internal error condition. e.g. frames not received by the MAC due to FIFO overflow condition.
rx_lane0_char_err	0
rx_lane0_disp_err	0
rx_lane1_char_err	0
rx_lane1_disp_err	0
rx_lane2_char_err	0
rx_lane2_disp_err	0
rx_lane3_char_err	0
rx_lane3_disp_err	0
rx_le_64_pkts	Number of packets received where the length is exactly 64 bytes.
rx_match_fault	Number of packets received which did not match a filter.
rx_multicst_pkts	Number of multicast packets received.

Table 73: Name sfxge_mac

Parameter	Description
rx_nodesc_drop_cnt	Number of packets dropped by the network adapter because of a lack of RX descriptors in the RX queue. Packets can be dropped by the NIC when there are insufficient RX descriptors in the RX queue to allocate to the packet. This problem can occur if the receive rate is very high and the network adapter is not able to allocate memory and refill the RX descriptor ring quickly enough to keep up with the incoming packet rate. A number of different steps can be tried to resolve this issue: 1. Disable the irqbalance daemon in the OS. 2. Distribute the traffic load across the available CPU/cores by setting rss_cpus=cores. Refer to Receive Side Scaling section. 3. Increase receive queue size using ethtool.
rx_octets	Total number of octets received.
rx_pause_pkts	Number of pause packets received with valid pause op_code.
rx_pkts	Total number of packets received.
rx_symbol_errors	Count of the number of times the receiving media is non-idle (the time between the Start of Packet Delimiter and the End of Packet Delimiter) for a period of time equal to or greater than minimum frame size, and during which there was at least one occurrence of an event that causes the PHY to indicate Receive Error on the MII.
rx_unicst_pkts	Number of unicast packets received.
tx_1024_to_15xx_pkts	Number of packets transmitted where the length is between 1024 and 15xx bytes. 1518(non VLAN), 1522(VLAN).
tx_128_to_255_pkts	Number of packets transmitted where the length is between 128 and 255 bytes.
tx_256_to_511_pkts	Number of packets transmitted where the length is between 256 and 511 bytes.
tx_512_to_1023_pkts	Number of packets transmitted where the length is between 512 and 1023 bytes.

Table 73: Name sfxge_mac

Parameter	Description
tx_65_to_127_pkts	Number of packets transmitted where the length is between 65 and 127 bytes.
tx_brdcst_pkts	Number of broadcast packets transmitted.
tx_def_pkts	The number of packets successfully transmitted after the network adapter defers transmission at least once when the medium is busy.
tx_errors	Number of packets transmitted with incorrect FCS.
tx_ex_col_pkts	Number of packets not transmitted due to excessive collisions. Excessive collisions occur on a network under heavy load or when too many devices contend for the collision domain. After 15 retransmission attempts + the original transmission attempt the counter is incremented and the packet is discarded.
tx_ex_def_pkts	Number of packets for which transmission is deferred for an excessive period of time.
tx_ge_15xx_pkts	Number of packets transmitted where length is between 15xx and 9000 bytes. 1518(non VLAN), 1522(VLAN).
tx_late_col_pkts	A sending device may detect a collision as it attempts to transmit a frame or before it completes sending the entire frame. If a collision is detected after the device has completed sending the entire frame, the device will assume that the collision occurred because of a different frame. Late collisions can occur if the length of the network segment is greater than the standard allowed length. Collision occurred beyond the collision window (512 bit times). This should always be zero as Solarflare adapters operate in full duplex mode.
tx_le_64_pkts	Number of frames transmitted where the length is less than 64 bytes.
tx_mult_col_pkts	Number of packets transmitted after being subject to multiple collisions.
tx_multicst_pkts	Number of multicast packets transmitted. Includes flow control packets.
tx_octets	Number of octets transmitted.
tx_pause_pkts	Number of pause packets transmitted.

Table 73: Name sfxge_mac

Parameter	Description
tx_pkts	Number of packets transmitted.
tx_sgl_col_pkts	Number of occurrences when a single collision delayed immediate transmission of a packet.
tx_unicst_pkts	Number of unicast packets transmitted. Includes packets that exceed that maximum length.

Table 74: Name sfxge_ndd

Parameter	Description
adv_cap_1000fdx	Refer to the corresponding field in the MAC statistics in Table 71 above. The adv_cap_* parameters represent a mirror image of the mac adv_*_cap parameter list for an Ethernet device. The parameters are also a subset of the cap_* statistics. If the cap_* value is 0, the corresponding adv_cap_* must also be 0, except for adv_cap_asmpause and adv_cap_pause parameters.
adv_cap_1000hdx	
adv_cap_100fdx	
adv_cap_100hdx	
adv_cap_10fdx	
adv_cap_10gfdx	
adv_cap_10hdx	
adv_cap_asm_pause	
adv_cap_autoneg	
adv_cap_pause	
cap_1000fdx	
cap_1000hdx	
cap_100fdx	
cap_100hdx	
cap_10fdx	
cap_10gfdx	
cap_10hdx	
cap_asm_pause	
cap_autoneg	
cap_pause	

Table 74: Name sfxge_ndd

Parameter	Description
crtime	Timestamp when samples were taken.
fcntl_generate	Flow control. When 1 generate pause frames.
fcntl_respond	Flow control -When 1 - pause transmission on receipt of pause frames.
intr_moderation	Interrupt moderation interval (microseconds) maximum value 20000 µs
lp_cap_1000fdx lp_cap_1000hdx lp_cap_100fdx lp_cap_100hdx lp_cap_10fdx lp_cap_10gfdx lp_cap_10hdx lp_cap_asm_pause lp_cap_autoneg lp_cap_pause	Refer to the corresponding link partner field in the MAC statistics in Table 71 above. The adv_cap_* parameters represent a mirror image of the mac adv_*_cap parameter list for an Ethernet device. The parameters are also a subset of the cap_* statistics. If the cap_* value is 0, the corresponding adv_cap_* must also be 0, except for adv_cap_asmpause and adv_cap_pause parameters.0
rx_coalesce_mode	Large Receive Offload. 0 = disabled (default), 1 = enabled, 2 = enabled - respecting TCP PSH boundaries.
rx_scale_count	Number of RSS channels to use per port. Default is 128, Minimum is 1.

Table 75: Name sfxge_rss

Parameter	Description
crtime	Timestamp when samples were taken.
evq0000_count	Number of RSS table entries for this event queue.
scale	Actual number of MSI-X interrupts.

Table 76: Name sfxge_rxq0000

Parameter	Description
crtime	Timestamp when samples were taken.
dma_alloc_fail	Memory allocation failure.
dma_alloc_nomem	Memory allocation failure.
dma_bind_fail	Memory allocation failure.
dma_bind_nomem	Memory allocation failure.
kcache_alloc_nomem	Memory allocation failure.
rx_pkt_mem_limit	Per interface memory limit for RX packet buffers.
rxq_empty_discard	Number of times the RX descriptor ring was empty causing a received packet to be discarded.

Table 77: Name sfxge_txq0000

Parameter	Description
crtime	Timestamp when samples were taken.
post	Number of packets posted to the transmit queue.
dpl_get_full_count	Number of times the Deferred Packet List limit was reached.
dpl_get_pkt_limit	Deferred Packet max packet limit
dpl_put_full_count	Number of times the Deferred Packet List limit was reached
dpl_put_pkt_limit	Deferred Packet max packet limit.
unaligned_split	Always 0.

Table 78: Name sfxge_vpd

Parameter	Description
crtime	Timestamp when samples were taken.
EC	Engineering change data.
ID	Solarflare adapter type.
PN	Solarflare adapter part number.

Table 78: Name sfxge_vpd

Parameter	Description
SN	Solarflare adapter serial number.
VD	Adapter firmware version.

Chapter 7: SR-IOV Virtualization Using KVM

This chapter describes Solarflare's unified approach to SR-IOV Virtualization using Linux KVM and identifies supported KVM guests. Solarflare SR-IOV enables accelerated cut-through performance while maintaining full compatibility with hypervisor based services and management tools.

7.1 Supported Platforms and Adapters

Solarflare KVM SR-IOV acceleration currently supports:

Host

- Red Hat Enterprise Linux 6.0, 6.1 and 6.2 KVM

Guest VM

- Red Hat Enterprise Linux 5.5, 5.6 and 5.7
- Red Hat Enterprise Linux 6.0, 6.1 and 6.2

Adapters

- All Solarflare SFN5xxx and SFN6xxx series adapters. Solarflare adapters support 127 VFs per port and 1024 vNICs each with a dedicated MSI-X interrupt.

Acceleration of guest VMs running other (non-Linux) operating systems is not currently supported although Solarflare are considering accelerating Windows guests in the longer term.

The hardware supports different configurations of (a) the number VFs exposed and (b) the number of vNICs (and therefore MSI-X interrupts) to give to each VF. This can be configured with the sfboot utility.

Currently the default configuration is 127 VFs each allocated 1 vNIC.

7.2 Linux KVM SR-IOV

Traditional Virtualization (without SR-IOV)

Traditional KVM networking involves bridging a physical network device to tap devices, which qemu connects to either emulated hardware (e1000, rtl8139), or to virtio devices. The guest operating system then uses the appropriate drivers to consume the emulated hardware.

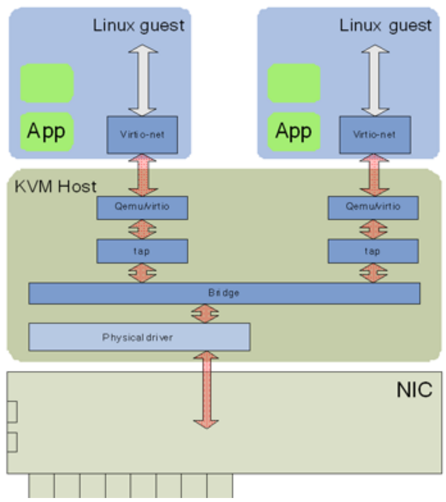


Figure 50: Guest to Guest Connectivity

The bridge establishes guest to guest connectivity. Unfortunately performance is poor, requiring data to be copied between the guest and KVM host, and between user level and kernel within the KVM host.

Typical Virtualization (with SR-IOV)

In emerging SR-IOV solutions a PCIe hardware VF is passed-through to the guest operating system. A network driver binds directly to this PCIe VF.

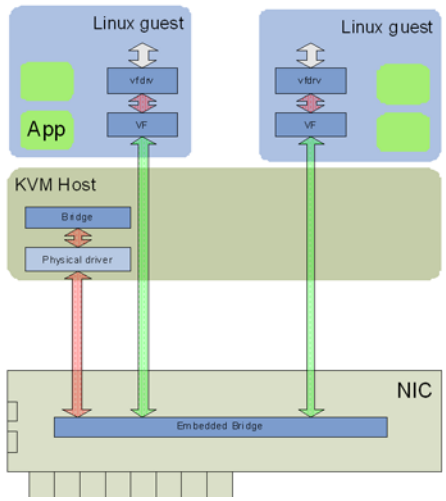


Figure 51: Direct Guest Access to NIC Hardware

This approach solves many of the performance limitations of traditional virtualized networking providing direct access to the network adapter from the guest VM.

However, the major downside of this approach is the guest VM now relies on the physical VF of the adapter for networking. If this VF changes in anyway then the guest VM completely loses networking access.

For example, this solution makes migration close to impossible to support as both the source and destination machine must be identical in every respect to the networking adapter. That is, not only identical at a hardware level (same adapter, same slot) but, also the same VF index must be available on the identical destination machine. For example, if VF 5 is being used by the VM at the source machine then for migration to succeed VF 5 must be free at the destination machine. This means that for migration to be possible VFs cannot be allocated on demand but assigned to fixed VMs across the complete cluster. Therefore, for deployments with more than a handful of VMs across the complete cluster this SR-IOV solution prevents the user from migrating VMs.

It is also worth noting that the networking interface in this model is now a vendor supplied driver and creation/configuration of networking interfaces must be done via this vendor driver and not the standard KVM network drivers.

Solarflare Plug-in Model

The Solarflare model for SR-IOV support is a hybrid of the traditional and typical approaches. The Solarflare "plugin" maintains the traditional (software) data path through virtio frontend to the KVM host (and then through the Linux bridge to the PF of the network driver). However, there is also an alternative (accelerated) data path through the VF driver directly to the network adapter from the guest. Packets can be received on either data path transparently to the guest VM's network stack. On transmit the loaded and enabled plugin decides whether to use the software path or accelerated path.

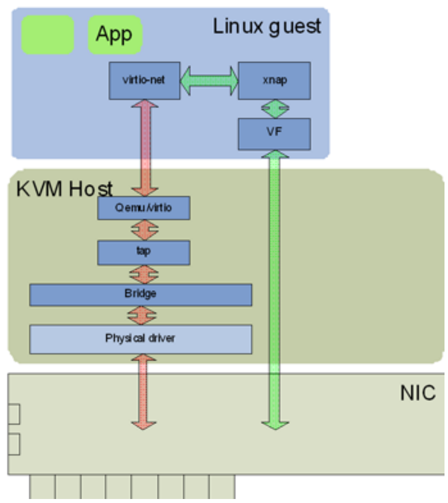


Figure 52: Solarflare Plug-in Model

A VM can be created/cloned using traditional tools and networking to/from the VM initially uses the standard software network path. If a VF on the network adapter is then passed-through into the guest, the guest sees new hardware has been "hot-plugged" and binds the Solarflare plugin driver to this VF. This plugin driver automatically registers with the virtio driver as an accelerated network plugin. Once the VF driver has registered, subsequent traffic to/from the guest uses the accelerated data path accessing the adapter directly from the guest. If the VF is hot "unplugged" (i.e. removed from the guest), the plugin de-registers with the virtio front end and the networking traffic reverts to the software data path.

This approach means there is no dependency on the VF or its driver for the networking data path of the VM. Acceleration can be disabled at any time if needed without losing network connectivity. Migration is fully supported in this model - between hosts with identical network adapters AND also between non-identical hosts. For example, migration is still possible between hosts containing network adapters from differing vendors (even if one of the adapters does not support SR-IOV).

When migrating a VM the typical operations are:

- Hot-unplug any network VF in the guest (to remove any hardware knowledge from the guest, networking in the guest VM falls back to the standard software data path).
- Migrate the guest VM to a new machine

- Optionally, allocate and hot-plug a new VF into the guest at the destination machine (the plugin loads, automatically registers with the virtio driver and the networking path uses the accelerated path).

Benefits of Solarflare's SR-IOV solution

- **Maximum performance**. Using SR-IOV reduces CPU utilization, increases bandwidth and lowers latency. Performance returns to near native (non-virtualized) levels.
- **Full support of migration**. Ability to migrate VMs accelerated with the SR-IOV solution - either to a machine also supporting the same SR-IOV solution or to a KVM machine with a non-Solarflare adapter.
- **Large number of VFs**. Solarflare adapters support 127 VFs per port - far more than other SR-IOV capable adapters. This allows up to 127 VMs per 10G port to be accelerated per host.
- **RSS support in guest VMs**. Solarflare adapters support up to 1024 vNICs per port. Multiple vNICs can be exposed through a single VF to a guest VM. This allows a guest VM to have multiple transmit and receive queues. The Solarflare plugin model fully supports intelligently spreading network traffic over multiple queues to scale performance over the available CPUs. This is termed receive side scaling (RSS) and is typically used in non-virtualized environments (Linux/Windows) to improve network performance. With the Solarflare plugin model when VMs are deployed to run on multiple (virtual) CPUs, each CPU can be given a dedicated transmit and receive queue so that network performance scales over the available CPU cores.

7.3 Installation

Platform support

To use SR-IOV, platform support for hardware virtualization must be enabled. Refer to Enabling Virtualization Extensions for more information. Take care to enable VT-d as well as VT on an Intel platform. To verify that the extensions have been correctly enabled refer to Verifying Virtualization Extensions.

On an Intel platform, the IOMMU must be explicitly enabled by appending `intel_iommu=on` to the kernel line in the `/boot/grub/grub.conf` file. Refer to PCI Passthrough for more information. AMD systems only require that the IOMMU is enabled in the BIOS. The system is ready for PCI passthrough once the IOMMU is enabled.

Step 1: Download and install host drivers

Download the Solarflare Linux drivers from support.solarflare.com:

- For RHEL 6.0, 6.1 - part number SF-100785-LS (minimum version 3.1.0.4088).
- For RHEL 6.2 - part number SF-103848-LS (minimum version 3.2.1.6090).

Install the sfc network drivers using the source rpm `sfc-3.<version>.src.rpm`. Full instructions for using a source rpm can be found in the Solarflare RPMs...Page 41. Reload the sfc driver to start using the new version.

> **NOTE:** Ensure that VFs are NOT in use when you unload the sfc driver. This is particularly relevant if you are upgrading from a previous alpha version of the Solarflare KVM SR-IOV package.

Step 2: Update adapter firmware and enable SR-IOV

Download the Solarflare Linux Utilities SF-104451-LS from support.solarflare.com:

1 Install the Solarflare Linux Utilities in dom0 using the rpm provided in this package:

```
# rpm -Uvh sfutils-<version>.rpm
```

2 Identify the current firmware version on the adapter:

```
# sfupdate
```

3 Upgrade the adapter firmware with sfupdate:

```
# sfupdate --write
```

4 Use sfboot to enable SR-IOV and enable 16 VFs:

```
# sfboot sriov=enabled vf-count=16
```

A reboot is required for the changes to take effect. After the reboot the sfc driver will initialize the VFs, and they will appear in lspci:

```
# lspci -d 1924:
06:00.0 Ethernet controller: Solarflare Communications SFL9021
[Solarstorm]
06:00.1 Ethernet controller: Solarflare Communications SFL9021
[Solarstorm]
06:00.2 Ethernet controller: Solarflare Communications Device 1813
06:00.4 Ethernet controller: Solarflare Communications Device 1813
06:00.6 Ethernet controller: Solarflare Communications Device 1813
06:01.0 Ethernet controller: Solarflare Communications Device 1813
06:01.2 Ethernet controller: Solarflare Communications Device 1813
06:01.4 Ethernet controller: Solarflare Communications Device 1813
06:01.6 Ethernet controller: Solarflare Communications Device 1813
06:02.0 Ethernet controller: Solarflare Communications Device 1813
```

Table 79 identifies sfboot SR-IOV configurable options.

Table 79: sfboot - SR-IOV options

Option	Default Value	Description
sriov=<enabled | disabled>	disabled	enable/disable hardware SR-IOV
vf-count=<n>	127	number of virtual functions advertised
vf-msix-limit=<n>	1	number of MSI-X interrupts per VF

NOTE: Enabling all 127 VFs per port with more than one MSI-X interrupt per VF may not be supported by the host BIOS and you may get 127 VFs on one port with no VFs on the other port. Contact your BIOS vendor for a BIOS upgrade or reduce the VF count.

Step 3: Install libvirt and virt-manager with SR-IOV support

Libvirt and virt-manager have been enhanced to support SR-IOV acceleration. It is suggested to upgrade libvrt components with the components in the supplied package.

To upgrade an existing libvirt/virt-manager installation on Red Hat **6.1** do the following:

```
# rpm -e libvirt-java-devel-0.4.7-1.el6.noarch
# rpm -e libvirt-java-0.4.7-1.el6.noarch

# rpm -Uvh python-virtinst-0.500.5-3.el6.sf2.noarch.rpm
# rpm -Uvh libvirt-0.8.7-18.el6.sf1.x86_64.rpm \
           libvirt-client-0.8.7-18.el6.sf1.x86_64.rpm \
           libvirt-python-0.8.7-18.el6.sf1.x86_64.rpm
# rpm -Uvh virt-manager-0.8.6-4.el6.sf2.noarch.rpm
```

To upgrade an existing libvirt/virt-manager installation on Red Hat **6.2** do the following:

```
# rpm –Uvh libvirt-0.9.4-23.el6.sf3.x86_64.rpm \
       libvirt-client-0.9.4-23.el6.sf3.x86_64.rpm \
       libvirt-python-0.9.4-23.el6.sf3.x86_64.rpm \
       libvirt-devel-0.9.4-23.el6.sf3.x86_64.rpm \
       libvirt-lock-sanlock-0.9.4-23.el6.sf3.x86_64.rpm \
       virt-manager-0.9.0-7.sf1.el6.x86_64.rpm
```

Guest Drivers

The Solarflare accelerated driver package is currently supplied as a tarball. It contains two drivers: an upgraded virtio-net driver (backported from 2.6.37), and xnap, the PCI driver for Solarflare VFs.

To install drivers on Red Hat 6.1:

```
# tar xvfz sfc-xnap-virtio-v1_0_0_0012.tgz
# make -C sfc-xnap-virtio-v1_0_0_0012/ modules_install
```

Restart the guests to start using the new drivers.

To install drivers on Red Hat 6.2:

The virtio kernel module must be rebuilt and installed before the xnap module can be rebuilt and installed.

1 As any user

```
rpmbuild --rebuild virtio-2.6.37-1.0.0.0016-1.el6.sf.src.rpm
```

2 As root install the binary rpm indicated by the "Wrote:" lines from rpmbuild

```
rpm -Uvh RPMS/x86_64/kmod-virtio-2.6.37-1.0.0.0016-1.el6.sf.x86_64.rpm
```

3 As any user

```
rpmbuild --rebuild xnap-1.0.0.0016-1.el6.src.rpm
```

4 As root install the binary rpm indicated by the "Wrote:" lines from rpmbuild

```
rpm -Uvh RPMS/x86_64/kmod-xnap-1.0.0.0016-1.el6.x86_64.rpm
```

7.4 Configuration Red Hat 6.1

Host Network Configuration

As previously described, Solarflare SR-IOV support uses a plugin model, whereby virtual functions accelerate virtio network adapters. This section presents an overview of how to configure virtio based networking.

- Configure Bridged networking on the hosts, creating a bridge for each Solarflare network device and attach the physical network device to the bridge. The instructions to configure bridging can be found at Redhat: Bridged networking with libvirt.
- Assign an IP address to the bridge. Verify network connectivity between the hosts over the Solarflare network drivers using ping (or a similar tool).
- For each guest on the host, create virtio network adapters attached to the newly created bridges. You can enable SR-IOV acceleration of each virtio adapter as described below.

XML Format for SR-IOV

A virtio interface onto a bridge "br1" could be implemented using the following XML fragment:

```
<interface type='bridge'>
  <mac address='00:50:56:3e:86:29'/>
  <source bridge='br1'/>
  <model type='virtio'/>
  <address type='pci' domain='0x0000' bus='0x00' slot='0x0a'
function='0x0'/>
</interface>
```

To accelerate this virtio adapter by using VFs provided by "eth4" modify the fragment as shown, adding the vf-hotplug element with hybrid=yes.

```
<interface type='bridge'>
  <mac address='00:50:56:3e:86:29'/>
  <source bridge='br1'/>
  <model type='virtio'/>
  <address type='pci' domain='0x0000' bus='0x00' slot='0x0a'
function='0x0'/>
```



```
    <vf-hotplug source='eth4' hybrid='yes'/>
  </interface>
```

If "br1" is on a vlan then add a vlan attribute as shown:

```
  <interface type='bridge'>
    <mac address='00:50:56:3e:86:29'/>
    <source bridge='br1'/>
    <model type='virtio'/>
    <address type='pci' domain='0x0000' bus='0x00' slot='0x0a'
  function='0x0'/>
    <vf-hotplug source='eth4' hybrid='yes' vlan='123' />
  </interface>
```

Virt-manager configuration for SR-IOV: Adding a new interface

A virt-manager GUI tool is supplied with the Solarflare driver distribution package. To run the GUI tool as root use the following command:

```
# /usr/bin/virt-manager
```

Alternatively, virt-manager can be on another host and connect to the KVM host via “File”- >”Add Connection”. Virt-manager has been extended to make SR-IOV configuration much easier. When adding a new interface there will be a new "SR-IOV Acceleration" combo box. It will default to "No" for new interfaces:

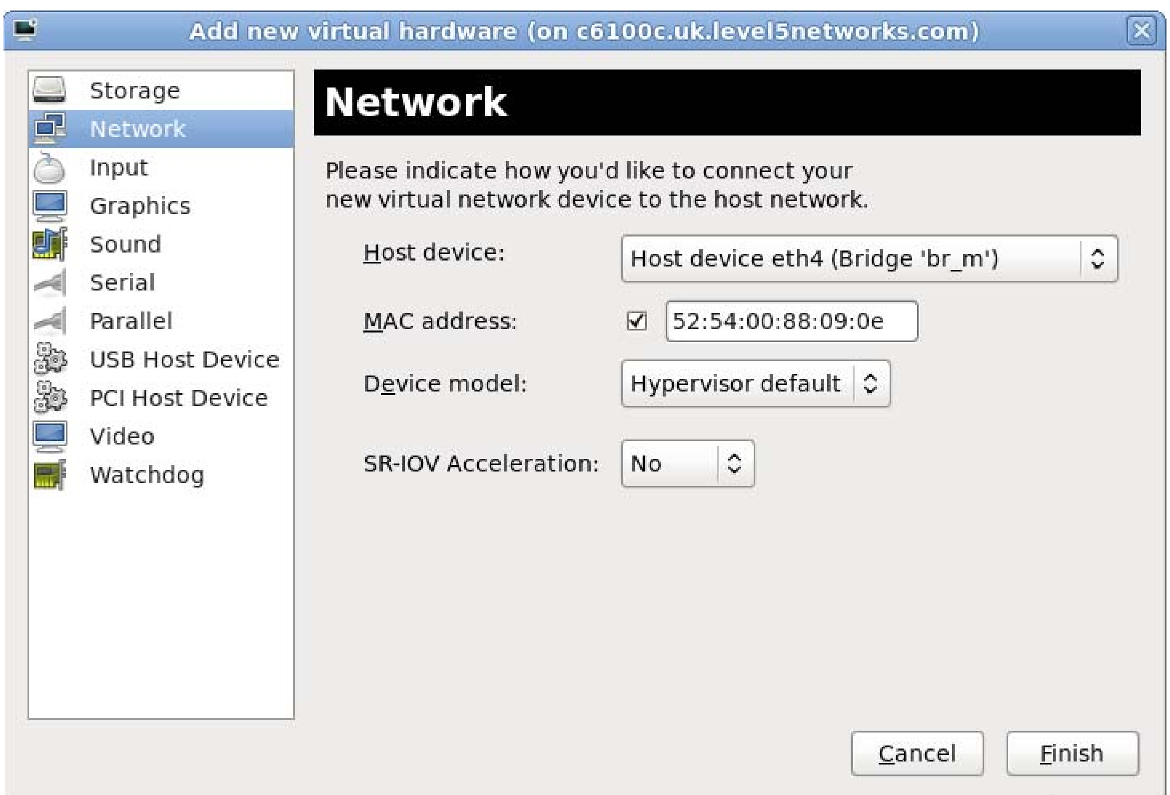


Figure 53: Virt-Manager GUI tool

To enable SR-IOV acceleration of the virtio adapter change the "SR-IOV acceleration mode" to "Hybrid", and the "Device model" to virtio.

Virt-manager configuration for SR-IOV: Modifying an existing adapter

It is also possible to change the "SR-IOV Acceleration mode" for existing adapters:

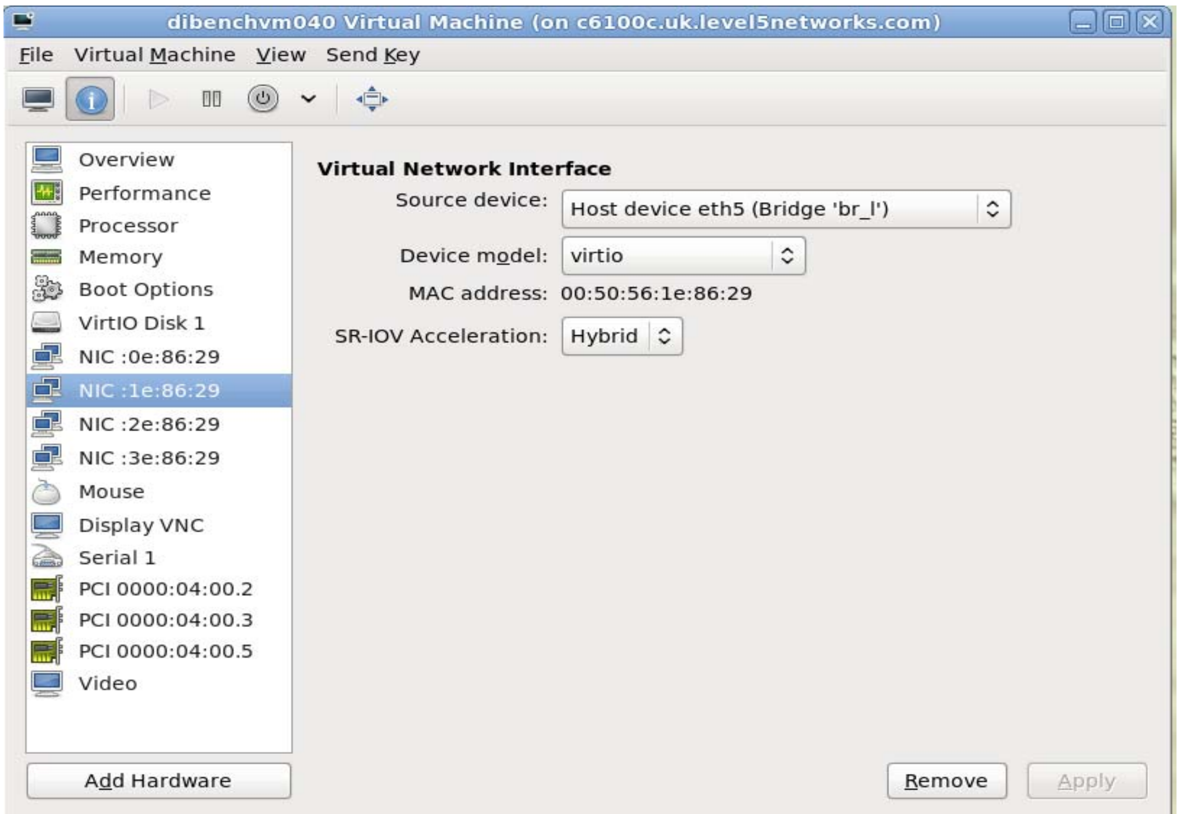


Figure 54: Change SR-IOV on Existing Adapter

Verifying SR-IOV

As described above, libvirt will manage VFs for interfaces with a vf-hotplug attribute. If there are spare VFs available when the VM is started then one (or more) VFs will be attached into the running guest. If the guest OS has the Solarflare VF drivers, and the interface is a virtio interface, then the virtio interface will be accelerated.

NOTE: Red Hat Enterprise Linux 5 Update 5 and Update 6 guests require the acpiphp module to be loaded before PCI hotplug will work:

```
# echo "modprobe acpiphp" >> /etc/rc.modules
# chmod +x /etc/rc.modules
# modprobe acpiphp
```


a. Once the VM has started, examine lspci to verify that a VF is present.

```
# lspci
00:08.0 Ethernet controller: Solarflare Communications Device 1803
00:09.0 Ethernet controller: Solarflare Communications Device 1803
```

b. The interface is only accelerated once it's brought up, after the interface is bought up use dmesg to verify that a VF is accelerating a virtio adapter:

```
# dmesg | grep -i xnap
xnap 0000:00:0a.0: accelerated eth2
```

7.5 Configuration Red Hat 6.2

Host Network Configuration

As previously described, Solarflare SR-IOV support uses a plugin model, whereby virtual functions accelerate virtio network adapters. These virtio network adapters are attached to the physical network device via a macvtap interface.

XML Format for SR-IOV

A virtio interface onto a macvtap interface could be implemented using the following XML fragment:

Network XML:

```
<network>
  <name>sfc-network</name>
  <uuid> 81ff0d90-c91e-6742-64da-4a736edb9a8f</uuid>
  <forward mode='vepa'>
    <interface dev='eth2'/>
  </forward>
</network>
```

Domain XML:

```
<interface type='network'>
  <source network='sfc-network'/>
  <mac address='00:50:56:3e:86:29'/>
  <model type='virtio'/>
  <address type='pci' domain='0x0000' bus='0x00' slot='0x0a'
     function='0x0'/>
</interface>
```

To accelerate this virtio adapter by using VFs provided by “eth2”, modify the fragment as shown using the pci-passthrough-hybrid mode.

Network XML:

```
<network>
```

```
  <name>sfc-network</name>
  <uuid> 81ff0d90-c91e-6742-64da-4a736edb9a8f</uuid>
  <forward mode='pci-passthrough-hybrid'>
    <pf dev='eth2'/>
  </forward>
</network>
```

Domain XML:

```
<interface type='network'>
  <source network='sfc-network'/>
  <mac address='00:50:56:3e:86:29'/>
  <model type='virtio'/>
  <address type='pci' domain='0x0000' bus='0x00' slot='0x0a'
     function='0x0'/>
</interface>
```

To create the macvtap interface on a vlan eth2.123 add a vlan attribute as shown:

Network XML:

```
<network>
  <name>sfc-network</name><uuid> 81ff0d90-c91e-6742-64da-4a736edb9a8f</
     uuid>
  <forward mode='pci-passthrough-hybrid'>
    <pf dev='eth2.123' vlan='123'/>
  </forward>
</network>
```

Domain XML:

```
<interface type='network'>
  <source network='sfc-network'/>
  <mac address='00:50:56:3e:86:29'/>
  <model type='virtio'/>
  <address type='pci' domain='0x0000' bus='0x00' slot='0x0a'
     function='0x0'/>
</interface>
```

Virt-manager configuration for SR-IOV: Adding a new interface

This Solarflare driver distribution includes an updated version of virt-manager - a GUI tool for managing VMs (refer to Virt-manager configuration for SR-IOV: Adding a new interface on page 331 for details). This can be used as an alternative method to configure VMs for SR-IOV rather than working directly with the XML definitions.

To run the GUI tool as root use the following command:

```
# /usr/bin/virt-manager
```


Alternatively, virt-manager can be on another host and connect to the KVM host via "File"- >"Add Connection".

Creating an SR-IOV network

1 Select "Connection Details" from virt-manager's "Edit" menu, and open the "Virtual Networks" tab
2 Click the "+" button in the bottom-left to open the network creation wizard
3 Choose a name for your network
4 On the address space page, untick the "Create address space" button. On the next page the "Enable
5 DHCP" button will be grayed out as it's not applicable without an address space
6 On the next page, select "Forwarding to physical network"
7 In the "Destination" box, choose the "Phyiscal device X" that corresponds to the Solarflare interface you wish to use
8 In the "Mode" box, select "Hybrid VF/macvtap"

Assigning an existing VM to an SR-IOV network

1 In the main virt-manager window, double-click the VM to manage it
2 Open the hardware tab by clicking the "(i)" button on the toolbar
3 Select the NIC you wish to use with SR-IOV from the list on the left
4 Update the "Source device" entry to use your SR-IOV network

Verifying SR-IOV

As described above, libvirt will manage VFs for interfaces with a new mode pci-passthrough-hybrid. If there are spare VFs available when the VM is started then one (or more) VFs will be attached into the running guest. If the guest OS has the Solarflare VF drivers, and the interface is a virtio interface, then the virtio interface will be accelerated.

Once the VM has started, examine lspci to verify that a VF is present:

```
$ lspci
00:08.0 Ethernet controller: Solarflare Communications Device 1803
00:09.0 Ethernet controller: Solarflare Communications Device 1803
```

The interface is only accelerated once it's brought up, after the interface is bought up USE dmesg TO verify that a VF is accelerating a virtio adapter:

```
$ dmesg | grep –i xnap
xnap 0000:00:0a.0: accelerated eth2
```


7.6 Performance Tuning

The guest drivers have been tuned for optimized bandwidth and CPU utilization with a variety of high bandwidth streaming tests. Some applications may perform better by changing the default values. Table 80 describes the tuning parameters and suggests values for streaming and latency dominated applications.

Table 80: Tuning Parameters

Parameter	Linux	Streaming	Latency
Receive ring size	rx_ring	Default	Default
Interrupt Moderation	rx_irq_mod_usecs	Default	0

To modify these settings:

1. Edit `/etc/modprobe.conf`, inserting a line like this:

```
options xnap rx_irq_mod_usec=<value> rx_ring=<value>
```

2. Reload the xnap driver

```
# modprobe -r xnap
# modprobe xnap
```

Performance Configuration

- Equipment Configuration

Performance tests were conducted between two (back to back) Dell PowerEdge C6100: 4 x Xeon X5600, 48G RAM. Host and Guest are configured on each machine.

- Host
  - Host OS: RHEL 6.2 64 bit.
  - The irqbalance service is stopped.
- Guest
  - The guest VM was running RHEL6.1 64bit.
  - The irqbalance service was stopped in the guest VM.
  - Benchmarking tool: Netperf.

Performance Results

Table 81 records bandwidth figures for 4 TCP streams per port, per direction, between each pair of VMs on the two servers (message size of 65535 bytes).

Table 81: Linux KVM Performance

Number of 10G ports	Traffic	Number of VMs	Baseline (no SR-IOV)	Accelerated (SR-IOV plug-in)
1	Unidirectional	1	6.64 Gbps	9.37 Gbps
1	Bidirectional	1	6.74 Gbps	11.5 Gbps
2	Bidirectional	1	7.37 Gbps	11.2 Gbps

7.7 Migration

Libvirt has been extended to fully support migrating a guest VM using SR-IOV acceleration between two KVM hosts.

Consider migrating a VM from host A to host B (Figure 55). Before migration libvirt will remove all VFs from the VM. Once the VM reaches host B VFs will be allocated, initialized and attached as previously described. If there are no VFs free then the VM will no longer be accelerated. If the migration fails for whatever reason then the VM will remain on host A, and the VFs will be reattached to the VM.

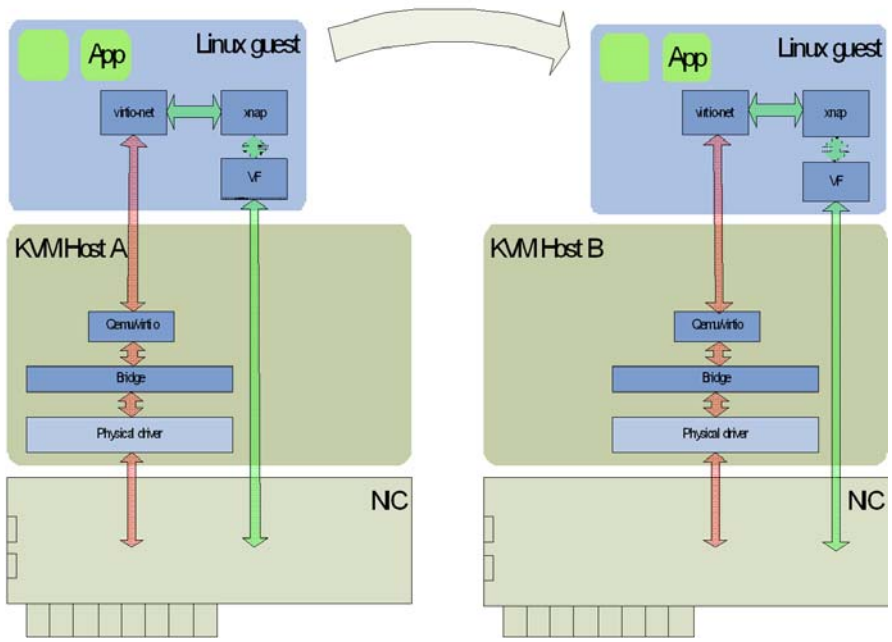


Figure 55: Migrating a guest - KVM

Limitations

- Virt-manager will support bridges on top of vlan interfaces but the vlan interface should be named as ethx.<vlan_id>.
- RHEL 6.1 driver - Libvirt will not configure VFs manually added to a VM configuration (via virt-manager or virsh edit). Only VFs attached via the vf-hotplug XML element will be configured.
- RHEL 6.2 driver - Libvirt will not configure VFs manually added to a VM configuration (via virt-manager or virsh edit). Only VFs attached via the `pci_passthrough-hybrid forward mode` and `pf dev` XML element will be configured.

Known Issues

- Some hardware platforms are unable to support 127 VFs on both ports simultaneously. The current workaround is to reduce the number of VFs exposed by the adapter using “sfboot”.
- When a Redhat Enterprise Linux 6 guest is migrated, occasionally the guest kernel fails to notice either the VF unplug before migration or the VF hotplug after migration. This issue is believed to be a Redhat kernel bug and is under investigation.
- Reloading the sfc driver while VFs are in use will result in a kernel panic. This is an upstream kernel bug that Solarflare are working to address.
- There is a known issue when using LRO with macvtap interfaces. This issue can be worked around by disabling LRO on the host machine. This issue does not affect the SRIOV accelerated datapath.
- There is a known issue whereby the user tries to PXE boot one KVM guest off another KVM guest, on the same host, over a macvtap interface the client does not receive the tftp packets sent by the server and the connection times out. Solarflare are following up this issue with RedHat. A workaround for this issue is disabling tx-checksumming on the PXE server VM.

Chapter 8: SR-IOV Virtualization for XenServer

This chapter describes Solarflare's unified approach to SR-IOV Virtualization using Xenserver™ 6 supporting Windows and Linux guests. Solarflare SR-IOV enables accelerated cut-through performance while maintaining full compatibility with hypervisor based services and management tools.

8.1 Supported Platforms and Adapters

Solarflare XenServer6 SR-IOV acceleration currently supports:

- XenServer 6.0, 6.1.
- Intel platforms supporting VT-d.
- AMD platforms supporting AMD-Vi.
- Guest VM - Win2k8r2 and RHEL 6.
- All Solarflare SFN5xxx and SFN6xxx series adapters.

The hardware supports different configurations of (a) the number VFs exposed and (b) the number of vNICs (and therefore MSI-X interrupts) to give to each VF. This can be configured with the sfboot utility.

Currently the default configuration is 127 VFs each allocated 1 vNIC.

NOTE: Solarflare's hybrid SR-IOV solution is no longer supported by Citrix and is limited to XenServer 6.0. Further, this solution is limited to supporting Windows guests and Linux guests running RHEL 6.1 (or earlier). Attempting to use this SR-IOV solution with guest VMs running a newer version of RHEL may expose a hypervisor bug that prevents network traffic passing.

8.2 XenServer6 SR-IOV

Traditional Virtualization (without SR-IOV)

Traditional Xen paravirtualized networking involves bridging (paravirtualized) Netback devices to physical network devices in dom0. The Netback driver interfaces with the Netfront driver running in the guest, facilitating guest to guest connectivity.

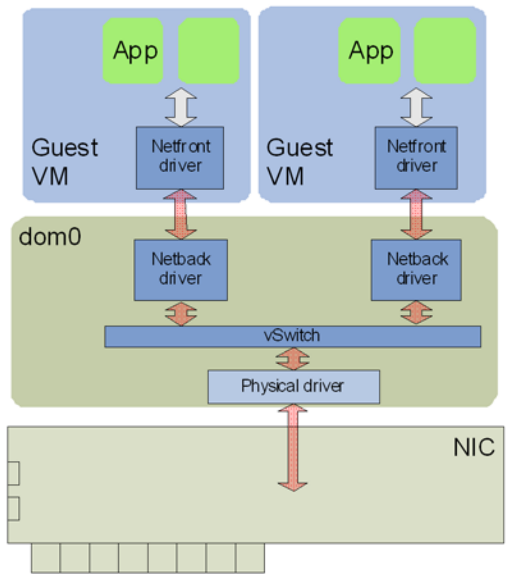


Figure 56: Guest to Guest Connectivity

As a result of hardware virtualization, data copies between the Netfront driver in the guest and the Netback driver in dom0 within the XenServer host become the bottleneck to the performance of this implementation.

Typical Virtualization (with SR-IOV)

In emerging SR-IOV solutions PCIe hardware virtual functions (VF) allow a single network hardware device to appear as multiple virtualized network devices to dom0. These virtualized network devices operate independently of one another and present characteristics of actual physical devices to dom0.

Using SR-IOV, a VF is passed-through to the guest operating system, and the guest network driver binds directly to this PCIe VF, allowing the guest to bypass dom0 and providing direct access to the network adapter from the guest VM. Direct access to the network hardware means that overheads associated with dom0-based networking (virtualization, data copies, etc.) are eliminated, providing significantly improved performance, see Figure 57.

However, a significant downside of this approach is that XenServer blocks migration of a VM when a VF is present, which significantly reduces the functionality of server virtualization.

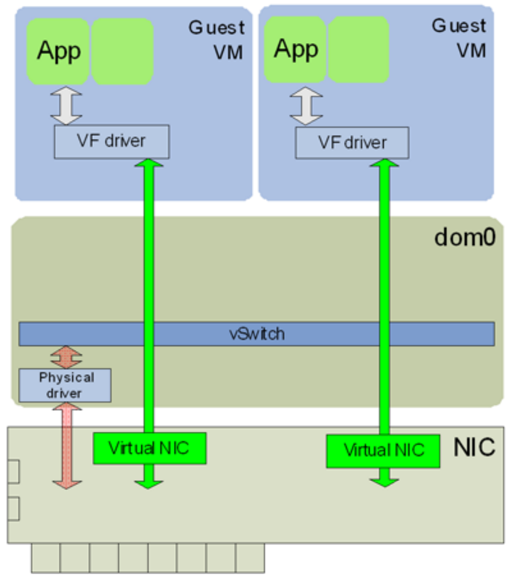


Figure 57: Direct Guest Access to NIC Hardware

It is also worth noting that the networking interface in this model is now a vendor supplied driver and creation or configuration of networking interfaces must be done via the vendor's driver and not the standard XenServer network drivers.

Solarflare Plug-in Model

Solarflare, in a collaborated development with Citrix, has implemented a unique unified approach to SR-IOV that enables accelerated cut-through performance while maintaining full compatibility with hypervisor-based services and management tools. Solarflare's 254 VFs enable highly scalable workload consolidation for large data center environments and virtual desktop infrastructure (VDI) deployments. Unlike other adapters, each Solarflare VF can use multiple DMA channels that enable the VF to scale over vCPUs using RSS and/or RFS. Solarflare's 2048 DMA channels provide the most scalable virtualized network I/O solution available in the market.

Solarflare's SR-IOV implementation uses a plug-in approach that maintains the traditional (software) data path through the XenServer paravirtualized drivers, and then through the vSwitch to the physical device network driver. In addition, there is an alternative (accelerated) data path through the VF driver directly to the network adapter from the guest. Packets are received on either data path transparently to the guest VM's network stack. For transmitted data, the enabled plug-in makes the decision on whether or not to use the accelerated path. Refer to Figure 58.

With this approach a VM can be created/cloned using traditional tools, and networking to/from the VM can initially use the standard software network path. Citrix XenServer6 will pass-through a VF from the network adapter into the guest. The guest identifies that new hardware has been hot plugged and binds the Solarflare plug-in driver to this VF. This plug-in driver automatically registers with the Netfront driver as an accelerated network plug-in. Once the VF driver has registered, subsequent traffic to/from the guest uses the accelerated data path accessing the adapter directly from the guest. If the VF is hot unplugged (i.e. removed from the guest), the plug-in deregisters with the Netfront driver and the networking traffic reverts to the software data path.

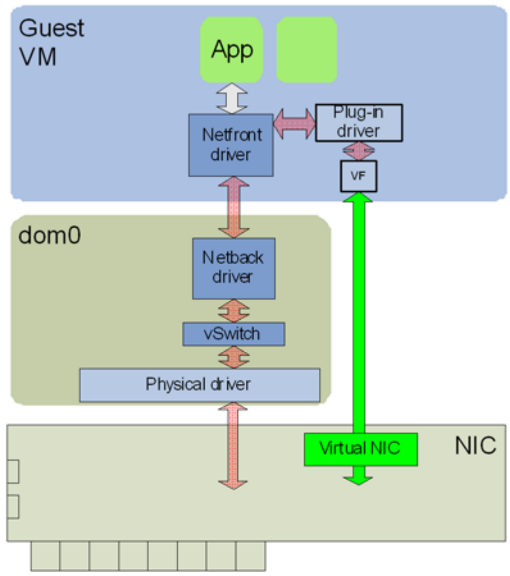


Figure 58: Network Plug-in Model

This approach means there is no dependency on the VF or its driver for the networking data path of the VM. Acceleration can be disabled at any time if needed without losing network connectivity, and migration is fully supported in this model. When a VM is being migrated, XenServer hot unplugs the VF from the VM and the network path reverts to the software path, and after migration is complete XenServer hot plugs a new VF from an adapter on the destination machine back to the VM and the networking path is again accelerated. Solarflare's unique approach also removes the limitations imposed by typical SR-IOV implementations, enabling VMs to be moved between non-identical hosts. For example, if a guest is migrated to a host containing a different vendor's NIC, then the hot plug event provides the opportunity to bind a new VF driver within the guest and re-establish accelerated networking. Equally, if the new host does not contain suitable hardware, then no accelerated path is established, yet networking will continue using the original (or traditional) paravirtualized architecture.

Benefits of Solarflare's SR-IOV solution

- **Maximum performance**. Using SR-IOV reduces CPU utilization, increases bandwidth and lowers latency. Performance returns to near native (non-virtualized) levels.
- **Full support of migration**. Ability to migrate VMs accelerated with the SR-IOV solution - either to a machine also supporting the same SR-IOV solution or to a XenServer system with a non-Solarflare adapter.
- **Large number of VFs**. Solarflare adapters support 127 VFs per port - far more than other SR-IOV capable adapters. This allows up to 127 VMs per 10G port to be accelerated per host.
- **RSS support in guest VMs**. Solarflare adapters support up to 1024 vNICs per port. Multiple vNICs can be exposed through a single VF to a guest VM. This allows a guest VM to have multiple

transmit and receive queues. The Solarflare plugin model fully supports intelligently spreading network traffic over multiple queues to scale performance over the available CPUs. This is termed receive side scaling (RSS) and is typically used in non-virtualized environments (Linux/ Windows) to improve network performance. With the Solarflare plugin model when VMs are deployed to run on multiple (virtual) CPUs, each CPU can be given a dedicated transmit and receive queue so that network performance scales over the available CPU cores.

8.3 Installation

Platform support

To use SR-IOV, platform support for hardware virtualization must be enabled. Refer to Enabling Virtualization Extensions for more information. On an Intel platform, the Xen hypervisor will, by default, use the Intel IOMMU if it is enabled in the BIOS.

On an AMD platform the Xen hypevisor command line must be modified to enable the IOMMU. Append the following statements to the hypervisor line in `/boot/extlinux.conf`

```
amd_iommu=on  iommu=amd-iommu-perdev-intremap
```

Install XenServer6 with SR-IOV supplemental pack

1. Burn the supplemental pack (`xs-SR-IOV-1.1.7-sfc.iso`) to a CD.
2. Insert the CD when prompted to do so by the XenServer6 installation.

Update adapter firmware and enable SR-IOV

1. Download the Solarflare Linux Utilities (SF-104451-LS) from support.solarflare.com.
2. Install the Linux Utilities in dom0 using the rpm provided in this package:
```
# rpm -Uvh sfutils-<version>.rpm
```
3. Display the current firmware version on the adapter:
```
# sfupdate
```
4. Upgrade the adapter firmware with sfupdate:
```
# sfupdate --write
```
5. Use sfboot to enable SR-IOV and enable 16 VFs:
```
# sfboot sriov=enabled vf-count=16
```
6. A reboot is required for the changes to take effect. After the reboot the sfc driver will initialize the VFs, and they will appear in lspci:
```
# lspci -d 1924:
06:00.0 Ethernet controller: Solarflare Communications SFL9021
[Solarstorm]
06:00.1 Ethernet controller: Solarflare Communications SFL9021
[Solarstorm]
06:00.2 Ethernet controller: Solarflare Communications Device 1813
06:00.4 Ethernet controller: Solarflare Communications Device 1813
06:00.6 Ethernet controller: Solarflare Communications Device 1813
```



```
06:01.0 Ethernet controller: Solarflare Communications Device 1813
06:01.2 Ethernet controller: Solarflare Communications Device 1813
06:01.4 Ethernet controller: Solarflare Communications Device 1813
06:01.6 Ethernet controller: Solarflare Communications Device 1813
06:02.0 Ethernet controller: Solarflare Communications Device 1813
```

Table 82 identifies sfboot SR-IOV configurable options.

Table 82: sfboot - SR-IOV options

Option	Default Value	Description
sriov=<enabled | disabled>	disabled	enable/disable hardware SR-IOV
vf-count=<n>	127	number of virtual functions advertised
vf-msix-limit=<n>	1	number of MSI-X interrupts per VF

NOTE: Enabling all 127 VFs per port with more than one MSI-X interrupt per VF may not be supported by the host BIOS and you may get 127 VFs on one port with no VFs on the other port. Contact your BIOS vendor for a BIOS upgrade or reduce the VF count.

Install the XenTools drivers

Install the XenTools drivers (`xensetup.exe`) included with XenServer6. This applies to both Windows and Linux guests.

Install the Solarflare SR-IOV drivers

For Linux Guests:

```
# tar xvfz sfc-xnap-netfront-v1_0_0_0012.tgz
# make -C sfc-xnap-netfront-v1_0_0_0012/ modules_install
```

For Windows Guests:

Install the Solarflare acceleration driver into the Windows guest using `xnapsetup.exe.`

8.4 Configuration

Acceleration

The SR-IOV supplemental pack manages all VF configuration. SR-IOV acceleration is configured on a per Virtual Interface (VIF) basis allowing the administrator to control which VMs are accelerated on a per network basis.

To enable SR-IOV acceleration of a VIF enable the `other-config:sriov` parameter:

```
# xe vif-param-set uuid=<vif uuid> other-config:sriov=true
```

The vif-uuid is the VIF based on VM and Network:

```
# xe vif-list network-name-label=<network label> vm-name-label=<vm
label>
```

Consult the XenServer6 documentation for more information on enumerating VIFs. To disable acceleration, remove the `other-config:sriov` parameter:

```
# xe vif-param-remove uuid=<vif uuid> param-name=other-config param-
key=sriov
```

Once the VM is rebooted (or started) VFs will be allocated, configured, and PCI hotplugged into the running guest.

Guest configuration

Check that the correct number of VF's are pushed into the guest using the following commands on DOM0.

```
# xl list
Name                 ID   Mem VCPUs State   Time(s)
Domain-0             0   729     4  r-----  130.4
dibenchvm080         1     0     1  ---s-d  17.8
dibenchvm020         2  2047     1  -b----  18.1

# xl pci-list <domain ID>
Vdev Device
09.0 0000:07:00.6
0a.0 0000:07:00.7
```

8.5 Performance Tuning

The guest drivers have been tuned for optimized bandwidth and CPU utilization with a variety of high bandwidth streaming tests. Some applications may perform better by changing the default values. Table 83 describes the tuning parameters and suggests values for streaming and latency dominated applications.

Table 83: Tuning Parameters

Parameter	Name		Application	
	Windows	Linux	Streaming	Latency
Receive ring size	rx_ring	rx_ring	Default	Default
Interrupt Moderation	irq_usecs	rx_irq_mod_usecs	Default	0

Windows Guests

1 Install the Solarflare SR-IOV guest drivers for Windows.

2 Create the following registry key:

`HKLM\SYSTEM\CurrentControlSet\services\XNAP\Parameters\`

3 Create any of the following registry values under the `XNAP\Parameters key`.

`irq_usecs REG_DWORD <value>`

`rx_ring REG_DWORD <value>`

4 Reboot the VM.

Linux Guests

1 Edit `/etc/modprobe.conf`, inserting the following entry:

`options xnap rx_irq_mod_usec=<value> rx_ring=<value>`

2 Reload the xnap driver:

```
# modprobe -r xnap
# modprobe xnap
```

Performance Results

- Equipment Configuration

Performance tests were conducted between two (back to back) Dell PowerEdge C6100: 4 x Xeon X5600, 48G RAM.

- Host

Host Virtualization plan used was XenServer6.

- Guest

A number of guest VMs running Windows Server 2008 R2 (64bit) were started on each server. The benchmarking tool used was IXIA Chariot (HighPerf test script) for measure bandwidth.

Windows Guest Bandwidth

Table 84 identifies bandwidth figures recorded for 5 TCP streams per port, per direction, between each pair of VMs on the two servers (message size of 65535 bytes, each VM was configured with 4 vCPUs).

Table 84: Windows Guest Bandwidth

Number of 10G ports	Traffic	Number of VMs	Baseline (no SR-IOV)	Accelerated (SR-IOV plug-in)
1	Unidirectional	1	1.66 Gbps	3.49 Gbps
1	Bidirectional	1	2.52 Gbps	3.88 Gbps
2	Bidirectional	1	2.71 Gbps	4.20 Gbps
1	Unidirectional	4	4.85 Gbps	9.39 Gbps
1	Bidirectional	4	5.99 Gbps	17.9 Gbps

Table 84: Windows Guest Bandwidth

Number of 10G ports	Traffic	Number of VMs	Baseline (no SR-IOV)	Accelerated (SR-IOV plug-in)
2	Bidirectional	4	6.64 Gbps	19.3 Gbps

Linux Guest Bandwidth

Table 85 identifies bandwidth figures recorded for 5 TCP streams per port, per direction, between each pair of VMs on the two servers (message size of 65535 bytes, each VM was configured with 4 vCPUs).

Table 85: Linux Guest Bandwidth

Number of 10G ports	Traffic	Number of VMs	Baseline (no SR-IOV)	Accelerated (SR-IOV plug-in)
1	Unidirectional	1	2.23 Gbps	9.25 Gbps
1	Bidirectional	1	1.91Gbps	15.3 Gbps
2	Bidirectional	1	3.65 Gbps	30.7 Gbps
1	Unidirectional	4	4.80 Gbps	9.31 Gbps
1	Bidirectional	4	5.80 Gbps	14.9 Gbps
2	Bidirectional	4	6.24 Gbps	32.8 Gbps

Limitations

- The Citrix XenTools bundled with XenServer6 do not support RSS. Therefore the Solarflare SR-IOV accelerated drivers currently do not support RSS on Windows.

Known Issues

- Some hardware platforms are unable to support 127 VFs on both ports simultaneously. The current workaround is to reduce the number of VFs exposed by the adapter using `sfboot`.
- VFs no longer appear in `xl pci-list` after a VM is rebooted. The VFs will be visible using lspci/device manager. This is a Citrix XenServer 6 toolstack issue that will be addressed in future XenServer versions.
- Migrating a Windows VM disables GSO (Generic Segmentation Offload), thereby reducing VM-VM bandwidth between VMs on the same host. This is a XenTools bug in the version released with Citrix XenServer 6, and should be resolved in a future Citrix hotfix.
- Do not reload the dom0 sfc driver when VFs are in use. This is an upstream Linux kernel bug.
- When a Red Hat Enterprise Linux 6 guest is migrated, occasionally the guest kernel fails to notice either the VF unplug before migration or the VF hotplug after migration. This issue is believed to be a Red Hat kernel bug and is under investigation. This issue is not seen on Windows guests.
- VF PCI-passthrough when using RHEL6.2 or newer guests fails due to loss of interrupt to the VF by the hypervisor. This issue is seen only when the VF is passed through to the guest. This issue does not exist on RHEL6.1 guests. This is an issue in the XenServer hypervisor.
- The Xen-tools rpm does not work on a RHEL6.0 guest. This is a Citrix bug.
- •The xs-sriov-accel patch is overwritten after the hotfixes are applied to XenServer6. To get around this issue reapply changes using the following command line:

```
cd / && patch -p1 < /var/xapi/patches/qemu.patch
```

For reference the patch file is:

```
diff -rup a/opt/xensource/libexec/qemu-dm-wrapper
b/opt/xensource/libexec/qemu-dm-wrapper
--- a/opt/xensource/libexec/qemu-dm-wrapper2011-08-12
     18:03:28.000000000+0100
+++ b/opt/xensource/libexec/qemu-dm-wrapper2011-08-12
     18:04:01.000000000+0100
@@ -82,6 +82,7 @@ def main(argv):
  qemu_dm = '/usr/lib/xen/bin/qemu-dm'
domid = int(argv[1])
qemu_args = ['qemu-dm-%d'%domid] + argv[2:]
+    qemu_args.append("-priv")
if is_sdk() is True:
  return fake_dm(domid)
```


Chapter 9: Solarflare Adapters on Mac 0S X

This chapter covers the following topics on the Mac 0S X® platform:

9.1 System Requirements

- Refer to Software Driver Support on page 13 for supported Mac OS X Distributions.
- Solarflare Mac OS X drivers are supported for all Solarflare SFN5xxx AND SFN6xxx series adapters.
- Driver package SF-107120-LS supports OS X 10.8 and earlier versions.
- Driver package SF-111621-LS supports OSX 10.9 and later versions.

9.2 Supported Hardware Platforms

The following Apple hardware platforms are supported:

- Mac Pro
- Mac Pro Server
- X-Serve (supported but not routinely tested by Solarflare)

9.3 Mac 0S X Platform Feature Set

The following table lists the features supported by Solarflare adapters on Mac OS X distributions.

Table 86: Mac OS X Feature Set

Large Receive Offload	TCP receive frame coalescing to reduce CPU utilization and improve TCP throughput
TCP Segmentation Offload	TCP transmit segmentation to reduce CPU utilization and improve TCP throughput
RMON	Statistics counters
Checksum offloads	IPv4, TCP and UDP
MSI Interrupts	
MTU	Standard 1500 byte and jumbo 9000 byte MTU

9.4 Thunderbolt

The Solarflare adapter driver provides basic support for Thunderbolt. When a network adapter is connected to a Thunderbolt-capable system e.g. via a Thunderbolt-to-PCIe chassis, the interfaces can be configured in the usual way.

Due to limitations in the Thunderbolt connection performance may be worse compared to using the Solarflare adapter in a PCIe slot.

Full support for Thunderbolt, including plugging and unplugging the Thunderbolt cable is planned for a future release.

9.5 Driver Install

Uninstall Previous Driver

An installed Solarflare network adapter driver **MUST BE UNINSTALLED** before upgrading to a new driver release.

1 Open System Preferences > Network.

2 Disable the service for all ports of the driver:

- choose an active driver service in the list

- click on the gear icon and choose ’Make Service Inactive’’

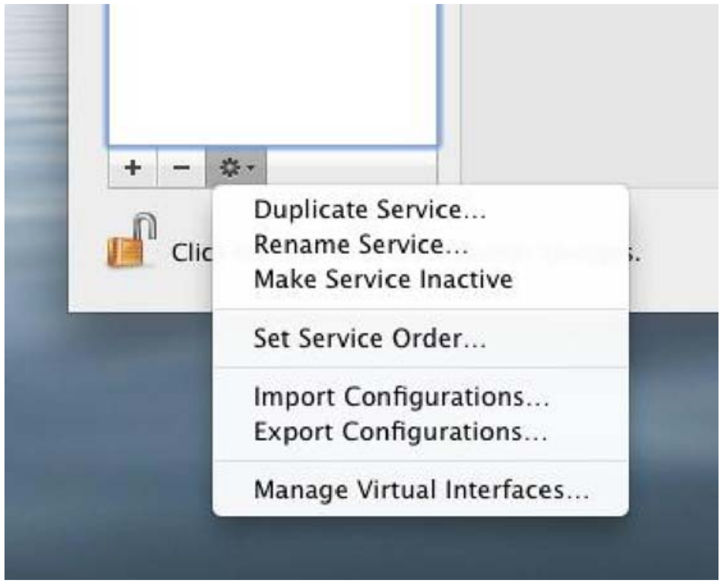


Figure 59: Disable Driver Services

3 Repeat above steps for all ports of the driver.

4 Double-click SF-107120-LS.dmg in Finder to mount the disk image. Invoke the Solarflare driver uninstall script in Terminal as root (replacing <version> with the version number of the install package that is being used)

```
/Volumes/Solarflare10GbE-<version>/uninstall.sh
```

Download and Install the Mac OS X Driver

1. Download SF-107120-LS.dmg into a convenient working directory.
2. Double click SF-107120-LS.dmg in Finder to mount the disk image.
3. Run the Solarflare10GbE.pkg install package and follow the install instructions.

Figure 60: Install Solarflare Driver Window

9.6 Interface Configuration

With the adapter driver installed, the network interface can be configured using the network interface settings menu:

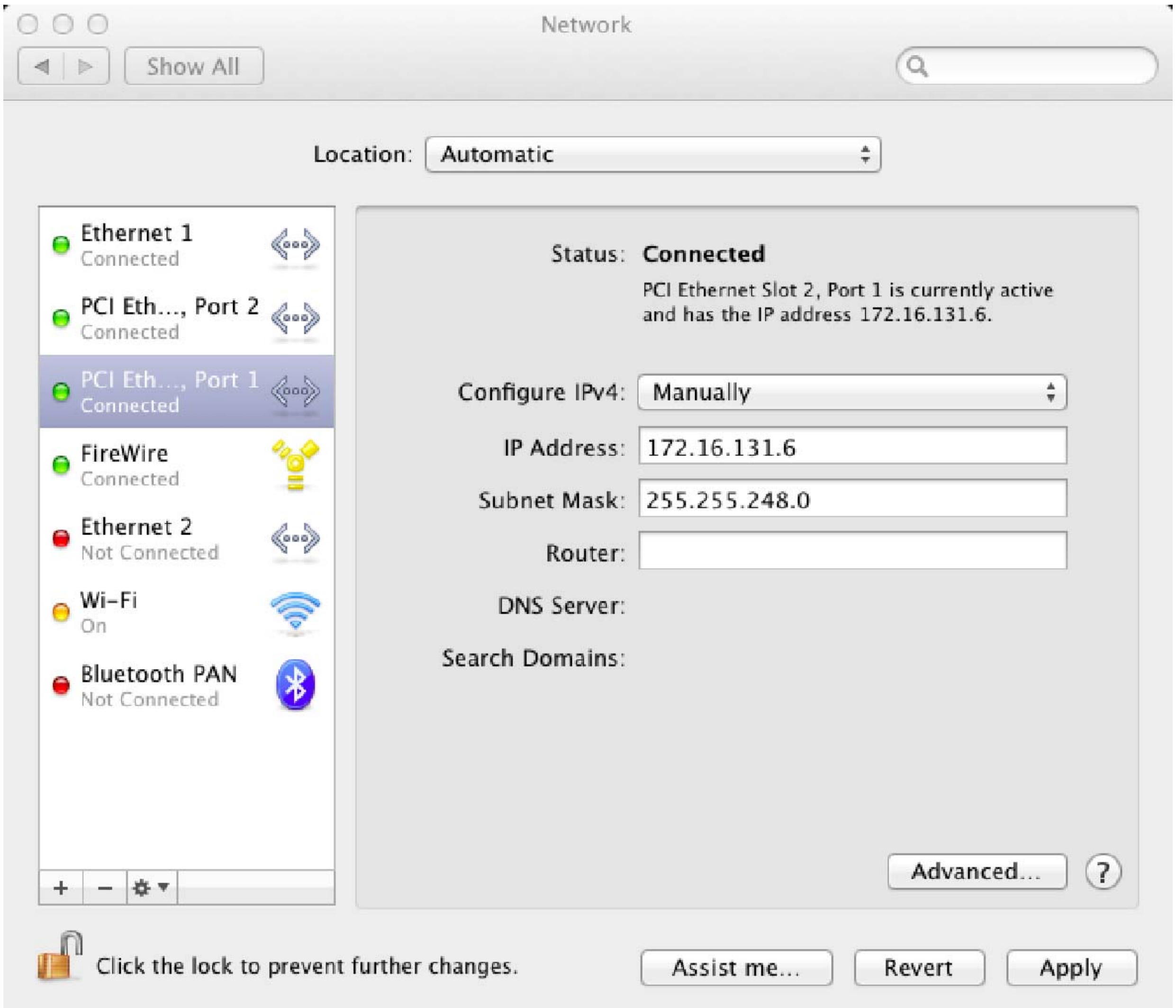


Figure 61: Solarflare Adapter Interface Configuration

9.7 Tuning

System Tuning

For many applications (including file serving) tuning the Mac OS X network stack for 10G operation can improve network performance. Therefore, for such applications it is possible to tune the Mac OS X kernel and network stack by applying the following settings in the `/etc/sysctl.conf` file. Settings added to /etc/sysctl.conf are effective following a machine reboot.

```
kern.ipc.maxsockbuf=4194304
net.inet.tcp.sendspace=2097152
net.inet.tcp.recvspace=2097152
net.inet.tcp.delayed_ack=2
```

Settings can also be updated using the following method - but these are non-persistent and will return to default values following a reboot:

```
sudo sysctl -w <name>=<value>
```

Optional Driver Tuning

The driver's default configuration has been chosen to provide optimal performance over a wide range of applications. It is recommended to only change the driver settings if advised to do so by Solarflare support.

9.8 Driver Properties via sysctl

Driver properties are also made visible via the `sysctl` program. Changes made via `sysctl` calls are applied immediately, and are not persistent (i.e. the changes are lost when the driver is unloaded or after a reboot). To make persistent changes to `sysctl` values, edit the file `/etc/sysctl.conf`.

Changes made via `sysctl` apply to a single driver interface, using the BSD name of the network interface. The BSD name of a network interface is shown by the ifconfig command line tool, and in the Network Utility application. For Ethernet interfaces, the BSD name starts with en followed by a number.

Table 87 identifies currently supported driver `sysctl` values.

Table 87: Mac OS X sysctl driver values

sysctl name	R/W	Value	Description
`net.sfxge.version`	RO		Driver version string
`net.sfxge.<enX>.mac`	RO		MAC address
`net.sfxge.<enX>.moderation`	RW	0 > 0	Disable interrupt moderation interrupt moderation (microsecs)

Table 87: Mac OS X sysctl driver values

sysctl name	R/W	Value	Description
net.sfxge.<enX>.rx_ring_size	RW	512 1024 2048 4096	Hardware receive ring entries
net.sfxge.<enX>.tx_ring_size	RW	512 1024 2048 4096	Hardware transmit ring entries
net.sfxge.<enX>.ipv4lro	RW	0 1	IPv4 LRO disabled IPv4 LRO enabled
net.sfxge.<enX>.ipv6lro	RW	0 1	IPv6 LRO disabled IPv6 LRO enabled
net.sfxge.<enX>.ipv4tso	RO	0 1	IPv4 TSO disabled IPv4 TSO enabled
net.sfxge.<enX>.ipv6tso	RO	0 1	IPv6 TSO disabled IPv6 TSO enabled

9.9 Firmware Update

The Solarflare driver package for Apple Mac OS X also includes the firmware update utility program sfupdate.

When the driver package is installed the sfupdate binary is installed into `/Library/Application Support/Solarflare10GbE` directory and a symbolic link placed in `/usr/local/bin/sfupdate`.

When upgrading or installing the network adapter driver it is recommended to upgrade the adapter firmware.

sfupdate: Command Usage

The general usage for sfupdate is as follows (as root):

```
sfupdate [--adapter=enX] [options]
```

where:

enX is the interface name of the Solarflare adapter to be upgraded.

`option` is one of the command options listed in Sfupdate Options on page 357.

The format for the options are `<option>=<parameter>`

Running the command `sfupdate` with no additional parameters will display the current firmware version for all Solarflare adapters and identifies whether the firmware within sfupdate is more up to date.

sfupdate: All Solarflare adapters

1. Run `sfupdate` to check that the firmware on all adapters is up to date.
2. Run `sfupdate --write` to update the firmware on all adapters.

sfupdate: Command Line Options

Table 88 lists the options for `sfupdate`.

Table 88: Sfupdate Options

Option	Description
`-h, --help`	Display help for the available options and command line syntax.
`-i, --adapter=enX`	Specifies the target adapter when more than one adapter is installed in the localhost. enX = Adapter ifname or MAC address (as obtained with `--list`).
`--list`	Shows the adapter ID, adapter name and MAC address of each adapter installed in the localhost.
`--write`	Re-writes the firmware from the images embedded in the `sfupdate` tool. To re-write using an external image, specify `--image=<filename>` in the command. `--write` fails if the embedded image is the same or a previous version. To force a write in this case, specify `--force` in the command.
`--force`	Force the update of all firmware, even if the installed firmware version is the same as, or more recent then, the firmware embedded in `sfupdate`.
`--image=(filename)`	Update the firmware using the binary image from the given file rather than from those embedded in the utility.
`-y, --yes`	Prompts for user confirmation before writing the firmware to the adapter.
`-v, --verbose`	Verbose mode.
`-s, --silent`	Suppress output while the utility is running; useful when the utility is used in a script.

Table 88: Sfupdate Options

Option	Description
`-V --version`	Display version information and exit.

9.10 Performance

The following section is an overview of benchmark tests results measured by Solarflare to provide an indication of expected performance with current drivers.

Performance tests were conducted on Mac OS X 10.7.2 on a pair of Mac Pro servers configured back-to-back. The Mac OS X network stack was tuned for 10G operation as described in Tuning on page 355.

Reference System Specification

- MacPro5,1, 3GB memory (all channels populated)
- Processor: Single Quad-Core Intel Xeon @ 2.8 GHz L2 Cache (per core): 256 KB, L3 Cache: 8 MB

Throughput (Netperf TCP_STREAM)

Results using Netperf IPv4 TCP_STREAM at 1500 MTU:

Table 89: Throughput Results

Message size	No. of streams	Bandwidth
64Kbyte	1	9.26 Gb/s
64Kbyte	1 bidirectional	17.8 Gb/s

Latency (Netperf TCP_RR)

Latency measured using Netperf IPv4 TCP_RR will depend on the interrupt moderation settings and the type of SFN5xxx adaptor used (10GBaseT cards have higher latency). Latency as measured on SFN5122F at the standard 1500 MTU is as follows:

- Interrupt moderation at 40µs : **45.7 µs** RTT/2
- Interrupt moderation disabled: **18.2 µs** RTT/2

File System Benchmarks (AJA System Test)

The AJA System Test benchmark provides some indication of likely network file system performance for video applications.

System Setup:

- 2.25GB ramdisk on file-system ‘target’ server. The test consisted of writing and then reading a 1.0GB file to and from this ramdisk
- SFN5122F SFP+ back-to-back configuration
- To configure a ramdisk for the test (of size 4500000 x 512k sectors):

```
$ sudo diskutil eraseVolume HFS+ "ramdisk" `hdiutil attach -nomount
ram://4500000`
```

Table 90: File System Benchmark Test Results

Protocol		1500 MTU		9000 MTU Jumbo	
AFP	**Frame size**	**Read MB/s**	**Write MB/s**	**Read MB/s**	**Write MB/s**
	720 X 468, 8 bit	439.5	547.6	433.0	574.4
	1920 x 1080, 10 bit	509.3	728.3	502.3	770.1
	4096 x 2160, 10 bit-RGB	521.3	807.0	516.0	849.5
SMB	1920 X 1080, 10 bit	312.7	255.7	370.0	291.3

Chapter 10: Solarflare Boot ROM Agent

Solarflare adapters support PXE and iSCSI booting, enabling diskless systems to boot from a remote target operating system. Solarflare adapters comply with PXE 2.1. This chapter covers the following topics:

Solarflare adapters are shipped with boot Rom support 'exposed', that is the Boot ROM Agent runs during the machine bootup stage allowing the user to enter the setup screens (via Ctrl+B) and enable PXE support when this is required. The Boot ROM Agent can also be invoked using the Solarflare supplied sfboot utility - For instructions on the sfboot method refer to the sfboot commands in the relevant OS section of this user guide. PXE boot is supported on all Solarflare adapters.

Some Solarflare distributors are able to ship Solarflare adapters with PXE boot enabled. Customers should contact their distributor for further information.

PXE and iSCSI network boot is not supported for Solarflare adapters on IBM System p servers.

10.1 Configuring the Solarflare Boot ROM Agent

Updating Firmware

Before configuring the Boot ROM Agent, Solarflare recommend that servers are running the latest adapter firmware which can be updated as follows:

- From a Windows environment you can use the supplied Command Line Tool sfupdate.exe. See Sfupdate: Firmware Update Tool on page 202 for more details.
- From a Linux environment, you can update the firmware via sfupdate. See Upgrading Adapter Firmware with Sfupdate on page 70.
- From a VMware environment, you can update the firmware via sfupdate. See Upgrading Adapter Firmware with Sfupdate on page 268.

NOTE: The Solarflare firmware supports both PXE and iSCSI.

Configuring the Boot ROM Agent

The Boot ROM Agent can be configured in the following ways:

- On server startup, press Ctrl+B when prompted during the boot sequence.
- From a Windows Environment, via SAM. See Using SAM for Boot ROM Configuration on page 173. Alternatively you can use the supplied Command Line Tool sfboot. See Sfboot: Boot ROM Configuration Tool on page 188.
- From a Linux environment, via sfboot. See Configuring the Boot ROM with sfboot on page 56.
- From a VMware environment, via sfboot. See Configuring the Boot ROM with Sfboot on page 258.

10.2 PXE Support

Solarflare Boot ROM agent supports the PXE 2.1 specification. PXE requires DHCP and TFTP Servers, the configuration of these servers depends on the deployment service used.

The following deployment services can be used:

Remote Installation Service (RIS) for Windows Server 2003

See the following link for installing and configuring RIS:

http://support.microsoft.com/kb/325862

See Using Remote Installation Service (RIS) on page 131 for more details on using RIS for unattended installation with Windows Server 2003.

Windows Deployment Service (WDS) for Windows Server 2003

See the following link for installing and configuring WDS server on Windows Server 2003:

http://technet.microsoft.com/en-us/library/cc766320%28WS.10%29.aspx

See Windows Deployment Service (WDS) for Windows Server 2003 on page 361 for more details on using WDS for unattended installation with Windows Server 2003.

Automated Deployment Services (ADS) for Windows Server 2003

See the following link for the requirements for using ADS:

http://www.microsoft.com/windowsserver2003/techinfo/overview/adssysreq.mspx

See Automated Deployment Services (ADS) for Windows Server 2003 on page 361 for more details on using ADS for unattended installation with Windows Server 2003.

Windows Deployment Service (WDS) for Windows Server 2008

See the following link for installing and configuring WDS on Windows Server 2008:

http://technet.microsoft.com/en-us/library/cc771670%28WS.10%29.aspx

See Windows Deployment Service (WDS) for Windows Server 2008 on page 361 for more details on using WDS for unattended installation with Windows Server 2008.

Linux

For Red Hat Enterprise and SUSE Linux Enterprise Server, please consult your Linux documentation.

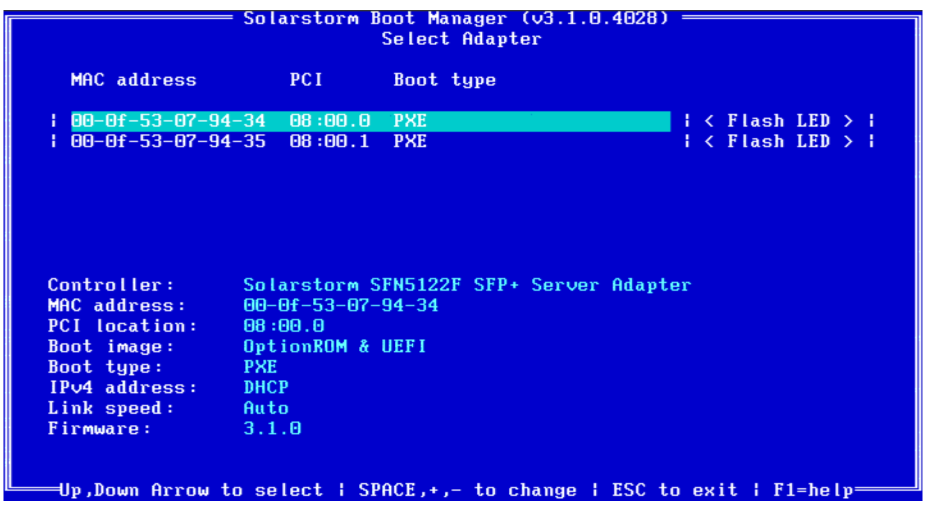
See Unattended Installation - Red Hat Enterprise Linux on page 47 and Unattended Installation - SUSE Linux Enterprise Server on page 48 for more details of unattended installation on Linux

Configuring the Boot ROM Agent for PXE

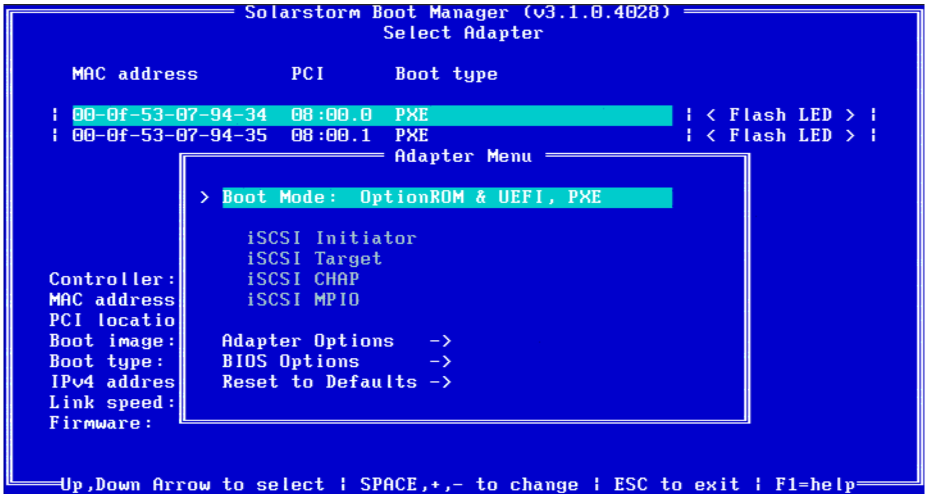
This section describes configuring the adapter via the Ctrl+B option during server startup. For alternative methods of configuring PXE see Configuring the Boot ROM Agent on page 361.

> **NOTE:** If the BIOS supports console redirection, and you enable it, then Solarflare recommends that you enable ANSI terminal emulation on both the BIOS and your terminal. Some BIOSs are known to not render the Solarflare Boot Manager properly when using vt100 terminal emulation.

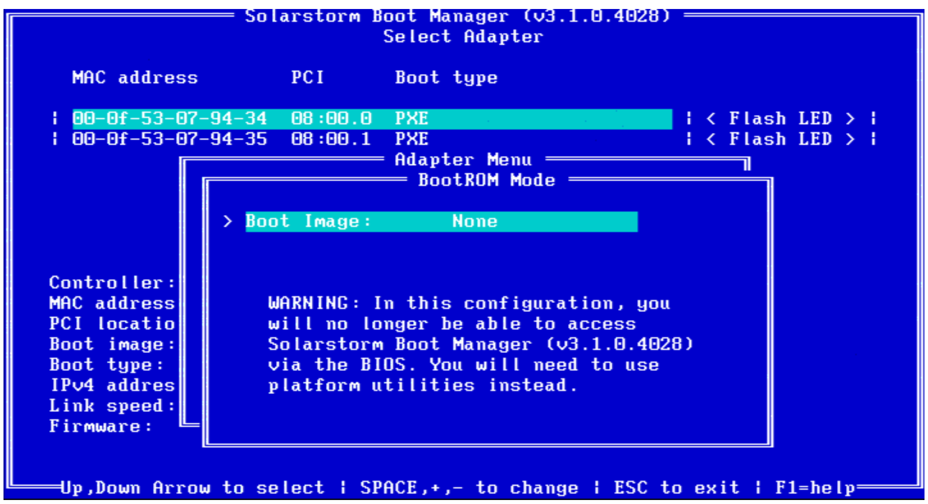
1 On starting or re-starting the server, press **Ctrl+B** when prompted. The Solarflare Boot Configuration Utility is displayed.



2 Use the arrow keys to highlight the adapter you want to boot via PXE and press Enter. The **Adapter Menu** is displayed.



3 From the **Boot Mode** option, press the arrow keys to change the **Boot Image** and/or the **Boot Type**.



4 From the **Boot Type**, press **Space** until PXE is selected.

5 Solarflare recommend leaving the **Adapter Options** and **BIOS Options** at their default values. For details on the default values for the various adapter settings, see Table 92 on page 381.

10.3 iSCSI Boot

Introduction

Solarflare adapters support diskless booting to a target operating system over Internet Small Computer System Interface (iSCSI). iSCSI is a fast, efficient method of implementing storage area network solutions.

The Boot ROM in the Solarflare adapter contains an iSCSI initiator allowing the booting of an operating system directly from an iSCSI target.

NOTE: Adapter teaming and VLANs are not supported in Windows for iSCSi remote boot enabled Solarflare adapters. To configure load balancing and failover support on iSCSI remote boot enabled adapters, you can use Microsoft MultiPath I/O (MPIO), which is supported on all Solarflare adapters.

10.4 Configuring the iSCSI Target

To the server (iSCSI initiator), the iSCSI target represents the hard disk from where the operating system is booted from. To enable connections from the server, you will need to allocate and configure a logical unit number (LUN) on an iSCSI target. The server (iSCSI initiator) will see the LUN as a logical iSCSI device and will attempt to establish a connection with it. You may need to enter details of the Solarflare adapter ID (MAC address) and other details to validate the connection.

Refer to the iSCSI target documentation for details on how to configure your target.

10.5 Configuring the Boot ROM

The server (iSCSI initiator) needs to contain at least one Solarflare network adapter. To enable the adapter for iSCSI booting, you will need to configure the Boot ROM with the correct initiator, target and authentication details. This can also be configured via the sfboot command line tool on all platforms, and through SAM on Windows.

For Windows, see Sfboot: Boot ROM Configuration Tool on page 188

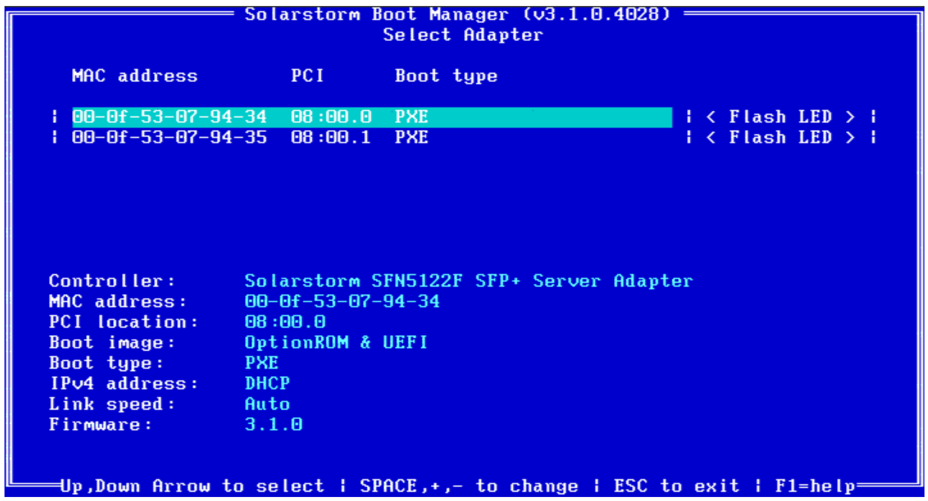
For Linux, see Configuring the Boot ROM with sfboot on page 56

For VMware, see Configuring the Boot ROM with Sfboot on page 258

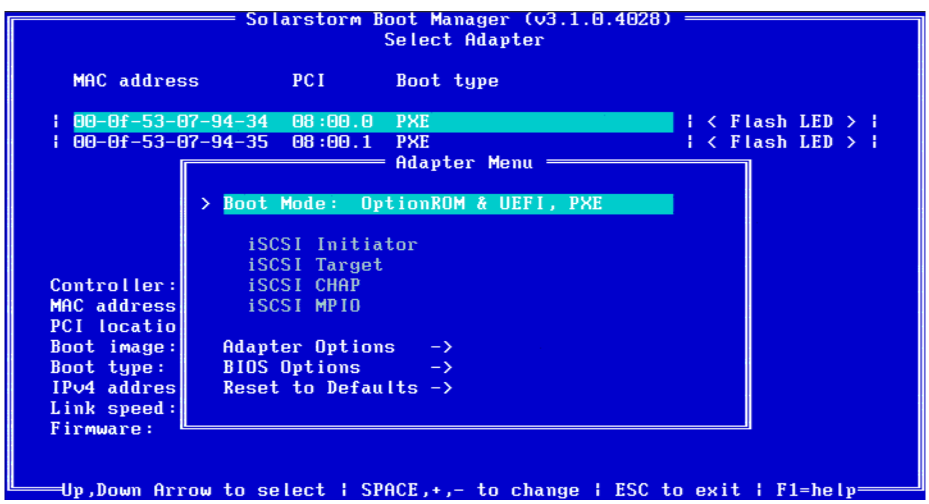
For SAM, see Using SAM for Boot ROM Configuration on page 173

1 Start or re-start the iSCSI initiator server and when prompted, press **Ctrl+B**. The Solarflare Boot Configuration Utility will display.

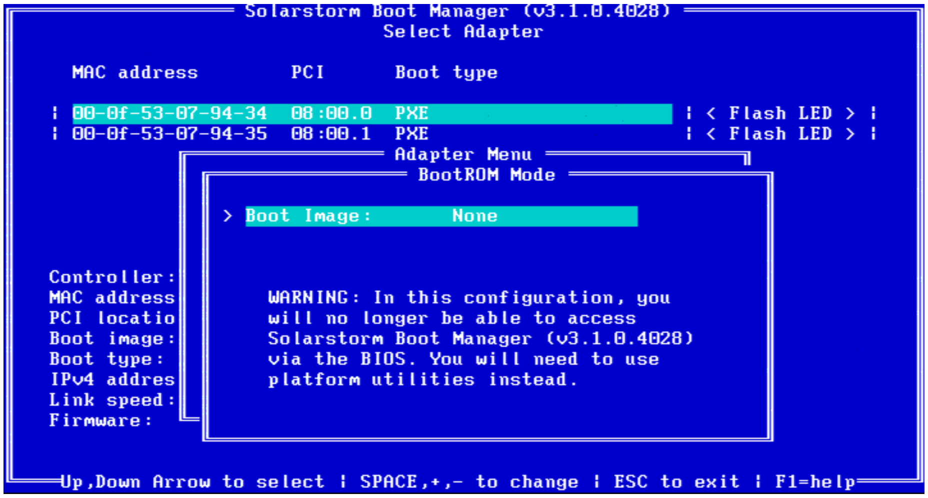
NOTE: If the BIOS supports console redirection, and you enable it, then Solarflare recommends that you enable ANSI terminal emulation on both the BIOS and your terminal. Some BIOSs are known to not render the Solarflare Boot Manager properly when using vt100 terminal emulation.



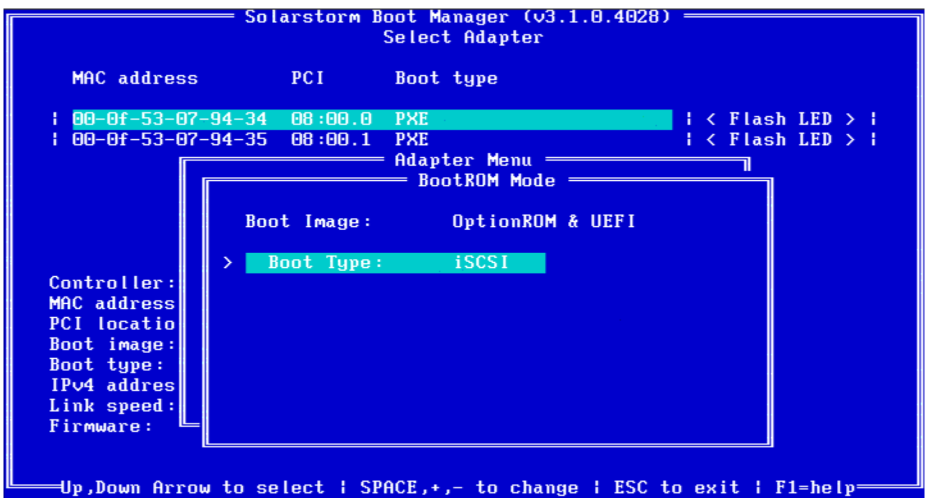
2 Highlight the adapter to configure and Press **Enter**. The **Adapter Menu** is displayed.



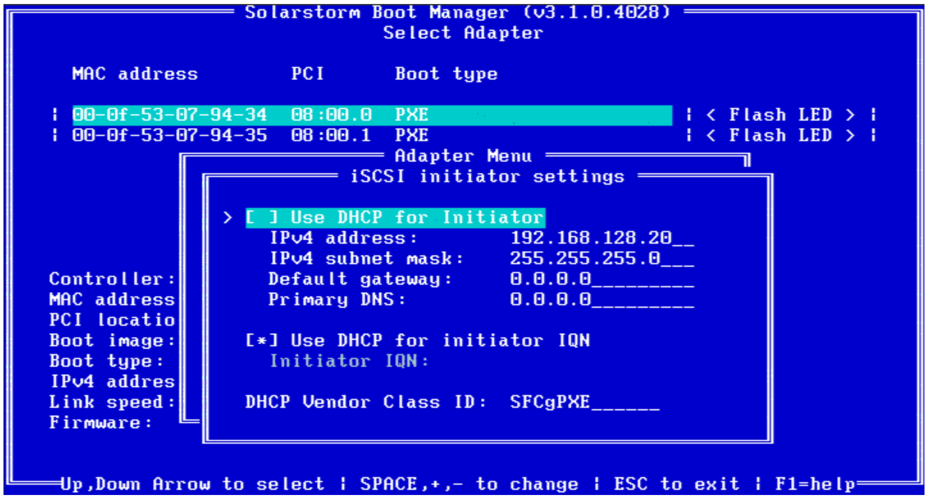
3 From the **BootROM Mode** option, press the arrow keys to change the **Boot Image** and or the **Boot Type**.



From the **Boot Type**, press **Space** until **iSCSI** is selected.



Press Enter. The iSCSI Initiator options are displayed.



Use DHCP for Initiator is selected as default. This instructs the adapter to use a DHCP server to obtain the relevant details to configure the Solarflare Boot ROM iSCSI initiator. See DHCP Server Setup on page 370. If you are not using DHCP, press enter and add the following details:

IP address: IP address of the Solarflare adapter to use at boot time.

Netmask: IP address subnet mask.

Gateway: Network gateway address. A gateway address may be required if the iSCSI target is on a different subnet from the initiator.

Primary DNS: Address of a primary DNS server.

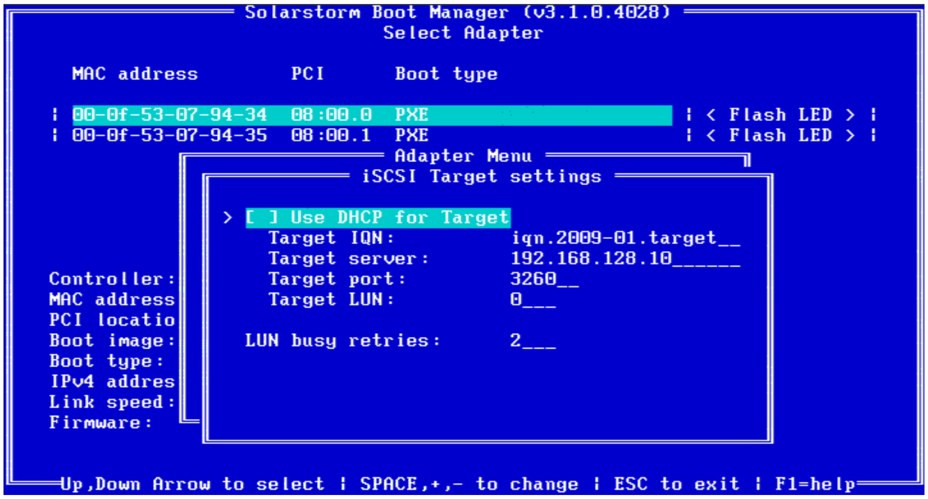
Use DHCP initiator IQN is selected as default. This instructs the adapter to obtain the iSCSI initator IQN from the DHCP server via option 43.203 or if this is not available to construct an iSCSI initator IQN from option 12. See DHCP Server Setup on page 370 for more details

Initiator IQN: The iSCSI initiator IQN of the Solarflare adapter if you are not using DHCP to obtain the iSCSI initiator IQN.

DHCP Vendor Class ID: If you are using DHCP to obtain the iSCSI initiator IQN, the adapter will use DHCP option 43 to try and obtain this information from the DHCP server. DHCP option 43 is described as “vendor specific information” and requires that the vendor id (DHCP option 60) configured at the DHCP server matches the vendor id configured in the Boot ROM. See DHCP Option 60, Vendor ID on page 371 for more details. Solarflare strongly recommend leaving this setting as “SFCgPXE”.

Press **Esc** to return to the Adapter Menu.

4 Highlight **iSCSI Target** and press **Enter**.



By default, the adapter uses DHCP to obtain details about the iSCSI target. See DHCP Server Setup on page 370 for details of how to enter this information into your DHCP server. If you are not using DHCP, press Enter and enter the following details:

Target IQN: Name of the iSCSI Target. The format of this is usually IQN or EUI: refer to your iSCSI Target documentation for details of how to configure this setting.

Target Server: IP address or DNS name of the target server.

TCP port: The TCP Connection port number to connect to on the iSCSI target (required). Default: 3260.

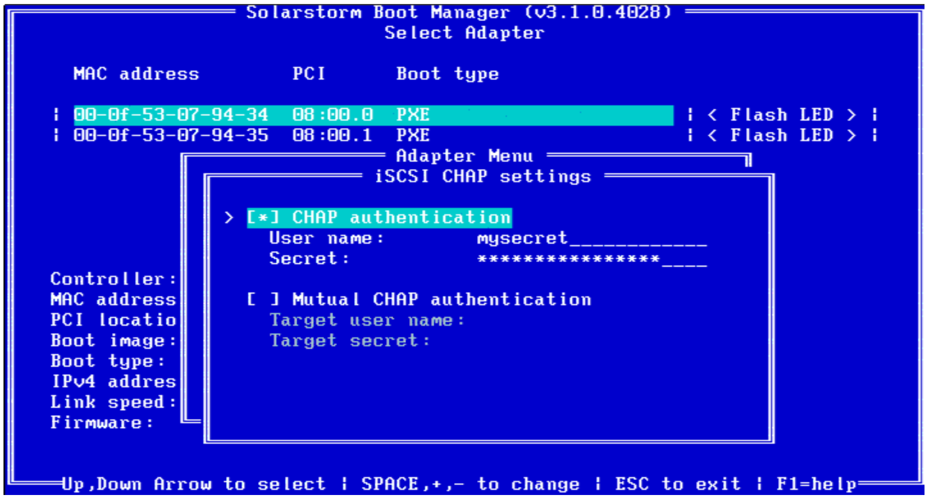
Boot LUN: Logical unit number (LUN) of the iSCSI Target (required). Default: 0. Values: 0-255.

The following settings can also be configured:

LUN busy retry count: Number of times the initiator will attempt to connect to the iSCSI target. Default: 2. Range: 0-255.

Press **Esc** to return to the Adapter Menu.

5 If CHAP authentication is required, highlight **iSCSI CHAP** and press **Enter**.



Enter **User Name** and **Secret** information.

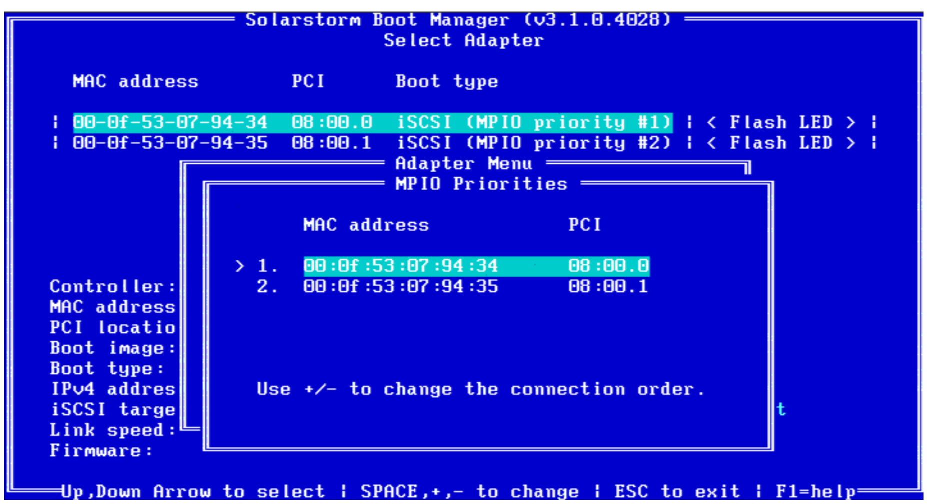
If Mutual CHAP is required as well as CHAP, hIghlight this option and press **Enter**.

Enter **Target user name** and **Target secret** information.

Press **Esc** to return to the Adapter Menu.

6 MPIO can be configured to provide alternative paths to the iSCSI target to increase the resilience to network outages. The MPIO priority defines the order the configured adapters are used to attempt to connect to the iSCSI target.

You can use the MPIO option to configure the MPIO rank for all adapters. Ensure all adapters to be used for MPIO are correctly configured for **iSCSI** boot. Highlight **iSCSI MPIO** and press **Enter**.



Note that you can set the MPIO rank for all Solarflare adapters from the configuration menus of any of the available adapters.

Press Esc to return to the Adapter menu.

7 When you have finished, select **Save and exit**.

10.6 DHCP Server Setup

If your network has a DHCP server, the adapter Boot ROM can be configured so the adapter is able to dynamically retrieve iSCSI initiator and target configurations from it on startup.

DHCP Option 17, Root Path

The root path option can be used to describe the location of the iSCSI target. This information is used in Step 4 on page 367.

The iSCSI root path option configuration strings uses the following format:

```
"iscsi:"<server name or IP
address>":"<protocol>":"<port>:<LUN>":"<targetname>
```

- **Server name**: FQDN or IP address of the iSCSI target.
- **Protocol**: Network protocol used by iSCSI. Default is TCP (6).
- **Port**: Port number for iSCSI. Default is 3260.
- **LUN**: LUN ID configured on the ISCSI target. Default is zero.
- **Target name**: iSCSI target name to uniquely identify the iSCSI target in IQN format. Example:

  `iqn.2009-01.com.solarflare`.

DHCP Option 12, Host Name

If the adapter is configured to obtain its iSCSI initiator IQN via DHCP and option 43.203 is not configured on your DHCP server, then the adapter will use the DHCP host name option to construct an iSCSI initiator IQN.

DHCP Option 3, Router List

If the iSCSI initiator and iSCSI target are on different subnets, configure option 3 with the default gateway or router IP address.

DHCP Option 43, Vendor Specific Information

Option 43 provides sub-options that can be used to specify the iSCSI initiator IQN and the iSCSI target IQN.

- Option 43.201 provides an alternative to option 17 to describe the location of the iSCSI target. The format for the iSCSI target IQN is the same as described for DHCP option 17
- Option 43.203 provides a method of completely defining the iSCSI initiator IQN via DHCP.

Table 91: DHCP Option 43 Sub-Options

Sub-Option	Description
201	First iSCSI target information in the standard root path format “iscsi:”<servername>”:”<protocol>”:”<port>”:”<LUN>”:”<targetname>
202	Secondary target IQN. This is **Not** supported.
203	iSCSI initiator IQN

NOTE: If using Option 43, you will also need to configure Option 60.

DHCP Option 60, Vendor ID

When using DHCP option 43 you must also configure option 60 (Vendor id). DHCP option 43 is described as “vendor specific information” and requires that the vendor id (DHCP option 60) configured at the DHCP server matches the vendor id configured in the Boot ROM. By default the Boot ROM uses the vendor id SFCgPXE.

10.7 Installing an Operating System to an iSCSI target

Introduction

This section contains information on setting up the following operating systems for iSCSI booting:

Installing Windows Server 2008 or 2008 R2

To install Windows Server 2008 or 2008 R2 (with or without a local drive present):

Prerequisites

- Configure the iSCSI target and Solarflare adapter Boot ROM, as described in Configuring the iSCSI Target on page 364 and Configuring the Boot ROM on page 364.
- Copy the correct Solarflare driver files to a floppy disk or USB flash drive. Refer to

Steps to Install

1. Insert the Windows Server 2008 or 2008 R2 DVD and restart the server. The Windows Server setup program will start.
2. Click **Load Driver** and browse to Solarflare drivers folder on the floppy or USB driver. Load the Solarflare VBD driver (if needed locate the INF file `netSFB*.inf`).
3. Click **Load Driver** a second time and browse to Solarflare drivers folder on the floppy or USB driver. Load the Solarflare NDIS driver (if needed locate the INF file `netSFN*.inf`).
4. After loading the drivers, click **Refresh** to refresh the list of available partitions.
5. Select the target partition that is located on the iSCSI target and continue installing Windows on the target.
6. Remove the Solarflare drivers disk.

Installing SUSE Linux Enterprise Server

For complete installation instructions, consult the relevant Novell documentation:

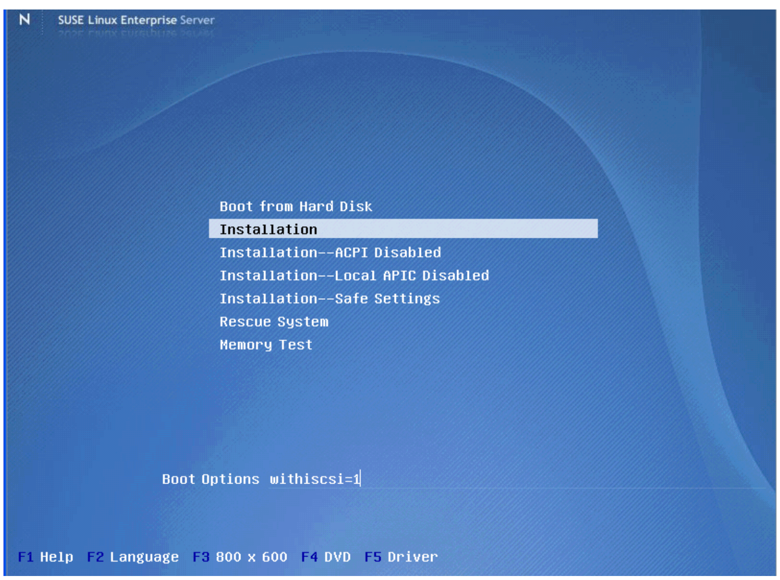
http://www.novell.com/documentation/

Prerequisites

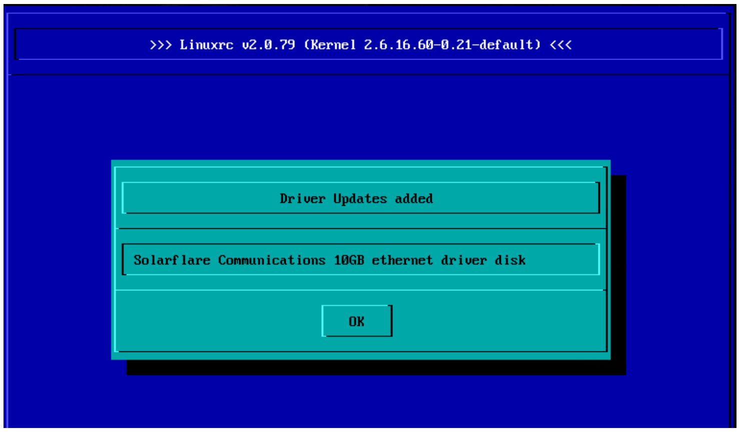
- Ensure you have all your iSCSI configuration information for the iSCSI target and iSCSI initiator. You will need to enter these details during the installation process.
- Ensure that the Solarflare Boot ROM is configured for iSCSI boot and can login to the selected iSCSI target.
- You will need the appropriate Solarflare driver disk. See Driver Disks for Unattended Installations on page 46 for more details.

Installation Process

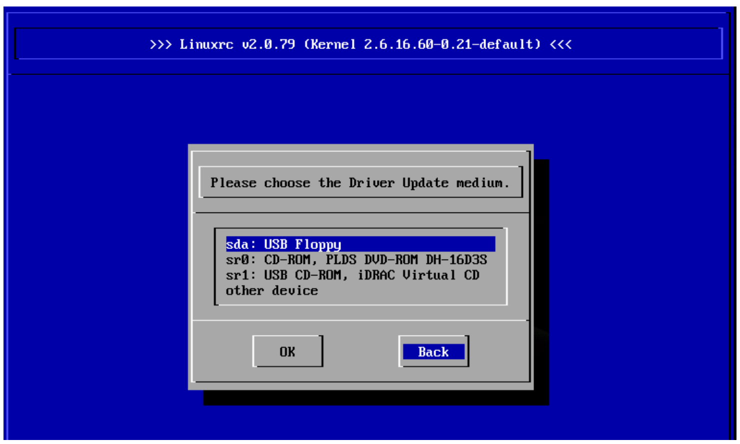
1. Boot from your DVD.
2. From the first installation screen, press **F5 Driver** and select **Yes**. Press **Return**.
3. Highlight Installation and enter the following Boot Option: `withiscsi=1`



4 If you see a **Driver Updates added** screen for a Solarflare driver disk, click **OK**.

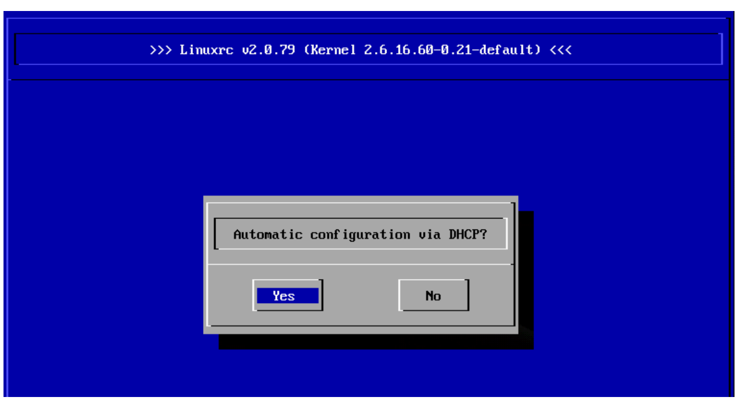


5 When prompted for further driver updates, click **Back** to return to the installer.



6 Select the network device. To check which is the Solarflare network adapter, press **Ctrl+Alt+F4**. To return to the Installation screen, press **Ctrl+Alt+F1**.

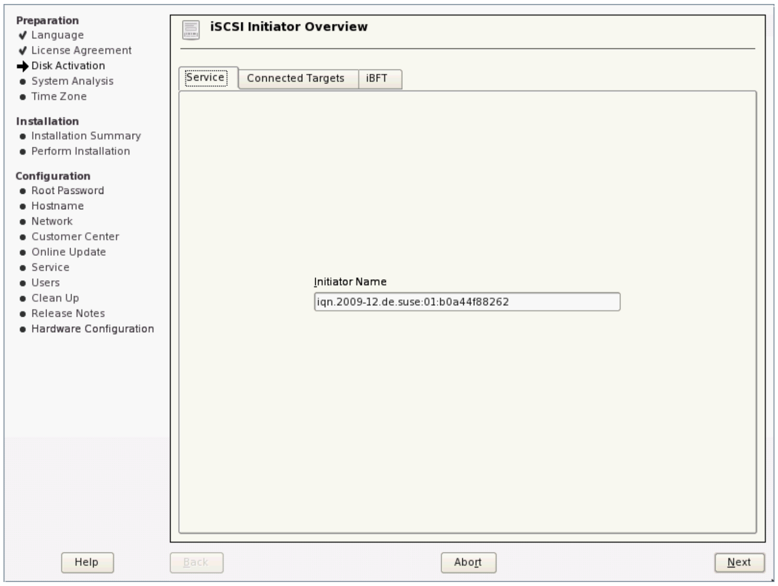
7 Select **Yes** from the **Automatic configuration via DHCP?** option.



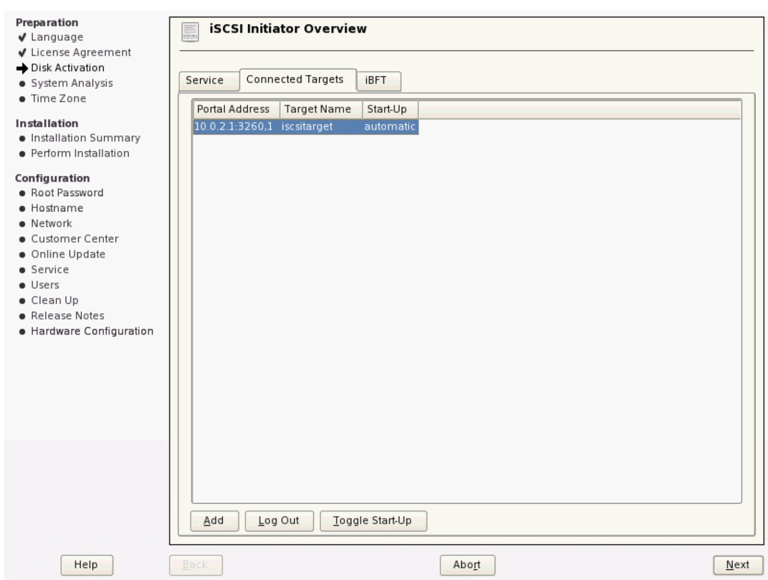
8 Follow the install steps until you reach the **Disk Activation** stage.

9 From the **Disk Activation > iSCSI Initiator Overview** stage, click the **Service** tab.

10 Note the SUSE auto generated **Initiator Name**, or replace this with your own.



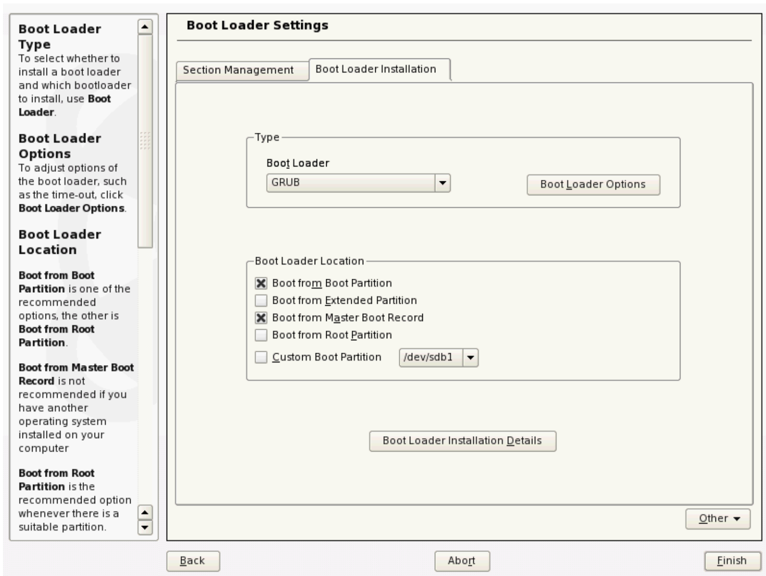
11 Click the **Connected Targets** tab. The target should be listed.



12 Ensure the **Start-Up** mode is correct for your installation. For SUSE Enterprise Linux Server 10, it should be **automatic**. For SUSE Enterprise Linux Server 11, it should be **onboot**. Click **Next** to continue.

13 From the **Installation Settings** screen, select the **Expert** tab, then click the **Booting** hyperlink. Select the **Boot Loader installation** tab.

14 Select **Boot from Master Boot Record** as well as **Boot from Boot Partition**. Click **Finish**.



15 When you reach the **Installation Summary** screen, select **Partitioning** to verify the installation device. Ensure that the desired iSCSI target is selected for the installation target. Click **Next**.

16 When the first stage of the install is complete, the system will reboot. Continue to the **Configure Boot Device Order** to add the iSCSI target and continue the installation process.

Following the server reboot, check that the iSCSI disk is in an appropriate place in the BIOS boot order. It may be displayed as 'Solarflare Boot Manager' or 'Hard drive C:', as there is no physical hard disk in the system.

If you don’t see either of the above options, check the messages output from the Solarflare Boot ROM during the boot process for DHCP or iSCSI login failures indicating a Boot ROM or DHCP configuration issue.

Installing Red Hat Enterprise Linux

For complete installation instructions, consult the relevant Red Hat documentation:

http://www.redhat.com/docs/manuals/enterprise/

Prerequisites

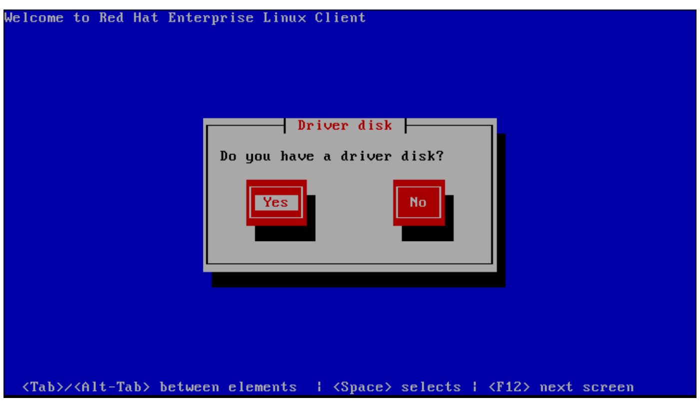
- Ensure you have all your iSCSI configuration information for the iSCSI target and iSCSI initiator. You will need to enter these details during the installation process.
- Ensure that Solarflare Boot ROM is configured for iSCSI boot and can login to the selected iSCSI target.
- You will need the appropriate Solarflare driver disk. See Driver Disks for Unattended Installations on page 46 for more details.

Installation Process

1 Boot from your DVD.

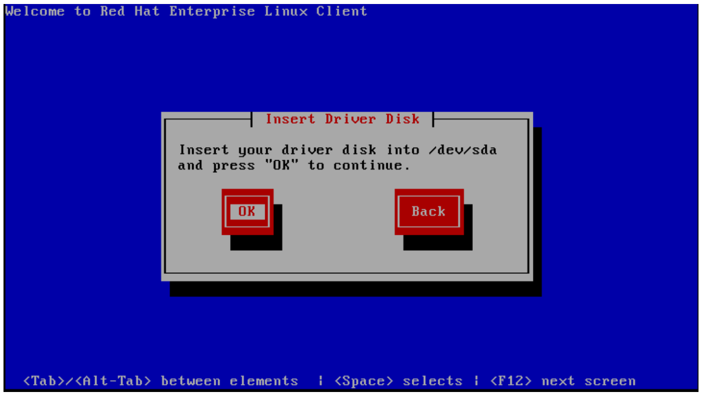
2 From the first installation screen, enter `linux dd`. Press **Return**.

3 When asked if you have a driver disk, select Yes.



4 A **Driver Disk Source** window is displayed. Select the source and select **Yes**.

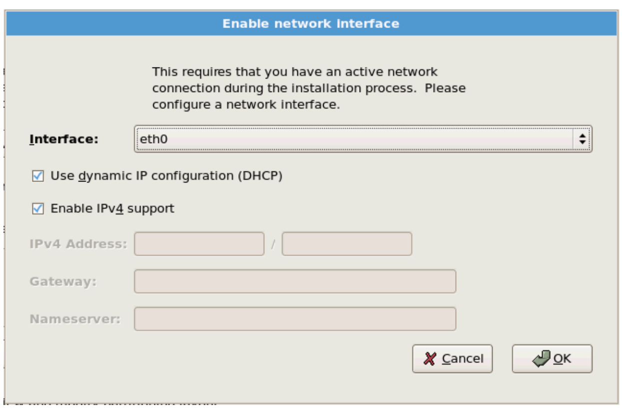
5 You will then be prompted to Insert your driver disk into the source specified in step 4.



6 You will be prompted to load more driver disks. Select **No**.

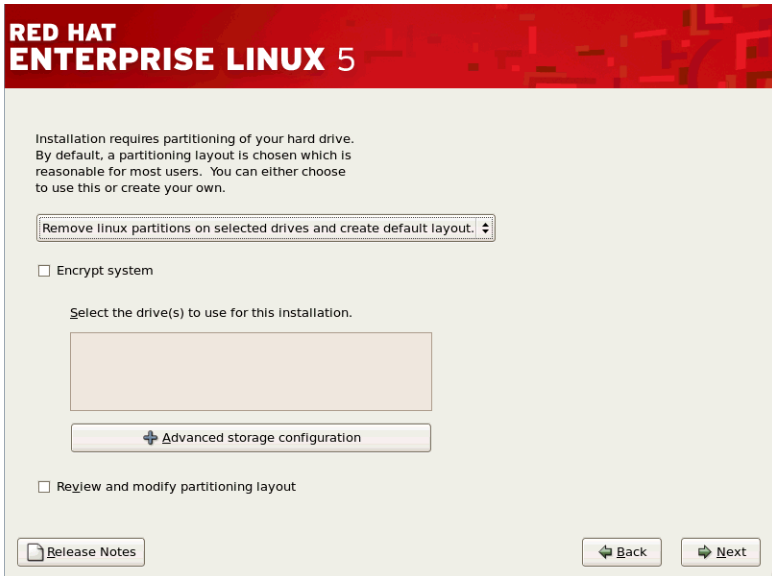
7 A **CD Found** screen will prompt you to test the CD before installation. Select **Skip**.

8 When an **Enable network interface** screen displays, select the **Solarflare adapter interface**. Ensure that **Use dynamic IP configuration (DHCP)** is selected.



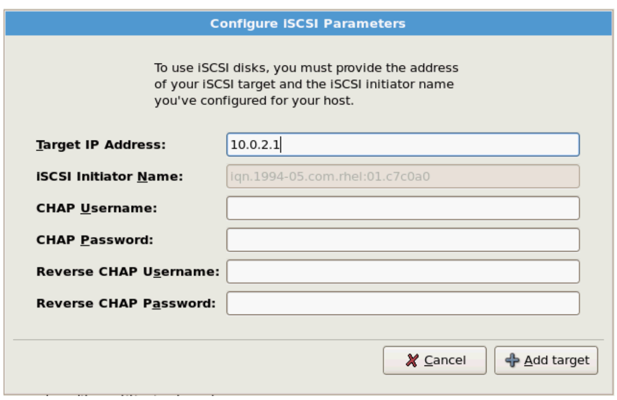
9 Follow the standard Red Hat installation steps until you reach the **Disk Partitioning Setup** menu.

10 From the **Disk Partitioning** menu, select **Advanced storage configuration** to add the iSCSI target.



11 In the **Advanced Storage Options** window, select **iSCSI** and click **Add iSCSI target**.

12 In the **Configure iSCSI Parameters** dialog box, enter your **Target IP Address**.



13 Click **Add target** to continue.

14 Click **Next** from the screen in step 10. A warning is displayed regarding the removal of all partitions. As the assumption is made that this is a clean install, click **Yes**.

If the drive(s) used for installation is displaying the correct device for the iSCSI LUN you configured, proceed with the rest of the installation. If the device configuration displayed is incorrect, check your details.

Following the server reboot, check that the iSCSI disk is in an appropriate place in the BIOS boot order. It may be displayed as 'Solarflare Boot Manager' or as 'Hard drive C:', as there is no physical hard disk in the system.

If you don't see either of the above options, check the messages output from the Solarflare Boot ROM the boot process for DHCP or iSCSI login failures indicating a Boot ROM or DHCP configuration issue.

10.8 Default Adapter Settings

Table 92 lists the various adapter settings and their default values. These are the values used if you select **Reset to Defaults** from the Boot Configuration Utility, or click **Default** from SAM.

Table 92: Default Adapter Settings

Setting	Default Value
Boot Image	Disabled
Link speed	Auto
Link up delay	5 seconds
Banner delay	2 seconds
Boot skip delay	5 seconds
Boot Type	PXE
Initiator DHCP	Enabled
Initiator-IQN-DHCP	Enabled
LUN busy retry count	2 seconds
Target-DHCP	Enabled
TCP port	3260
Boot LUN	0
DHCP Vendor	SFCgPXE
MPIO attempts	3
MSIX Limit	32

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