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Setting up Sun Logical Domains for deploying Veritas Storage Foundation for Oracle RAC (SFRAC)

Contents

Introduction

This document discusses various configuration scenarios and the corresponding workflows for setting up Sun Logical domains (LDoms) to deploy Veritas Storage Foundation for Oracle RAC (SFRAC). The scenarios describe the deployment of SFRAC on LDoms in a single physical host as well as on multiple physical hosts.

Intended audience

This document is intended for Symantec Systems Engineers (SE), Technical Support Engineers (TSE), and System Administrators for understanding, evaluating, or setting up virtualized environments using Sun LDoms for deploying SFRAC. This document assumes that the reader has prior knowledge of SFRAC.

Introduction to SUN LDoms

Logical Domains (LDoms) from SUN Microsystems is a technology that allocates resources such as processors, memory, disks or network devices to logical containers and manages them as logical domains within the physical host. The resulting LDom has its own operating system and manages resources independently in its realm.

The Hypervisor is the core enabler of Logical Domains. A firmware layer on the flash PROM of the motherboard, it is also a thin software layer comprising of a stable interface and the sun4v platform between the operating system and the hardware. The hypervisor provides a set of support functions to the operating system, so that the operating system does not need to know internal details of hardware functioning. This allows the operating system to simply call the hypervisor with calls to the sun4v platform. This communication interface is often described as a stable interface. The hypervisor is the engine that abstracts the hardware in a way that enables it to hide or expose various aspects of the hardware to the operating system. For example, the hypervisor can choose to expose some CPUs but not others, and some amount of memory but not all of it to the LDoms. The hypervisor is responsible for maintaining separation between domains. It also provides the capability to create logical domain channels through which domains can communicate with each other.

LDoms is hardware-dependent and works with the latest SUN Coolthreads servers. Refer to the SUN LDoms documentation for more information on the latest supported hardware.

The following figure shows the hypervisor and the stable interface.
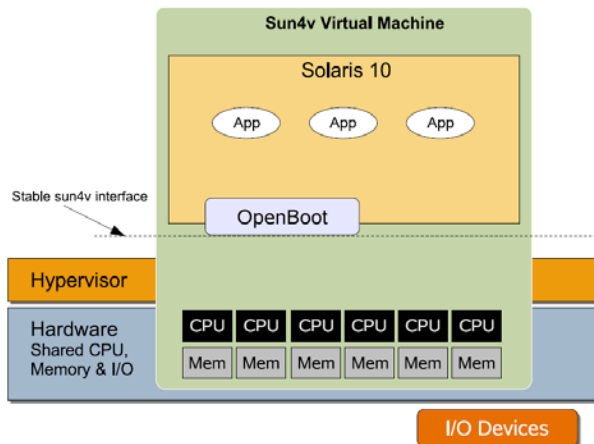
Logical Domain roles

LDoms can be set up to function in any of the following roles:

Control domain: The Control domain is the physical host that has access to all physical resources on the system. The Logical Domains manager software, which is used for managing the guest and I/O domains, is installed on this domain. The Control domain can also serve as an I/O domain and provide services to other guest domains.

I/O domain: The I/O domain has direct access to I/O devices. There can be a maximum of two I/O domains in an LDom setup. The domain is also called as the service domain when it provides I/O services to other guest domains.

Guest domain: The Guest domain uses the services delivered by the service domain to access physical devices. The Guest domain exists as an independent entity with virtual resources and own copy of operating system.

Benefits of using SFRAC with LDoms

The LDom technology provides a very cost-effective alternative architecture for deploying SFRAC. The same physical server can be used for multiple applications within various logical domains with optimal resource utilization.

Configuration scenarios for SFRAC with LDoms

This section describes the server configuration, on which various scenarios have been tested, the pre-requisites for the scenarios, and the configuration scenarios for setting up LDoms to deploy SFRAC.

Note: The commands required to perform the setup tasks in various scenarios are consolidated in the appendix. See Appendix B

The following server configuration is used for the setup scenarios presented in this document:

Server: SUN T2000 Server
Processor: 24 T1 Based Processor (4Cores * 6 Threads per core)
Memory: 8 GB
PCI Devices: 2 NIC Cards +1 HBA per BUS, all on board hard drives belong to one PCI bus.
Firmware Version: SPARC-Enterprise-T2000 System Firmware 6.7.3
Operating System: Solaris 10 update 6
Software: LDoms Manager 1.1, SFRAC 5.0MP3, Oracle 10g (10.2.0.4)

Note: SFRAC 5.0 MP3 and upwards supports SUN LDoms.
Detailed SFRAC certification matrix URL can be accessed from the references section.

Refer to the SUN LDom documentation for more details of the firmware levels required for LDoms manager 1.1. SUN LDom documentation URL can be accessed from the references section.

Configuration Scenarios

The following configurations scenarios are tested for deployment with SFRAC.

1) SFRAC with Oracle RAC DB on I/O domains of two hosts
2) SFRAC with Oracle RAC DB on Guest domains of two hosts
3) SFRAC with Oracle RAC DB on Guest domains of a single Host
4) SFRAC with Oracle RAC DB on Guest domain and I/O domain of a single host

Pre-requisites for the configuration scenarios

Perform the following steps before setting up LDoms to work with SFRAC.

a) Install LDoms Manager Software.
b) Configure the physical host as a primary domain.

   The primary domain will serve as the control/IO/service domain by default.
c) Create new LDom configurations.

1) SFRAC with Oracle RAC DB on I/O domains of two hosts

This section describes the tasks required to set up I/O domains on two hosts for deploying SFRAC. Make sure that you have completed the pre-requisite tasks for the scenario.

To set up I/O domains on two hosts for deploying SFRAC:

a)   Create the secondary I/O domain.

b)   Provision a PCI bus from the primary domain to the secondary I/O domain.

c)   Create virtual network service in the primary domain. The virtual interface connected to the service will be used by the secondary I/O domain as its public interface. The interfaces that remain on the secondary I/O domain will be used for LLT heartbeat.

d)   Create virtual disk service on the primary domain. The virtual disk connected to the service will be used by the secondary I/O domain as its root disk.

e)   Install Solaris operating system on the secondary I/O domain using Jumpstart method. After OS installation, all devices present on the provisioned PCI bus are visible on the secondary I/O domain.

f)   Repeat steps **a** through **e** on the second host.

After setting up the I/O domains on the two hosts install and configure SFRAC.
After installing and configuring SFRAC, setup Oracle RAC DB.

SFRAC documentation URL can be accessed from the references section.

Benefits

a)   The computing resources on the hosts are available to other LDoms.

b)   Direct access to storage ensures better database performance.

Limitations

If the I/O load is extensive, the I/O latency on other LDoms will be high.
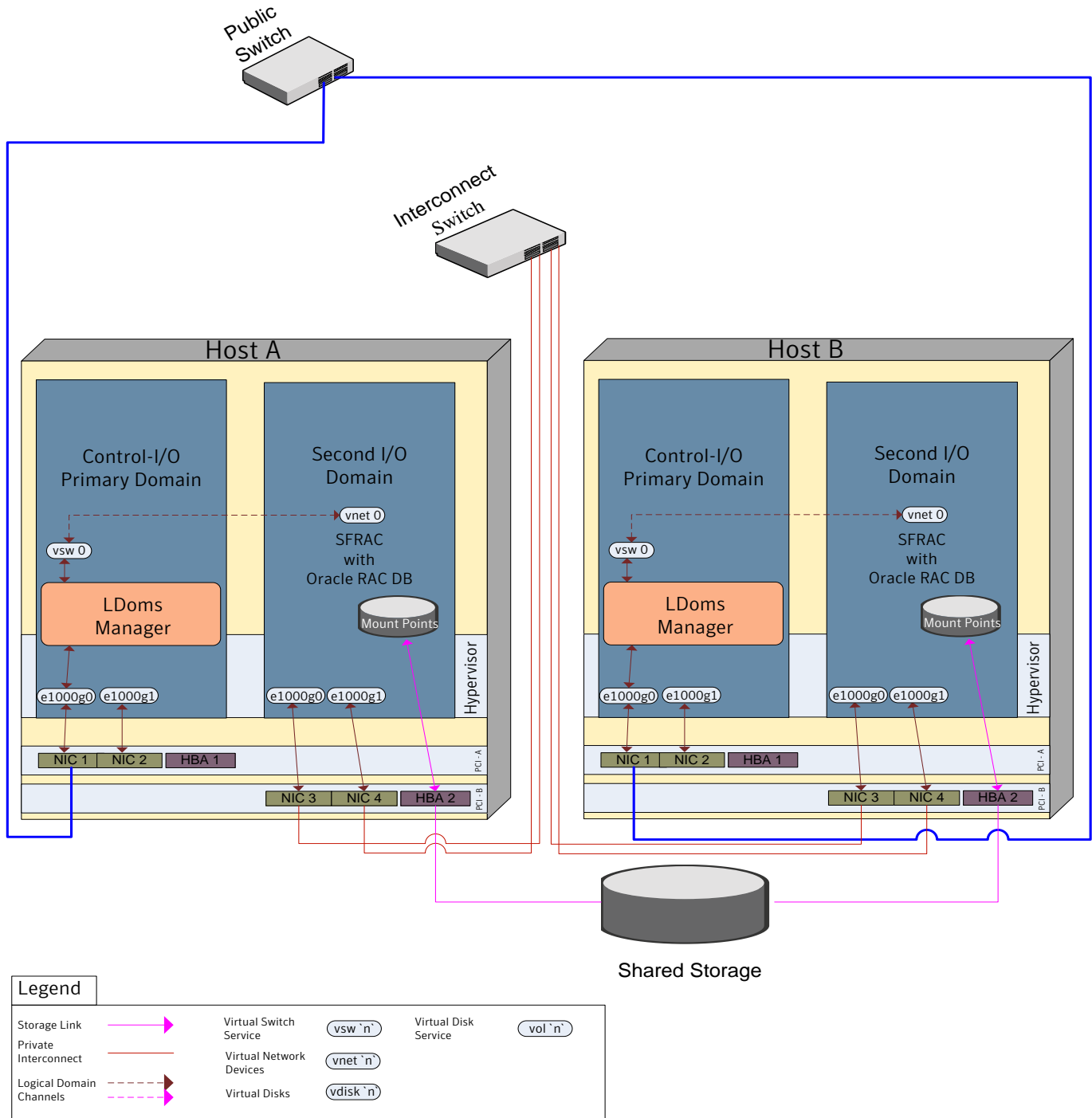
Setting up Sun Logical Domains for deploying SFRAC

Fig 1.a SFRAC with Oracle RAC DB on I/O domains of two hosts

2) SFRAC with Oracle RAC DB on Guest domains of two hosts

This section describes the tasks required to set up Guest domains on two hosts for deploying SFRAC.

Make sure that you have completed the pre-requisite* tasks for the scenario.

To set up Guest domains on two hosts for deploying SFRAC:

a) Create virtual disk and network services on the primary domain. The virtual services are bound to the virtual devices created for the guest LDom. A guest LDom accesses the physical hardware through the virtual devices connected to the virtual services. Assign individual services for each disk from storage. This helps to maintain sequence of the disks in the guest domain.

b) Create the guest domain.

c) Create the virtual devices on the guest domain and bind it to the virtual services created on the primary domain

d) Install Solaris operating system on the guest domain using Jumpstart method.

e) Repeat steps **a** through **d** on the second host.

After setting up the Guest domains on the two hosts install and configure SFRAC.

After installing and configuring SFRAC, setup Oracle RAC DB.

*Complete SFRAC documentation URL can be accessed from the references section.

Benefits

a) The configuration provides a completely virtualized domain.

b) The hardware resources can be effectively utilized with other LDoms.

Limitations

Since there is no direct disk access from the virtual domain to the physical disk, there could be a minor lag on disk access times.

Fig 2.a SFRAC with Oracle RAC DB on Guest domains of two hosts

3) SFRAC with Oracle RAC DB on Guest domains of single host

This section describes the tasks required to set up Guest domains on a single host for deploying SFRAC.

Note: This setup is recommended for use as a four-node cluster by using an additional physical host with the same configuration.

Make sure that you have completed the pre-requisite tasks* for the scenario.

To set up Guest domains on a single host for deploying SFRAC:

a) Create a split PCI configuration on a T2000 Server.

   Each bus has 2NICs and 1HBA.

   For details on split PCI configuration see appendix. A

b) Create one primary domain and one secondary domain. The primary domain must be configured to be used as a control and I/O Domain (primary service domain). The secondary domain must be initially configured as an I/O domain. Next, configure the secondary I/O domain to be used as a secondary service domain. The primary domain is used to create and assign the services for this secondary service domain.

c) Both the primary and secondary Service domains see the storage through its respective paths.

d) Create the disk and network services on the primary service domain and assign it to Guest LDom A.

e) Create and assign a different set of disk and network services for the secondary service domain using the primary service domain. This ensures that services for Guest LDom B are provided by the secondary service domain.

f) Install Solaris operating system on the secondary service domain and the Guest LDoms using Jumpstart method.

   After setting up Guest domains on a host, install and configure SFRAC.

   After installing and configuring SFRAC, setup Oracle RAC DB.

   *Complete SFRAC documentation URL can be accessed from the references section.

Additional steps for SFRAC

Set the public link to be used as a low priority heartbeat link due to unavailability of NICs.

Benefits

a) Reduction in the number of physical servers used makes it a very cost-effective setup.

b) The setup is easy to create and maintain. It is also flexible and portable.

c) Many guest LDoms from multiple systems can be joined together to form a bigger cluster.

d) If the primary domain reboots, only the guest LDom attached to it is affected. The guest LDom attached to the secondary service domain continues to be available. Please note that shutting down the primary domain halts all domains.

Limitations

a) Hardware failures act as a single point of failure, bringing down all associated domains.

b) Almost all physical resources are consumed in the creation of this setup on a T2000 Server.

Public Switch

Interconnect Switch

Physical Host

Hypervisor

Control-I/O Primary Domain

Guest LDom A

vnet 0
vnet 1
vdisk `n`

SFRAC with Oracle RAC DB

e1000g0   e1000g1   vol `n`

Secondary Service Domain

Guest LDom B

vnet 0
vnet 1
vdisk `n`

SFRAC with Oracle RAC DB

e1000g0   e1000g1   vol `n`

LDoms Manager controlled by Primary Domain

e1000g0   e1000g1   vds `n` Shared Storage

e1000g0   e1000g1   vds `n` Shared Storage

NIC 1   NIC 2   HBA 1

NIC 3   NIC 4   HBA 2

PCI - A

PCI - B

Shared Storage

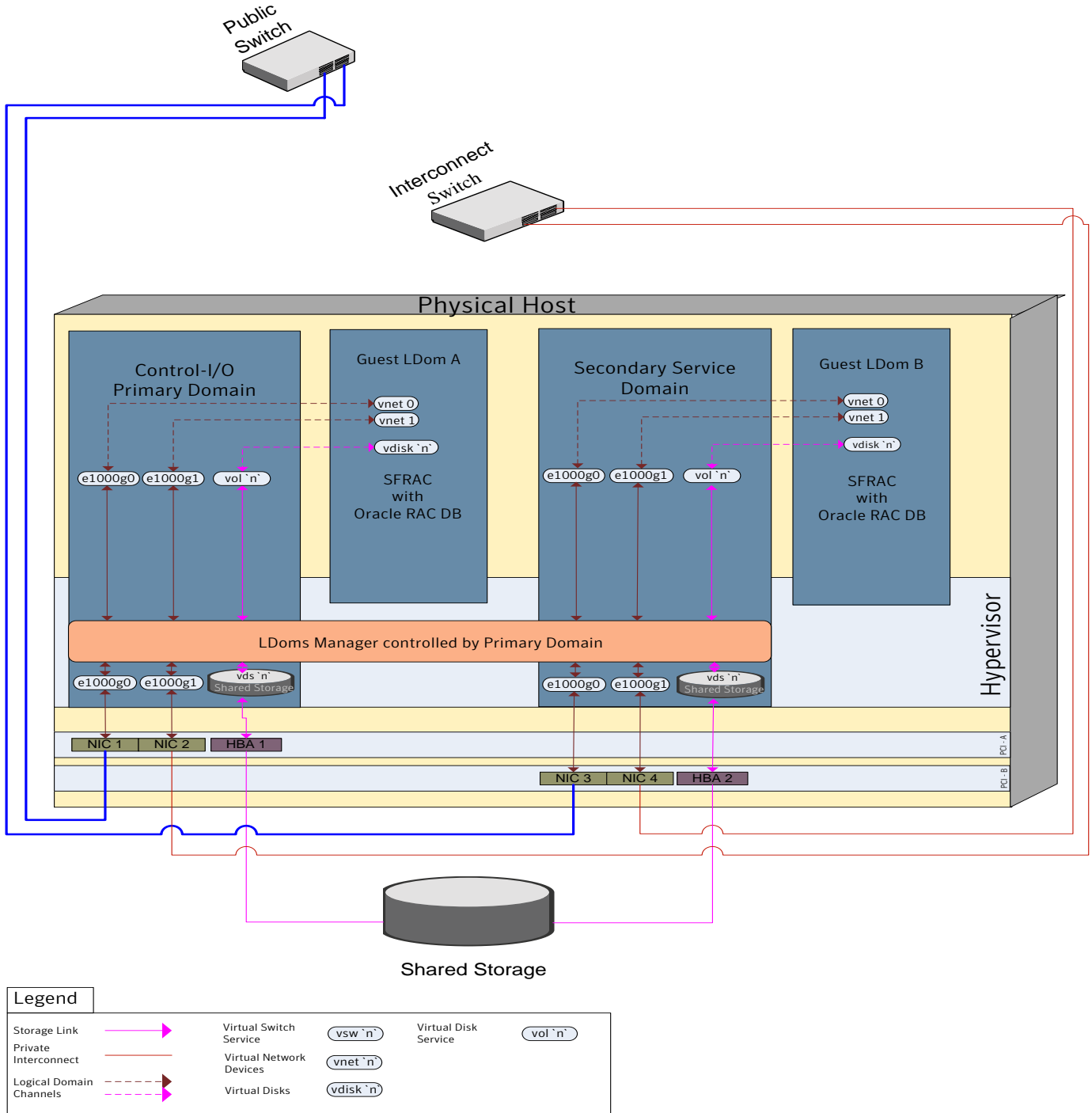| Legend			
Storage Link	→	Virtual Switch Service	vsw `n`
Private Interconnect	—	Virtual Network Devices	vnet `n`
Logical Domain Channels	---▶	Virtual Disks	vdisk `n`
	---▶		

Virtual Disk Service   vol `n`

Fig 3.a SFRAC with Oracle RAC DB on Guest domains of single host

4) SFRAC with Oracle RAC DB on I/O domain and Guest domain of single host

This section describes the tasks required to set up Guest domains on single host for deploying SFRAC.

Note: This setup is recommended for use as a four-node cluster by using an additional physical host with the same configuration.

Make sure that you have completed the pre-requisite tasks* for the scenario.

Steps to set up Guest domains of single host for deploying SFRAC

a) Create a split PCI configuration on a T2000 Server.
    Each bus has 2NICs and 1HBA.
    For details on split PCI configuration see appendix. A
b) Create the secondary I/O domain
c) Provision a PCI bus from the primary domain to the secondary I/O domain.
d) Create virtual disk service on the primary domain. The virtual disk connected to the service is used by the secondary I/O domain as its root disk.
e) Create the disk and network services on the primary service domain and assign it to the guest domain.
f) Install Solaris operating system on the secondary service domain and the guest domain using Jumpstart method.

After setting up I/O Domain and Guest domain on a host, install and configure SFRAC. After installing and configuring SFRAC, setup Oracle RAC DB.

*SFRAC documentation URL can be accessed from the references section.

Additional steps for SFRAC

a) Set the public link to be used as a low priority heartbeat link due to unavailability of NICs.

b) Run the command "oifcfg" after installation of Oracle Clusterware. This is required to resolve the issue of different interface names on the guest LDom and the secondary I/O LDoms.

c) Configure MultiPrivNic manually.

Benefits

a) Guest LDoms can be added to the host at any time unlike in Scenario 3 where all resources are utilized leaving no room for additional LDoms.

b) This setup results in better disk performance as compared to Scenario 3.

c) If the primary domain reboots, only the guest LDom attached to it is affected. The guest LDom attached to the secondary service domain continues to be available. Please note that shutting down the primary domain halts all domains..

Disadvantages

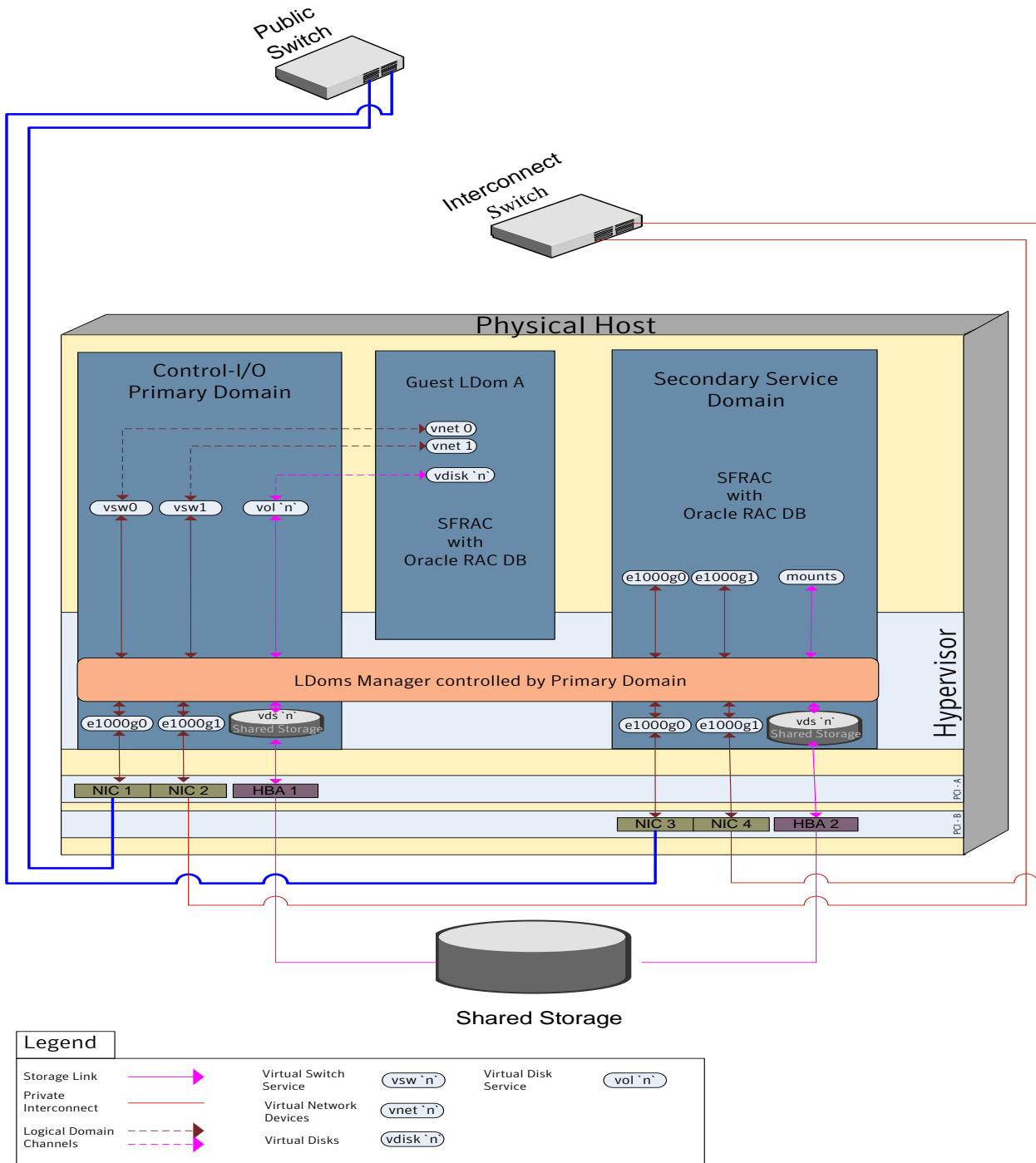Hardware failures act as a single point of failure, bringing down all associated domains.

Fig 4.a SFRAC with Oracle RAC DB on I/O domain and Guest domain of single host

Best Practices for LDoms Setup

The following best practices are recommended for LDoms Setup.

1) On SUN platforms supporting LDoms, each CPU core supports four executing threads. These are represented as virtual CPUs on the system. Thus, a system with eight CPU cores would have 32 virtual CPUs. An LDom can operate with half a CPU core i.e 2 virtual CPUs, such being the case, a CPU core will be shared between LDoms. There are hardware resources that are allocated per CPU core basis and are shared between threads of that core. If threads are shared between LDoms, it can cause a performance degradation due to cache trashing. Hence, it is recommended to allocate a complete CPU core to an LDom rather that splitting it.

2) A domain having direct I/O access is recommended for database applications. Although database applications can run on virtual devices, there may be a slight performance degradation. Test deployments, where performance might be of lesser concern can use virtual disks for database applications.

3) Its strongly recommended to distribute LDoms on separate physical machines for clustered applications since it provides high availability in case of a physical hardware failure.

Note: For high Oracle workloads the minimum recommended configuration is 4 CPU/Cores and 8GB RAM.

Appendix A: Split PCI configuration

In the following SPLIT PCI configuration diagram, pci_a is used by one domain and pci_b is used by the other domain.
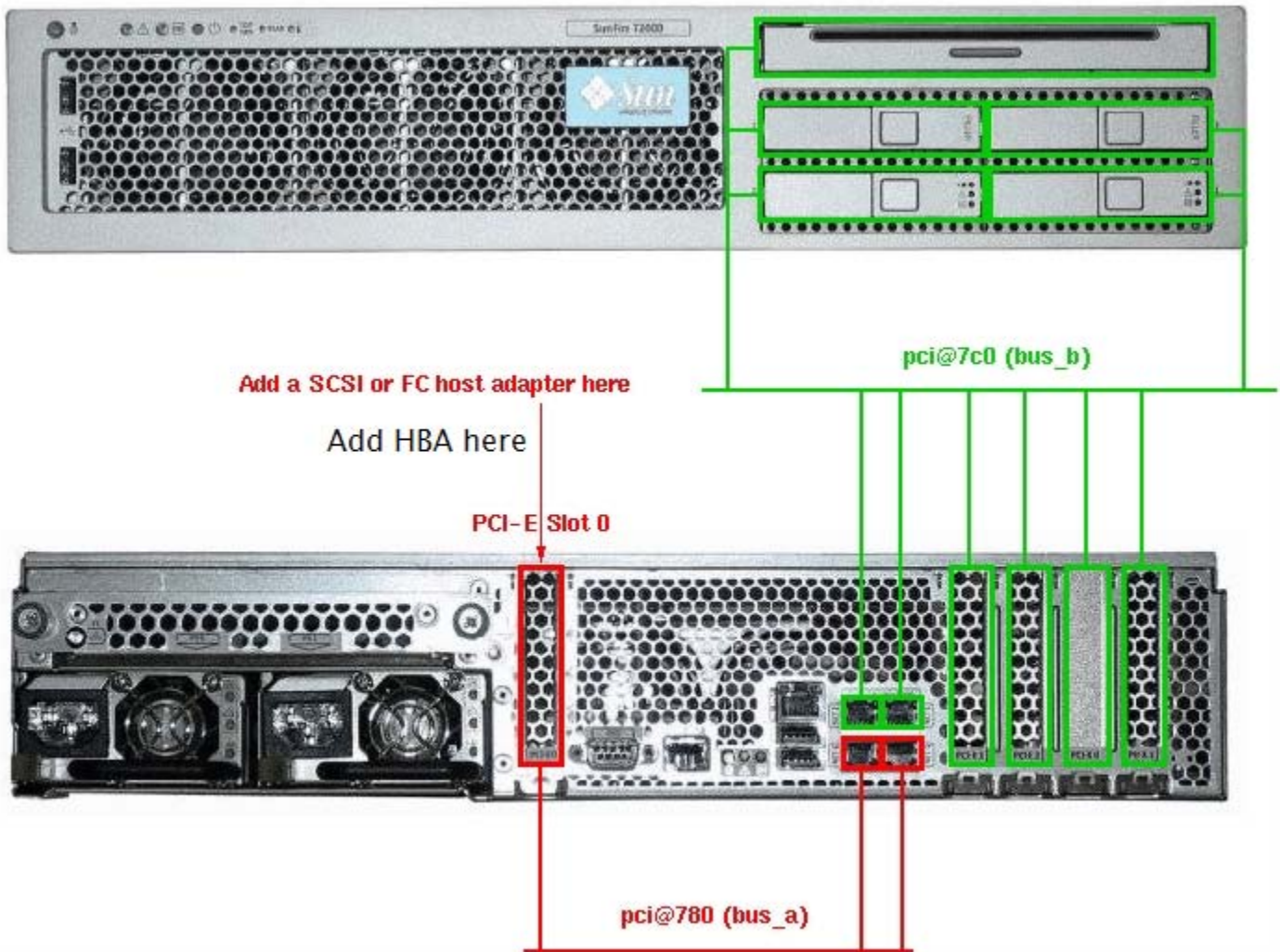
Appendix B: List of commands for setting up LDoms

This section provides the list of commands that correspond to the setup tasks discussed in the various configuration scenarios.
For detailed information on the commands and their usage, refer to the SUN LDom documentation.

1)   To view the current LDom configuration on the system:
```
ldm list-spconfig
```
Example: `ldm list-spconfig`

2)   To create a logical domain:
```
ldm add-domain <domain Name>
```
Example: `ldm add-domain secondary`

3)   To assign virtual CPUs to a logical domain:
```
ldm add-vcpu <No of VCPUS> <Domain Name>
```
Example: `ldm add-vcpu 8 secondary`

4)   To assign memory to a logical domain：
```
ldm set-memory <Amount of Memory> <Domain Name>
```
Example: `ldm add-memory 2g secondary`

5)   To set cryptographic units for a logical domain:
```
ldm set-mau <No of Crypographic Units> <Domain Name>
```
Example: `ldm add-mau 1 secondary`

6)   To create virtual disk service on the primary or secondary service domain.
This command must be run from the primary domain only:
```
ldm add-vds <Virtual Service Name> <Domain Name>
```
Example: `ldm add-vds secondary-vds1 secondary`

7) To create virtual network service on the primary or secondary service domain.

This command must be run from the primary domain only:

`ldm add-vsw net-dev=<Network Device Name> <Virtual Service Name> <Domain Name>`

Example: `ldm add-vsw net-dev=e1000g2 secondary-vsw0 secondary`

8) To connect the physical disk to the virtual disk service:

`ldm add-vdsdev <Physical Disk> <Vol Name>@<Virtual Disk Service Name>`

Example: `ldm add-vdsdev /dev/dsk/c1t1d0s2 vol1@primary-vds0`

9) To bind the virtual disk service to the virtual disk in a guest domain:

`ldm add-vdisk <Virtual Disk Name> <Vol Name>@<Virtual Disk Service Name> <Domain Name>`

Example: `ldm add-vdisk vdisk1 vol1@primary-vds0 secondary`

10) To bind the console of a guest domain to virtual console service.

This command must be run only for the primary domain.

By connecting to the console, the boot process can be managed:

`ldm add-vcc port-range=<Range of Ports> <Virtual Service Name> primary`

Example: `ldm add-vcc port-range=5000-5100 primary-vcc0 primary`

11) To add a pcibus to a primary domain or a secondary I/O domain:

`ldm add-io <Pci Device> <Primary/Secondary I/O Domain>`

Example: `ldm add-io pci@7c0 secondary`

11) To remove a pcibus from a primary domain or a secondary I/O domain:

`ldm remove-io <Pci Device> <Primary/Secondary I/O Domain>`

Example: `ldm remove-io pci@7c0 secondary`

12) To bind all services and devices defined for the logical domain:

`ldm bind-domain <Domain Name>`

Example: `ldm bind-domain sfldom1`

13) To start the logical domain:

`ldm start-domain <Domain Name>`

Example: `ldm start-domain sfldom1`

14) To set boot time variables:

`ldm set-variable <Variable and Value> <Domain Name>`

Example: `ldm set-variable auto-boot\?=false secondary`

15) To create and save a new Service Processor configuration:

`ldm add-spconfig <New Configuration Name>`

Example: `ldm add-spconfig sfldom`

Setting up a sample LDom configuration for deploying SFRAC

The following setup describes a sample configuration workflow along with the corresponding commands for scenario 3. Run the commands on the primary domain except where stated otherwise.

1) Set up the primary domain.

```
ldm add-vds primary-vds0 primary
ldm add-vds primary-vds1 primary
ldm add-vds primary-vds2 primary
ldm add-vds primary-vds3 primary
ldm add-vcc port-range=5000-5100 primary-vcc0 primary
ldm add-vsw net-dev=e1000g0 primary-vsw0 primary
ldm add-vsw net-dev=e1000g1 primary-vsw1 primary
ldm set-mau 1 primary
ldm set-vcpu 8 primary
ldm set-memory 2g primary
ldm remove-io pci@7c0 primary
```

2) Save the LDom configuration.

```
ldm list-spconfig
ldm add-spconfig sfldom
```

Reboot the server.

```
shutdown -i6 -g0 -y
```

3) Set up the second service domain.

```
ldm add-domain secondary
ldm add-vcpu 8 secondary
ldm add-memory 2g secondary
ldm add-io pci@7c0 secondary
ldm add-vdsdev /dev/dsk/c1t1d0s2 vol1@primary-vds0
ldm add-vdisk vdisk1 vol1@primary-vds0 secondary
ldm set-variable auto-boot\?=false secondary
ldm bind-domain secondary
ldm start-domain secondary
```

Set up Solaris 10 on the secondary service domain using Solaris JumpStart. The operating system can also be installed on an LDom using other methods. Refer to the SUN documentation for more information.

4) Add services to the secondary service domain.

```
ldm add-vds secondary-vds1 secondary
ldm add-vds secondary-vds2 secondary
ldm add-vsw net-dev=e1000g2 secondary-vsw0 secondary
ldm add-vsw net-dev=e1000g3 secondary-vsw1 secondary
```

5) Set up multiple guest LDoms.

Set up guest LDom 1.

```
 ldm add-domain sfldom1
ldm add-vcpu 8 sfldom1
ldm add-memory 1984m sfldom1
ldm add-vnet vnet0 secondary-vsw0 sfldom1
ldm add-vnet vnet1 secondary-vsw1 sfldom1
ldm add-vdsdev /dev/dsk/c1t2d0s2 vol2@primary-vds2
ldm add-vdisk vdisk2 vol2@primary-vds2 sfldom1
ldm set-variable auto-boot\?=false sfldom1
ldm bind-domain sfldom1; ldm start-domain sfldom1
```

Set up guest LDom 2.

```
ldm add-domain sfldom2
ldm add-vcpu 8 sfldom2
ldm add-memory 1984m sfldom2
ldm add-vnet vnet0 primary-vsw0 sfldom2
ldm add-vnet vnet1 primary-vsw1 sfldom2
ldm add-vdsdev /dev/dsk/c1t3d0s2 vol3@primary-vds3
ldm add-vdisk vdisk3 vol3@primary-vds3 sfldom2
ldm set-variable auto-boot\?=false sfldom2
ldm bind-domain sfldom2; ldm start-domain sfldom2
```

6) Assign shared devices to guest LDom 2 from the primary service domain.

6.a) Create services.

```
ldm add-vds primary-vds4 primary
ldm add-vds primary-vds5 primary
ldm add-vds primary-vds6 primary
ldm add-vds primary-vds7 primary
ldm add-vds primary-vds8 primary
ldm add-vds primary-vds10 primary
ldm add-vds primary-vds11 primary
ldm add-vds primary-vds12 primary
ldm add-vds primary-vds13 primary
```

6.b) Connect the physical device to Virtual Disk Service.

```
ldm add-vdsdev /dev/dsk/c0t5006016041E02D28d4s2 vol4@primary-vds4
ldm add-vdsdev /dev/dsk/c0t5006016041E02D28d5s2 vol5@primary-vds5
ldm add-vdsdev /dev/dsk/c0t5006016041E02D28d6s2 vol6@primary-vds6
ldm add-vdsdev /dev/dsk/c0t5006016041E02D28d7s2 vol7@primary-vds7
ldm add-vdsdev /dev/dsk/c0t5006016041E02D28d8s2 vol8@primary-vds8
ldm add-vdsdev /dev/dsk/c0t5006016041E02D28d10s2 vol10@primary-vds10
ldm add-vdsdev /dev/dsk/c0t5006016041E02D28d11s2 vol11@primary-vds11
ldm add-vdsdev /dev/dsk/c0t5006016041E02D28d12s2 vol12@primary-vds12
ldm add-vdsdev /dev/dsk/c0t5006016041E02D28d13s2 vol13@primary-vds13
```

6.c) Bind the virtual disk service to virtual disk of guest LDom 2.

```
ldm add-vdisk vdisk4 vol4@primary-vds4 sfldom2
ldm add-vdisk vdisk5 vol5@primary-vds5 sfldom2
ldm add-vdisk vdisk6 vol6@primary-vds6 sfldom2
ldm add-vdisk vdisk7 vol7@primary-vds7 sfldom2
ldm add-vdisk vdisk8 vol8@primary-vds8 sfldom2
ldm add-vdisk vdisk10 vol10@primary-vds10 sfldom2
ldm add-vdisk vdisk11 vol11@primary-vds11 sfldom2
ldm add-vdisk vdisk12 vol12@primary-vds12 sfldom2
ldm add-vdisk vdisk13 vol13@primary-vds13 sfldom2
```

7) Assign the shared devices to guest LDom 1 from the secondary service domain.

7.a) Create services.

```
ldm add-vds secondary-vds4 secondary
ldm add-vds secondary-vds5 secondary
ldm add-vds secondary-vds6 secondary
ldm add-vds secondary-vds7 secondary
ldm add-vds secondary-vds8 secondary
ldm add-vds secondary-vds10 secondary
ldm add-vds secondary-vds11 secondary
ldm add-vds secondary-vds12 secondary
ldm add-vds secondary-vds13 secondary
```

7.b) Connect physical device to virtual disk service.

```
ldm add-vdsdev /dev/dsk/c2t5006016041E02D28d4s2 vol4@secondary-vds4
ldm add-vdsdev /dev/dsk/c2t5006016041E02D28d5s2 vol5@secondary-vds5
ldm add-vdsdev /dev/dsk/c2t5006016041E02D28d6s2 vol6@secondary-vds6
ldm add-vdsdev /dev/dsk/c2t5006016041E02D28d7s2 vol7@secondary-vds7
ldm add-vdsdev /dev/dsk/c2t5006016041E02D28d8s2 vol8@secondary-vds8
ldm add-vdsdev /dev/dsk/c2t5006016041E02D28d10s2 vol10@secondary-vds10
ldm add-vdsdev /dev/dsk/c2t5006016041E02D28d11s2 vol11@secondary-vds11
ldm add-vdsdev /dev/dsk/c2t5006016041E02D28d12s2 vol12@secondary-vds12
ldm add-vdsdev /dev/dsk/c2t5006016041E02D28d13s2 vol13@secondary-vds13
```

7.c) Bind virtual disk service to virtual disk of guest LDom 1.

```
ldm add-vdisk vdisk4 vol4@secondary-vds4 sfldom1
ldm add-vdisk vdisk5 vol5@secondary-vds5 sfldom1
ldm add-vdisk vdisk6 vol6@secondary-vds6 sfldom1
ldm add-vdisk vdisk7 vol7@secondary-vds7 sfldom1
ldm add-vdisk vdisk8 vol8@secondary-vds8 sfldom1
ldm add-vdisk vdisk10 vol10@secondary-vds10 sfldom1
ldm add-vdisk vdisk11 vol11@secondary-vds11 sfldom1
ldm add-vdisk vdisk12 vol12@secondary-vds12 sfldom1
ldm add-vdisk vdisk13 vol13@secondary-vds13 sfldom1
```

8) Install Solaris 10 operating system on the guest LDoms using Jumpstart method.
The operating system can also be installed on an LDom using other methods. Refer to the SUN documentation for more information.

9) Setup SFRAC and Oracle RAC DB.
For instructions, see the Veritas Storage Foundation for Oracle RAC Installation and configuration Guide. SFRAC documentation URL can be accessed from the references section.

References

For more information, see the following documents:

a) LDoms documentation URL:
 http://www.sun.com/servers/coolthreads/LDoms/index.jsp

b) LDom tech note URL:
http://seer.entsupport.symantec.com/docs/307635.htm

c) SFRAC documentation URL:
http://entsupport.symantec.com/

d) SFRAC certification matrix URL:
http://seer.entsupport.symantec.com/docs/280186.htm

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