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LDoms Deep Dive – IO Best Practices for Oracle VM Server for SPARC

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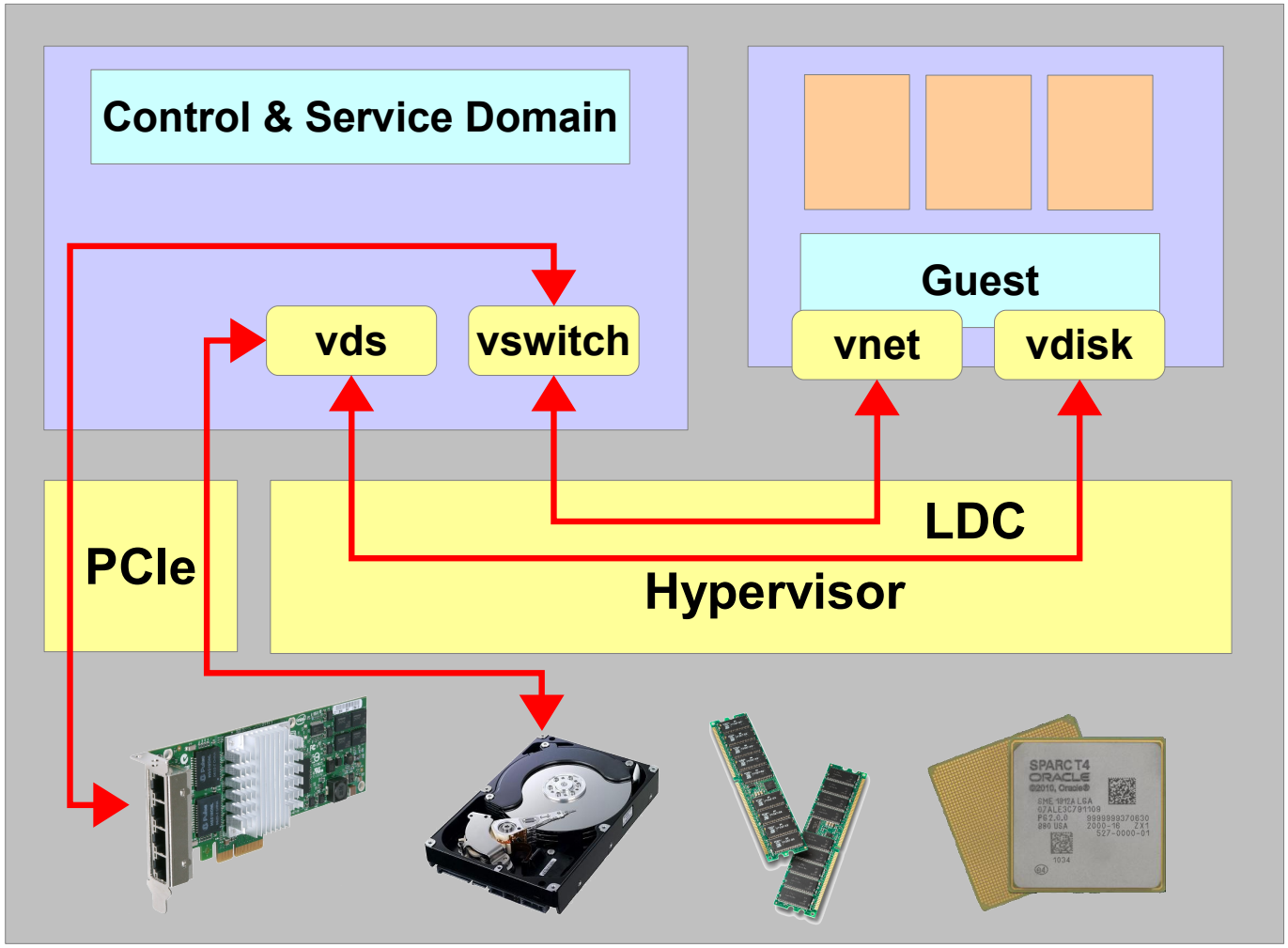
Agenda

- **Introduction to LDom Virtual IO**
- Virtual Disk IO for High Performance
- Virtual Networking
  - Default Configuration
  - Reducing Latency
  - Saving on LDC Channels
- Not so Virtual IO
  - SDIO
  - SR-IOV
  - Root Domains
- Redundant IO

General Recommendations

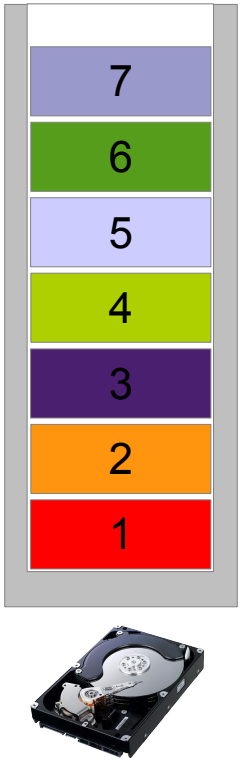
- Set the right expectations
  - Virtual IO isn't physical IO
- Use Solaris 11
  - at least in the Control- and IO-Domains
- Virtualization doesn't change physics
  - It does give us more options
- If “all virtual” isn't good enough, go physical

Domain Components



Virtual Disk IO – Considerations

- Each disk IO will see additional latency
  - impact depends on IO blocksize!
- One LDC per vDisk
  - read and write traffic sharing one channel
- One SCSI queue per vDisk



Virtual Disk IO – High Performance Recommendation

- Multiple vDisks
  - multiple SCSI queues
- Same service time per IO
- Less wait time per IO
- Better overall latency
- Higher throughput
- Redo Logs on dedicated vDisk
- Same approach as with traditional storage

Virtual Disk IO – Further Aspects

- NPIV
  - Multiple WWWns on a single SAN port
  - Supported by Solaris (10 and 11)
  - Usable for normal LDom disk backends
  - This is not a virtual HBA
- For highest performance requirements, use
  - SDIO
  - Root Domains

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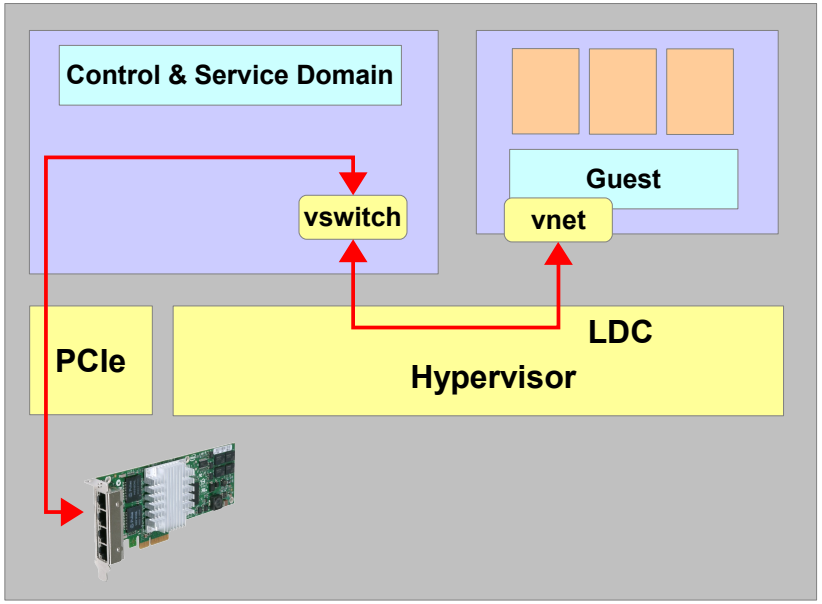
Virtual Networking

Default Configuration

- Network access using virtual switch connected through LDCs
- Very flexible
- Supports Live Migration
- Additional Latency



Virtual Networking

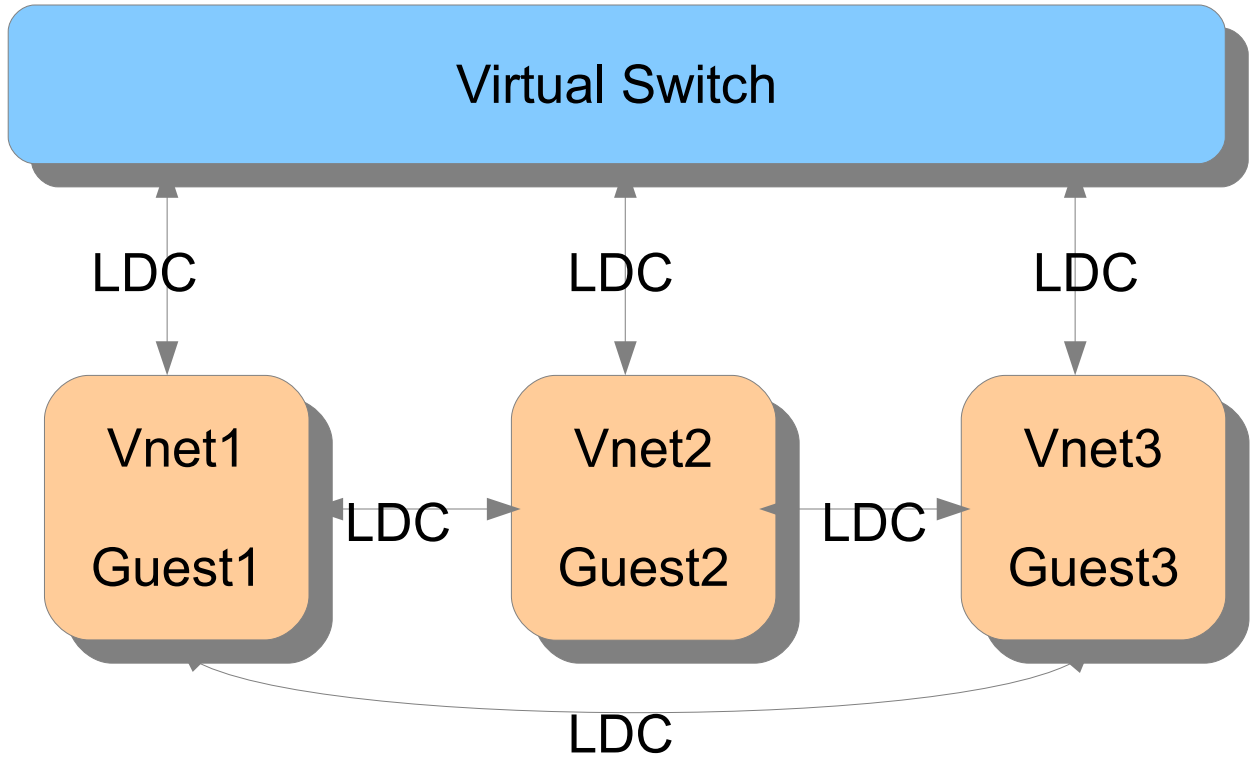
Reducing Latency

- Per-Domain feature: “extended-mapin-space”
- Requires Solaris 10u10 or Solaris 11
  - Guest & Control Domain
- Requires LDoms 2.2
- New virtual network implementation detail
  - Reduced CPU utilization
  - Reduced latency
- Requires a reboot of both guest and control domain
- Uses 4MB of free RAM per guest domain

Inter-Vnet LDC Channels

Reduce LDC usage for complex network setups

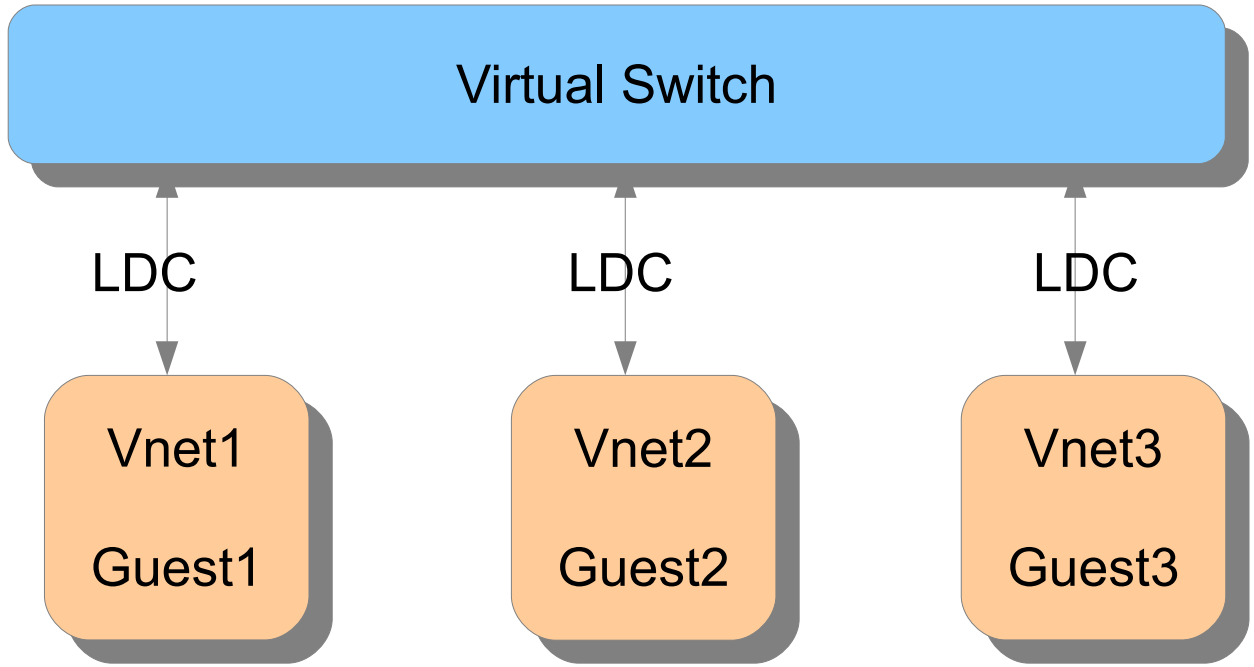
- Default behaviour: NxM LDCs



Inter-Vnet LDC Channels

Reduce LDC usage for complex network setups

- New (optional) behaviour: LDC tree



Inter-Vnet LDC Channels Details

- New CLI option 'inter-vnet-link'
  - Default: ON
  - Virtual Switch wide setting, affects all Vnets in a Virtual Switch.
  - Can be dynamically enabled/disabled without stopping the Guest domains
  - The Guest domains dynamically handle this change

Virtual Networking Recommendations

- Apply “extended-mapin-space” to domains with latency sensitive applications. That might be all domains...
- Jumbo Frames for high throughput
- If short on LDCs, use “inter-vnet-link=on”

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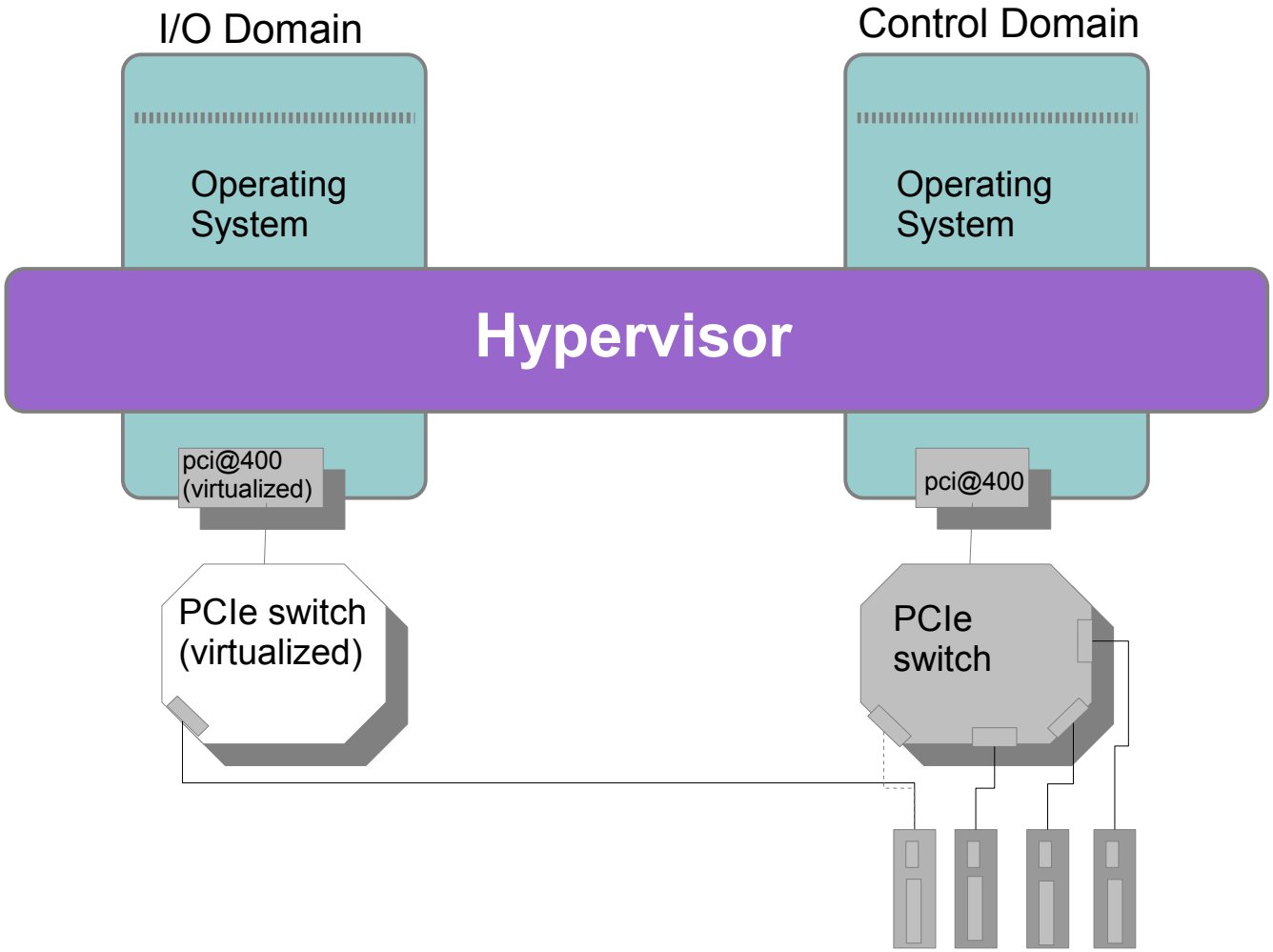
Not so Virtual IO

Hardware Access for Guest Domains

- Fully virtual IO
  - is very flexible
  - supports Live Migration
  - supports Dynamic Reconfiguration
  - is freely and abundantly available
- Virtualized Hardware
  - is as fast as “real” hardware
  - prohibits Live Migration
  - does not support Dynamic Reconfiguration
  - needs to be paid for
  - uses PCIe slots in your server

Not so Virtual IO

SDIO – Giving a PCIe Slot to a Domain



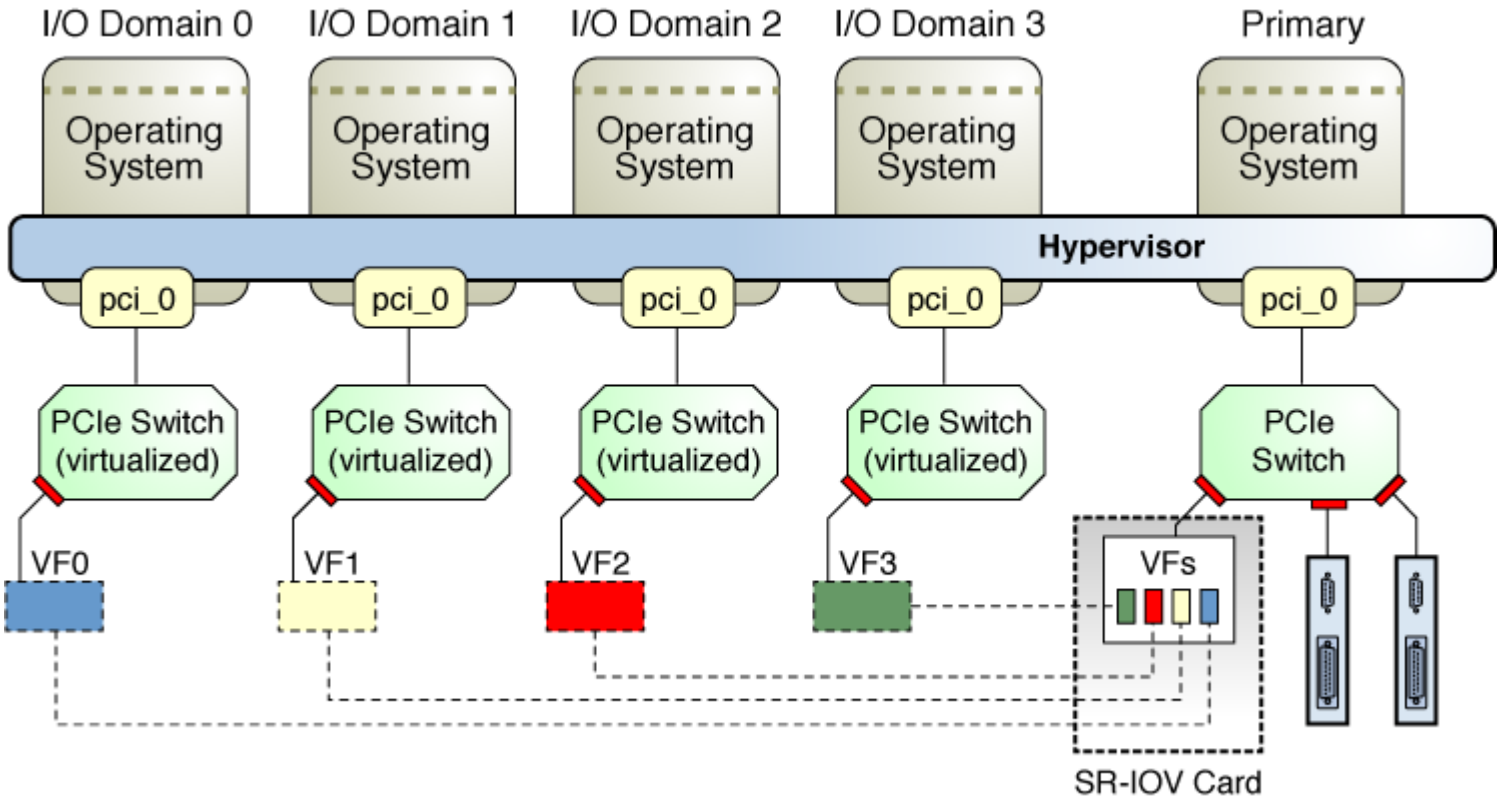
SDIO Considerations

- Has no performance penalty
- Supports devices other than disk and network
  - Tape being the most typical example
- Creates a dependency on the Control Domain
- Does not support Dynamic Reconfiguration
- Disables Live Migration of the guest
- Not supported by all PCIe adapters
  - See MOS note 1325454.1 for details

Not so Virtual IO

SR-IOV – Network Hardware Virtualization

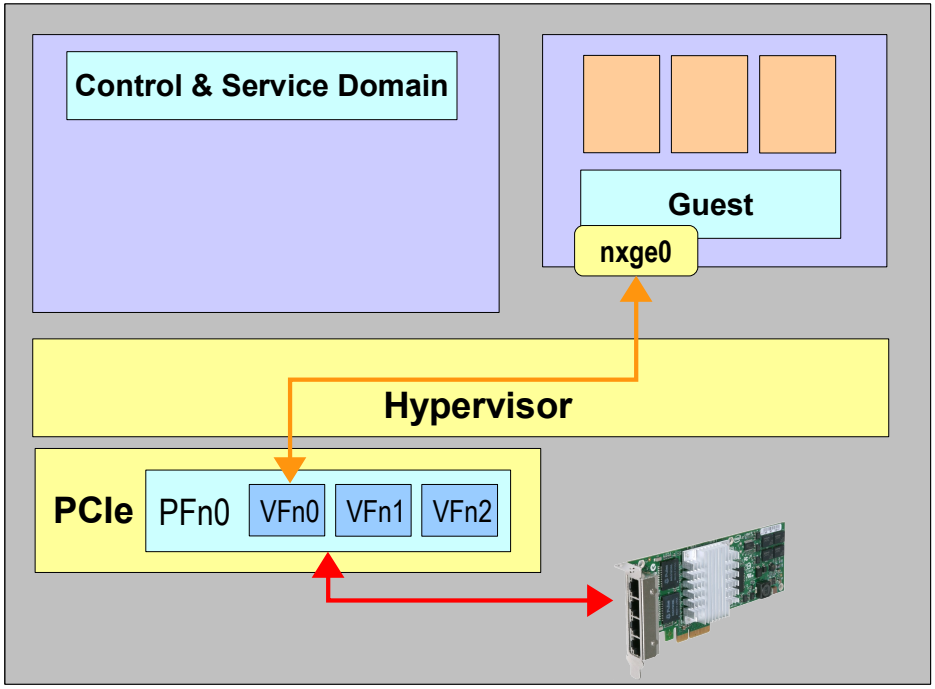
- PCIe Standard
- Requires hardware support on the card



SR-IOV in LDoms

Virtual Network Ports with Bare Metal Performance

- Create VFs in Control Domain
- Assign VFs to Guests
  - Don't forget MAC-Addresses
- Guest uses physical NIC driver (nxge, igb)
- Network-Only feature
  - no HBAs available that would support SR-IOV



SR-IOV Example

```
root@sun:~# ldm create-vf /SYS/MB/NET0/IOVNET.PF0 \
      mac-addr=0:14:4f:fb:8a:20 alt-mac-addrs=auto
root@sun:~# reboot

root@sun:~# ldm ls-io
NAME                          TYPE   DOMAIN   STATUS
----                          ----   ------   ------
/SYS/MB/NET0/IOVNET.PF0       PF     -
/SYS/MB/NET0/IOVNET.PF0.VF0   VF     -

root@sun:~# ldm add-io /SYS/MB/NET0/IOVNET.PF0.VF0 jupiter

root@sun:~# ldm ls-io
NAME                          TYPE   DOMAIN   STATUS
----                          ----   ------   ------
/SYS/MB/NET0/IOVNET.PF0       PF     -
/SYS/MB/NET0/IOVNET.PF0.VF0   VF     jupiter

root@jupiter:~# dladm show-phys
LINK         MEDIA           STATE      SPEED  DUPLEX    DEVICE
net0         Ethernet        up         0      unknown   vnet0
net2         Ethernet        up         1000   full      igbvf0
```

SR-IOV Considerations

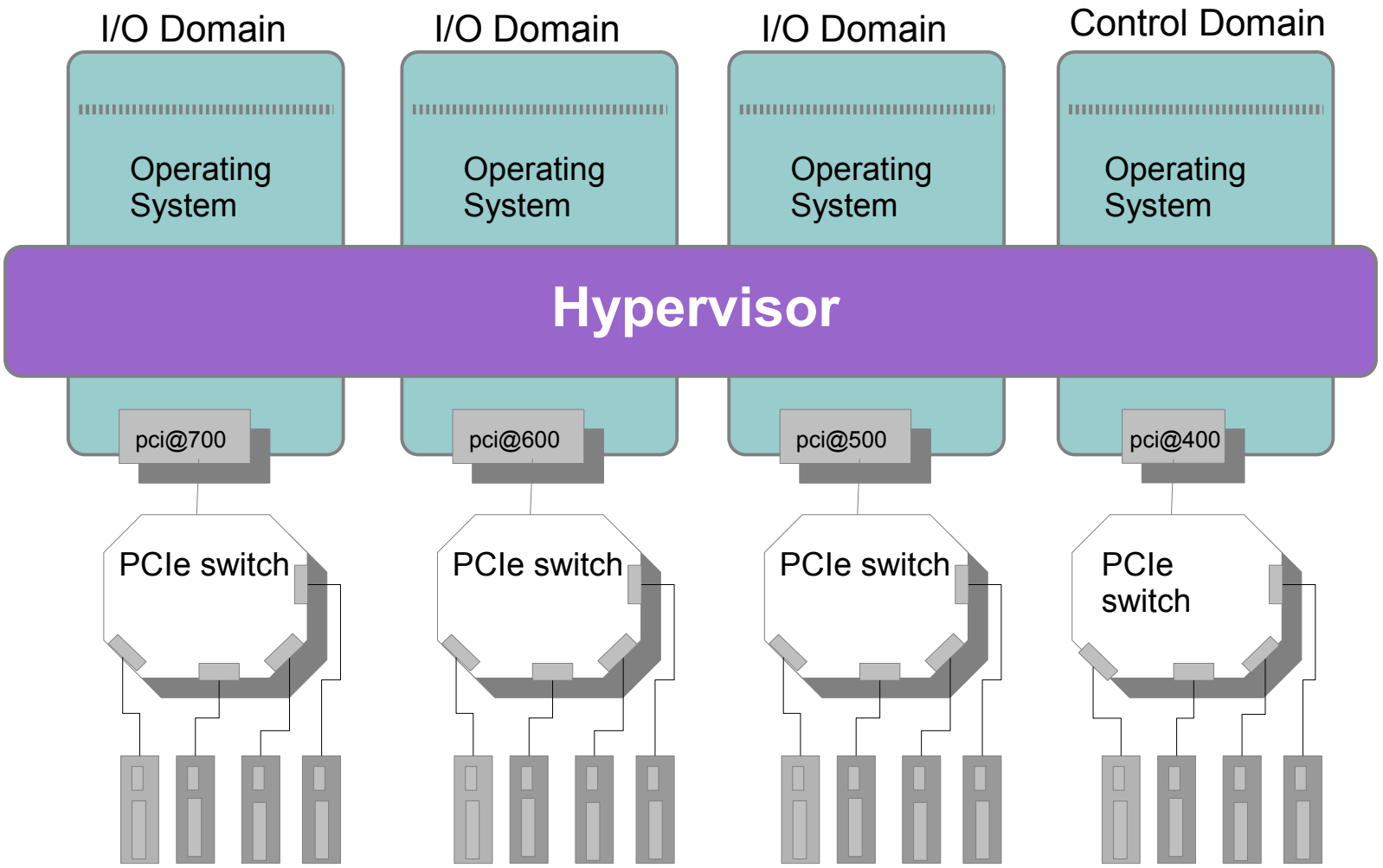
- Performance
  - near native latency & throughput
  - VFs somewhat limited compared to PFs depending on HW
- Better utilization of NIC hardware
- Cost reduction
  - fewer hardware adapters required
- Live Migration disabled for domains with Virtual Functions
- Dependancy on primary domain (similar to SDIO)
- Solaris11 VNICs on a VF are supported.
  - But limited to the number of alt-mac-addrs assigned to it.
- Up to 15 IO-Domains per PCIe RC

SR-IOV Software Requirements

- Platform FW that supports SR-IOV.
  - The version of the FW is platform dependent.
- LDoms manager version 2.2 or later.
- Root domain OS that supports SR-IOV:
  - Solaris 11 or later
  - S10U11 – when it becomes available
- Guest domain OS:
  - Solaris 11 or later
  - S10U10 with a VF driver patches
  - S10U11 – when it becomes available

Root Domains

Is This Still Virtualization?



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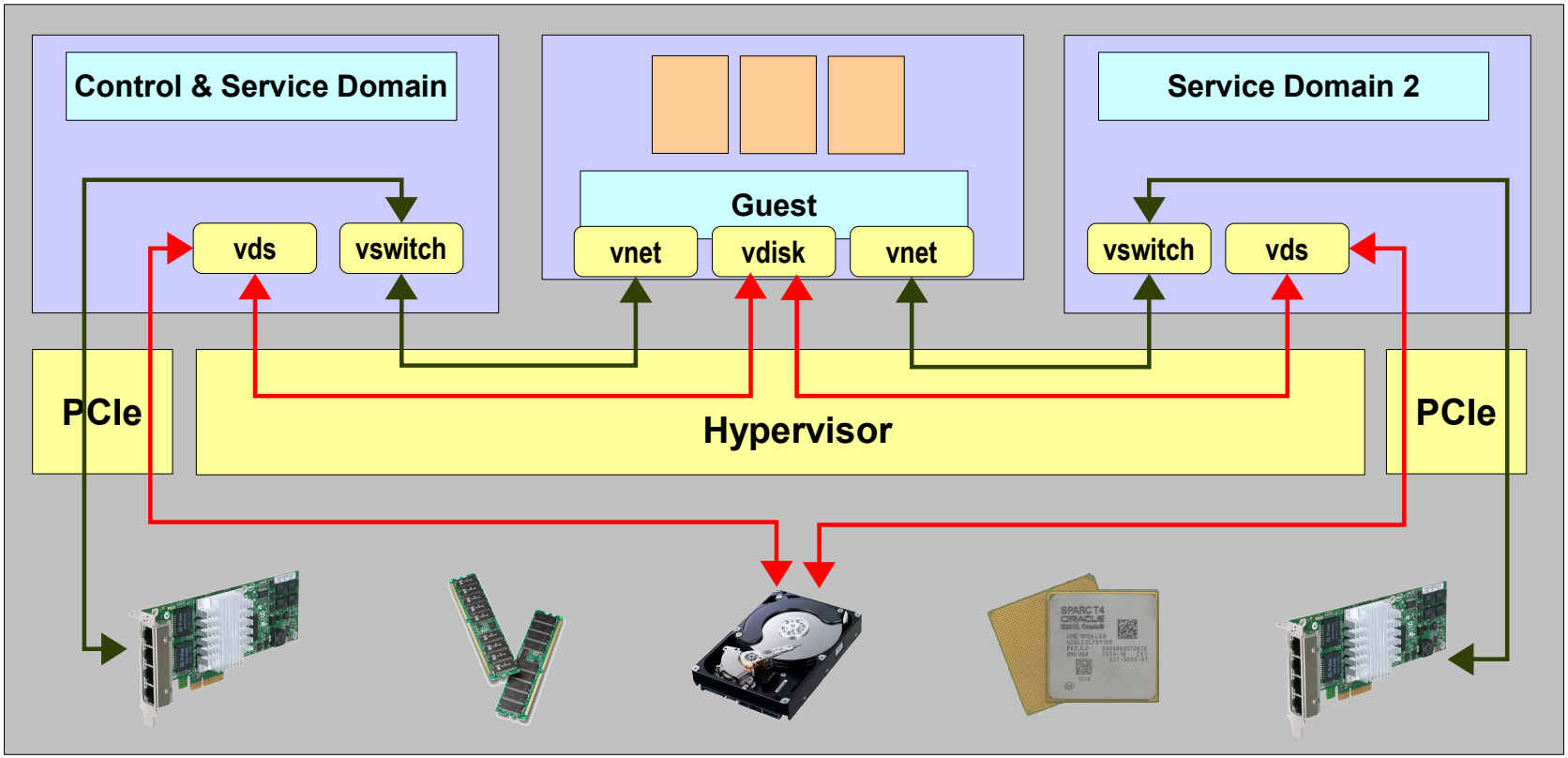
Redundant IO Domains



Redundant IO domain (1): Create Domain

```
root@sun # ldm remove-io pci@400 primary

root@sun # ldm create io-domain
root@sun # ldm set-vcpu 16 io-domain
root@sun # ldm set-memory 8g io-domain

root@sun # ldm add-io pci@400 io-domain
root@sun # ldm add-vsw net-dev=igb0 switch-second io-domain
root@sun # ldm add-vds io-vds io-domain

root@sun # ldm set-variable auto-boot\?=false io-domain
root@sun # ldm bind io-domain ; ldm start io-domain

root@sun # telnet localhost 5001
```

Redundant IO domain (2): MP-IO for Guest

```
root@sun # ldm set-vdsdev mpgroup=mars \
               mars.root@primary-vds
root@sun # ldm add-vdsdev mpgroup=mars \
               /guests/mars.root mars.root@io-vds

root@sun # ldm add-vnet net1 switch-second mars

root@sun # ldm set-vsw linkprop=phys-state switch-second
root@sun # ldm set-vsw linkprop=phys-state switch-primary

root@sun # ldm set-vnet linkprop=phys-state net0 mars
root@sun # ldm set-vnet linkprop=phys-state net1 mars
```

Redundant IO domain (3): IPMP for Guest

```
root@mars:~# ipadm create-ip net0
root@mars:~# ipadm create-ip net1
root@mars:~# ipadm add-ipmp -i net0 -i net1 ipmp0
root@mars:~# ipadm create-addr -T static \
                  -a 10.131.6.98/24 ipmp0/v4

shinker@mars:~$ ipadm show-if
IFNAME     CLASS    STATE    ACTIVE OVER
lo0        loopback ok       yes    --
ipmp0      ipmp     ok       yes    net0 net1
net0       ip       ok       yes    --
net1       ip       ok       yes    --
```

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