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SOLARIS

Simple, Flexible, Fast: Virtualization in 11.4

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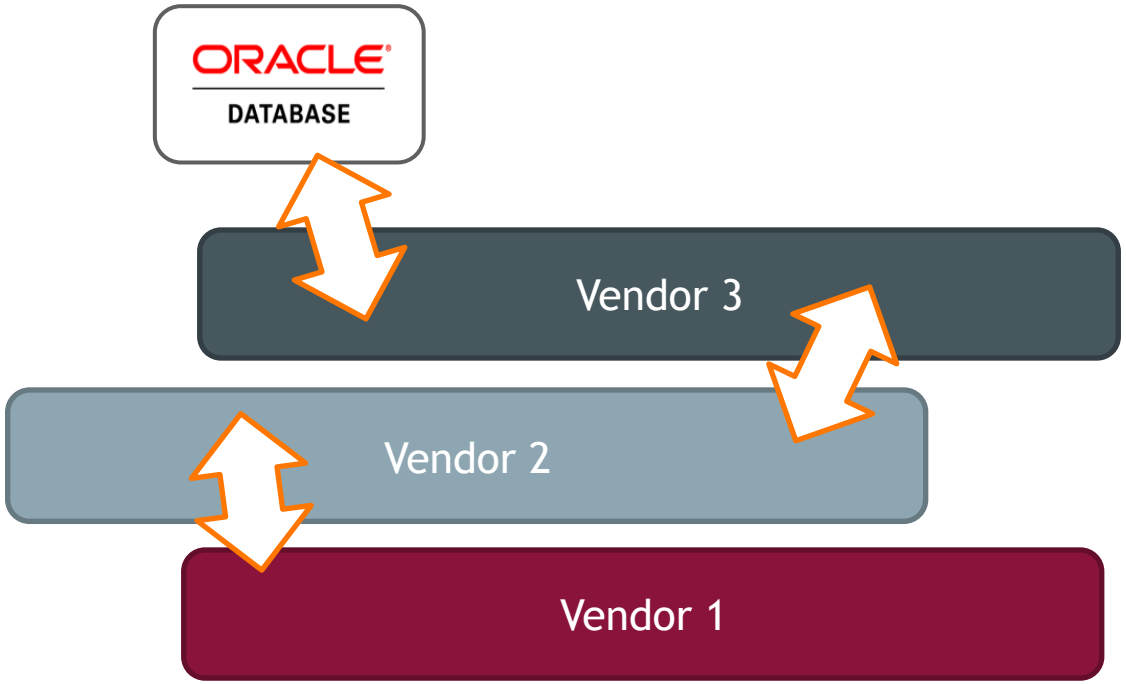
Solaris Virtualization vs. the Competition

OS and Virtualization - Engineered Together

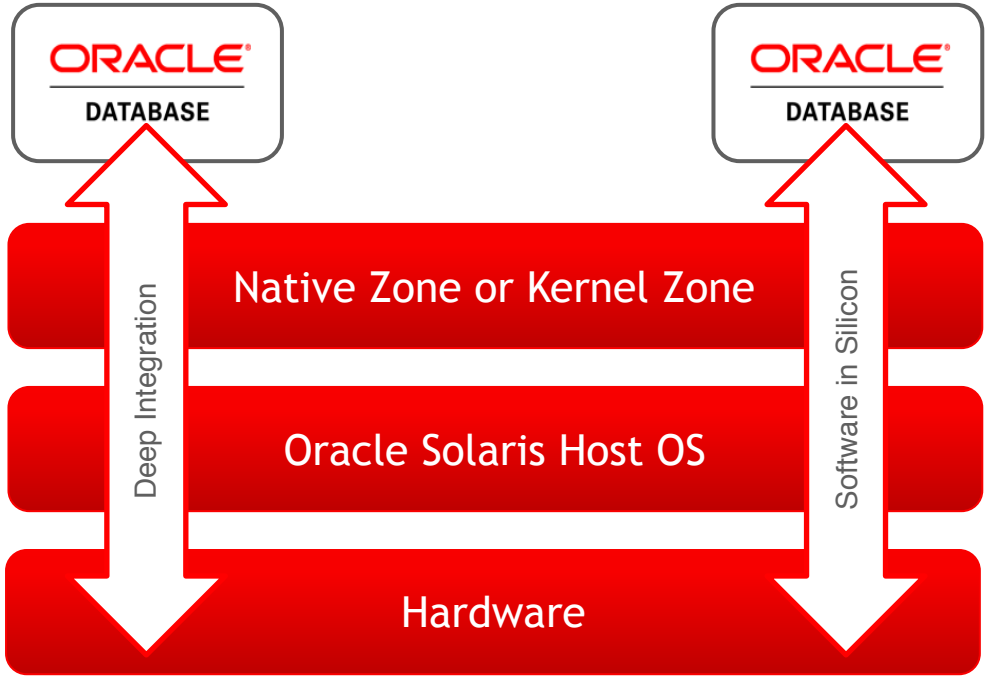
Traditional Hypervisors

Separate, isolated, slow

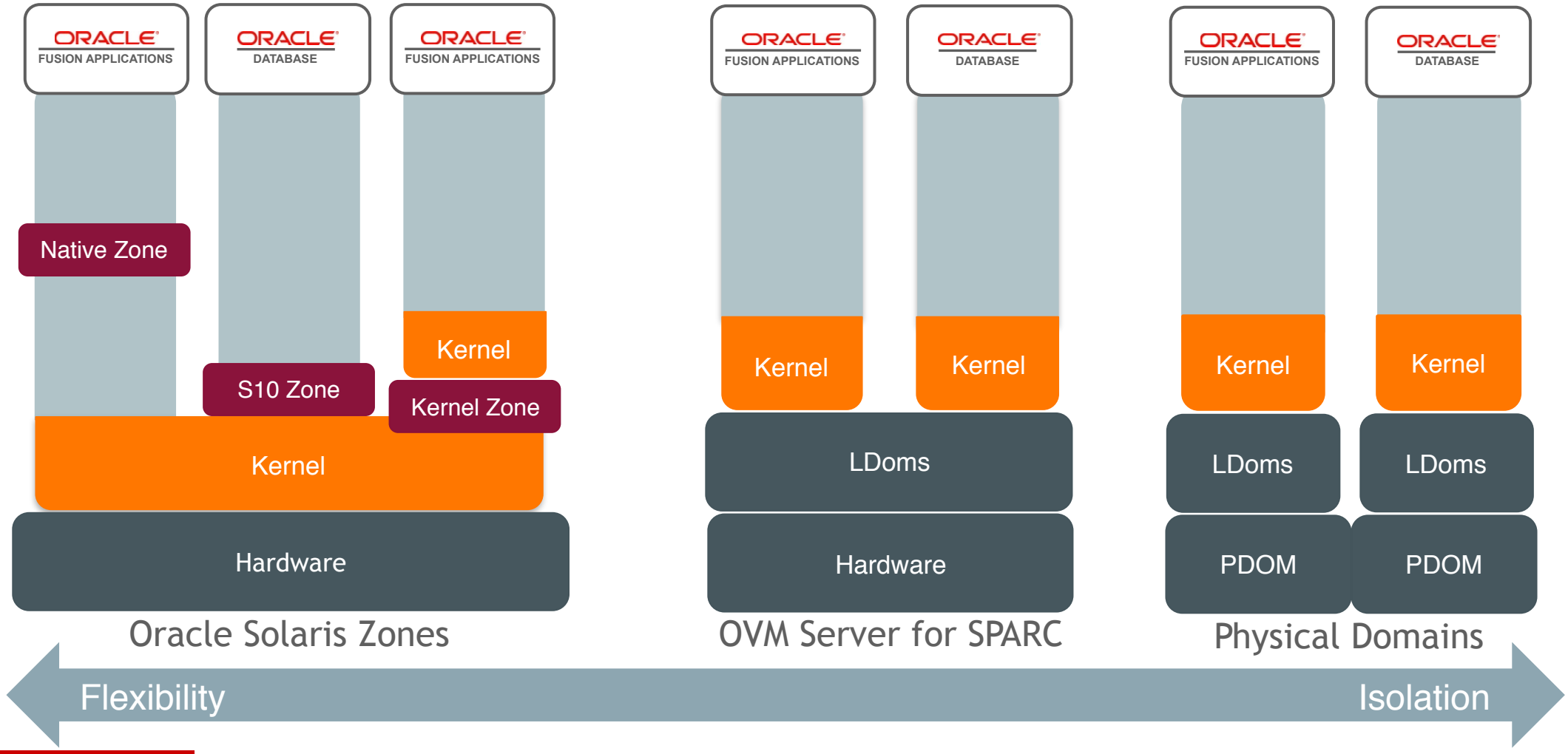


Native Zones, Kernel Zones

Engineered, performant, robust, secure

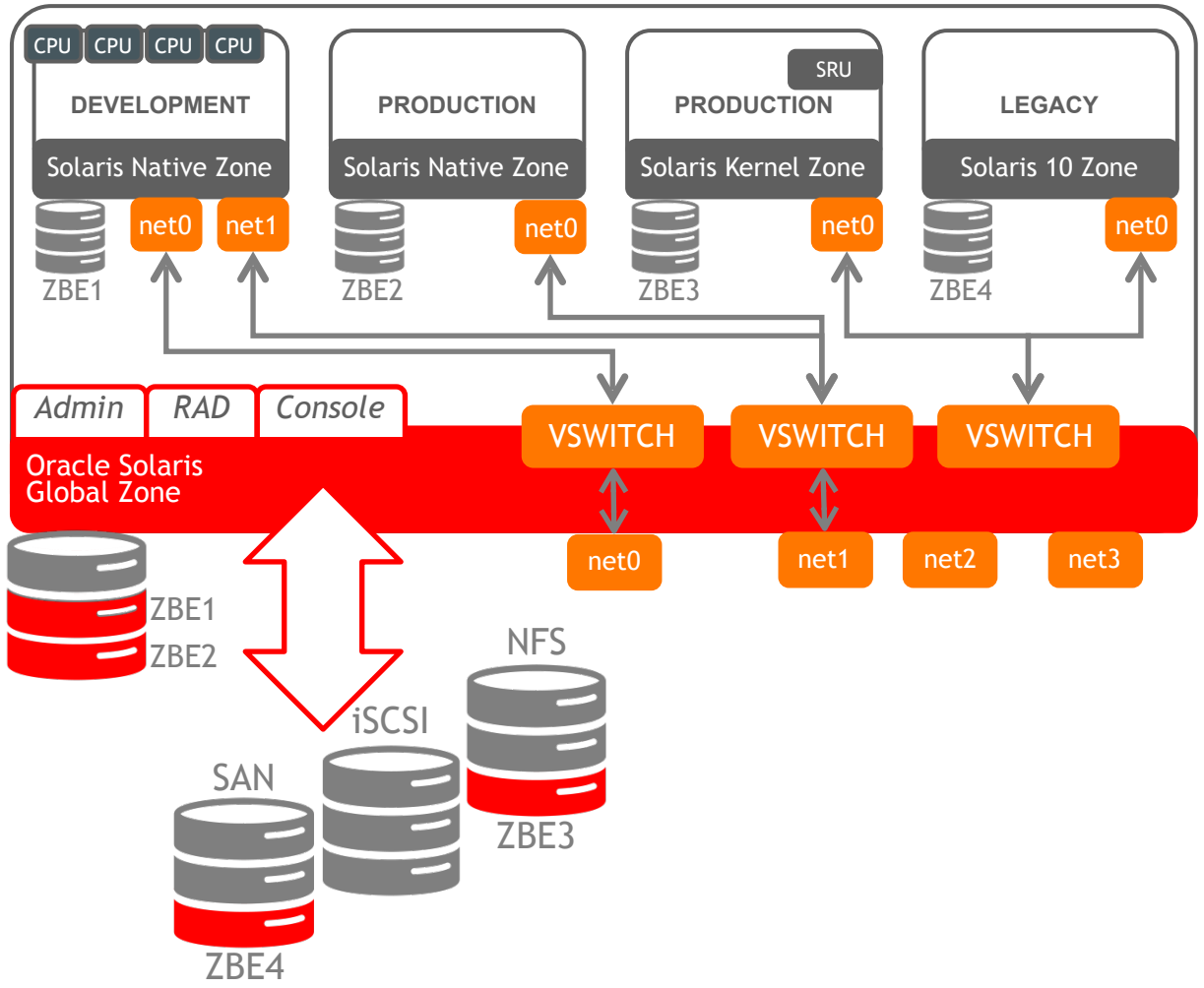


Virtualization Types



Oracle Solaris Zones

- Used by almost every Solaris customer
- Direction: the “cloud space” moving towards OS virtualization
- From 11.2 all apps should be running inside a zone of some kind



Evolution of Zones in Oracle Solaris

Solaris 10 (2005)

- First widely adopted OS-level virtualization technology
- Container technology
- Shared kernel

Solaris 11 (2012)

- Exclusive IP/Virtual networking
- Zones on shared storage
- Parallel updates
- Immutable zones
- Mature technology

Solaris 11.2 (2014)

- New type of zone: Kernel Zone
- Live zone reconfiguration
- CMT awareness in zones
- OpenStack integration

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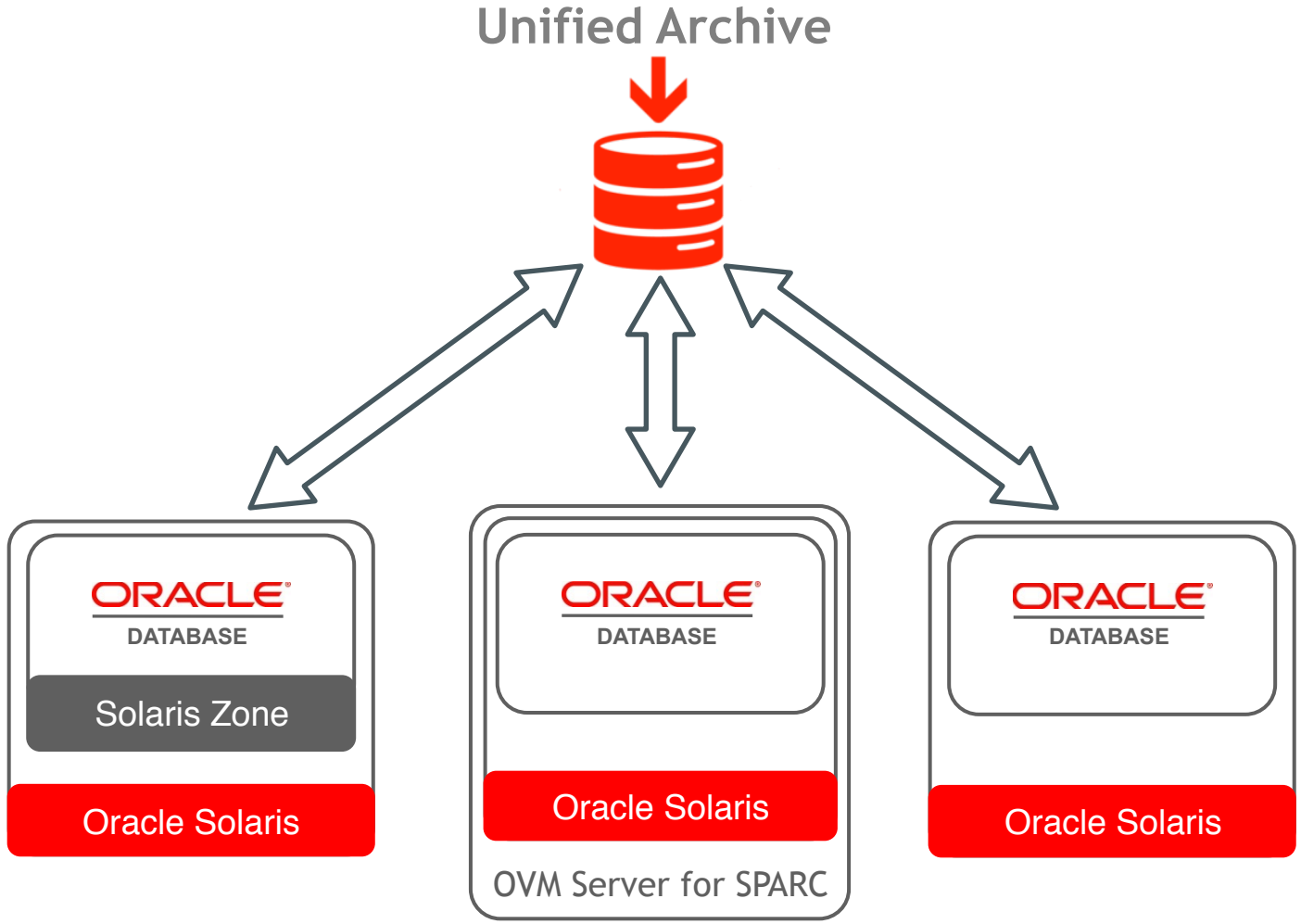
Deploy And Move Between Virtualization Types

- No Virtualization “lock-in”
- Even move back to bare metal
- Move from Development to Test to Production with confidence



11.3 Highlights for Native Zones

- Virtualized clock
  - across reboots
- **`rcapd`** improvements
  - better performance
  - simpler configuration
- NPIV support
- Immutable zones enhancements
- **`zonecfg`** usability improvements

11.3: Read-Only Virtual Machines

Protect the Application Infrastructure

- Immutable Zones
  - Read only virtualization
  - Also possible with global zone and OVM Server for SPARC guest
  - Access via a trusted path
- New - Dynamic Zones setting, allows creation of zones
- Ready made “templates” via **`file-mac-profile`** property

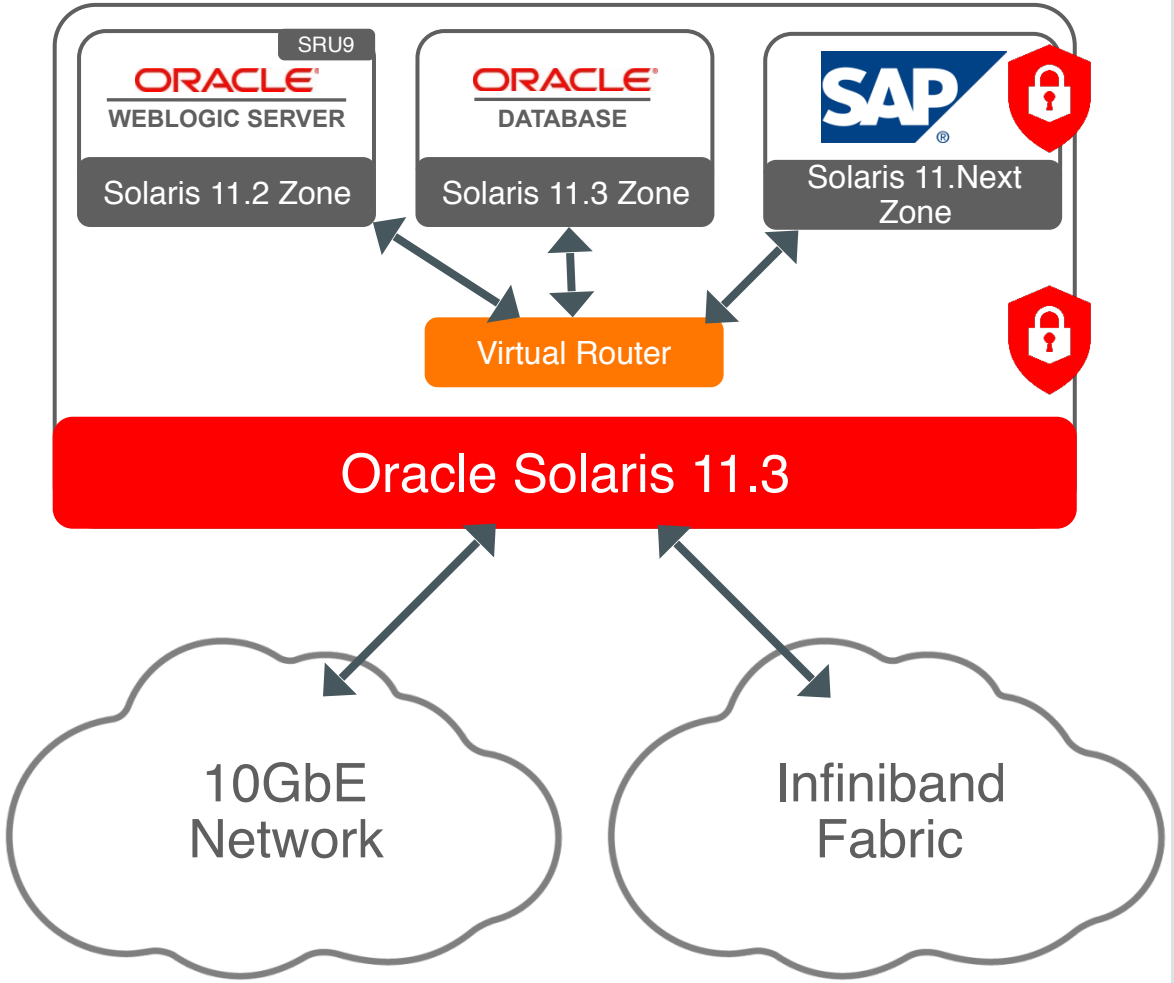
	None	Flexible	Fixed	D-Zone	Strict
/, /usr, /lb, …	Writeable	Read Only	Read Only	Read Only	Read Only
/etc	Writeable	Writeable	Read Only	Read Only	Read Only
/var	Writeable	Writeable	Writeable	Writeable	Read Only
other	Writeable	Read Only	Read Only	Read Only	Read Only
Create Zone	Yes	No	No	Yes	No

11.3: `zonecfg(8)` usability improvements

- Templates
  - To provide default values for properties
  - Just read-only zone configuration files
  - They also reside in /etc/zones
- Unique IDs for **`zonecfg`** resources
  - Previously, long selection string possibly needed when multiple instances of the same resource existed.

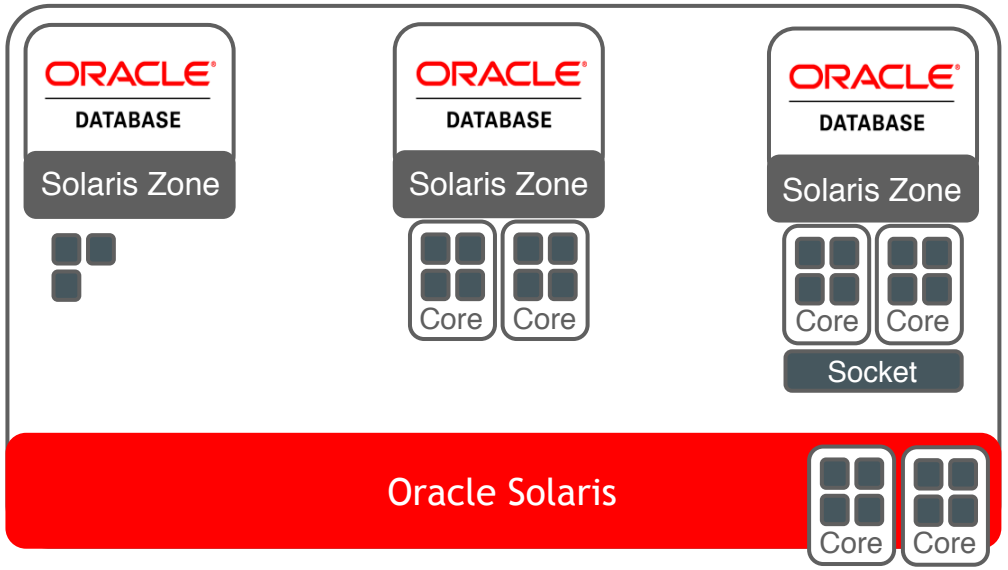
11.3 Highlights for Kernel Zones

- Live migration
  - secure; multi-threaded; migration classes for SPARC (for x86 in 11.4)
- NFS ZOSS support
  - not supported for native zones
- Live zone reconfiguration
- ADI support
- SR-IOV NIC and Infiniband support
- Verified boot
  - kernel modules verified before loading and executing



11.3: Zone Resource Management Improvements

- Assign Zone CPU resources by CPUs, Cores, and Sockets
- Applies to Zones and Resource Pools
- Use **`psrinfo –t`** to show socket/core/cpu layout
- Makes configuring and complying with license hard partition rules much easier
- Recognized license boundary



Solaris 11.4 Highlights

Main Focus Areas

- Simplified, very flexible management for all zone brands
- Extended life-cycle management
- Kernel Zones feature parity and performance

11.4: Management Improvements

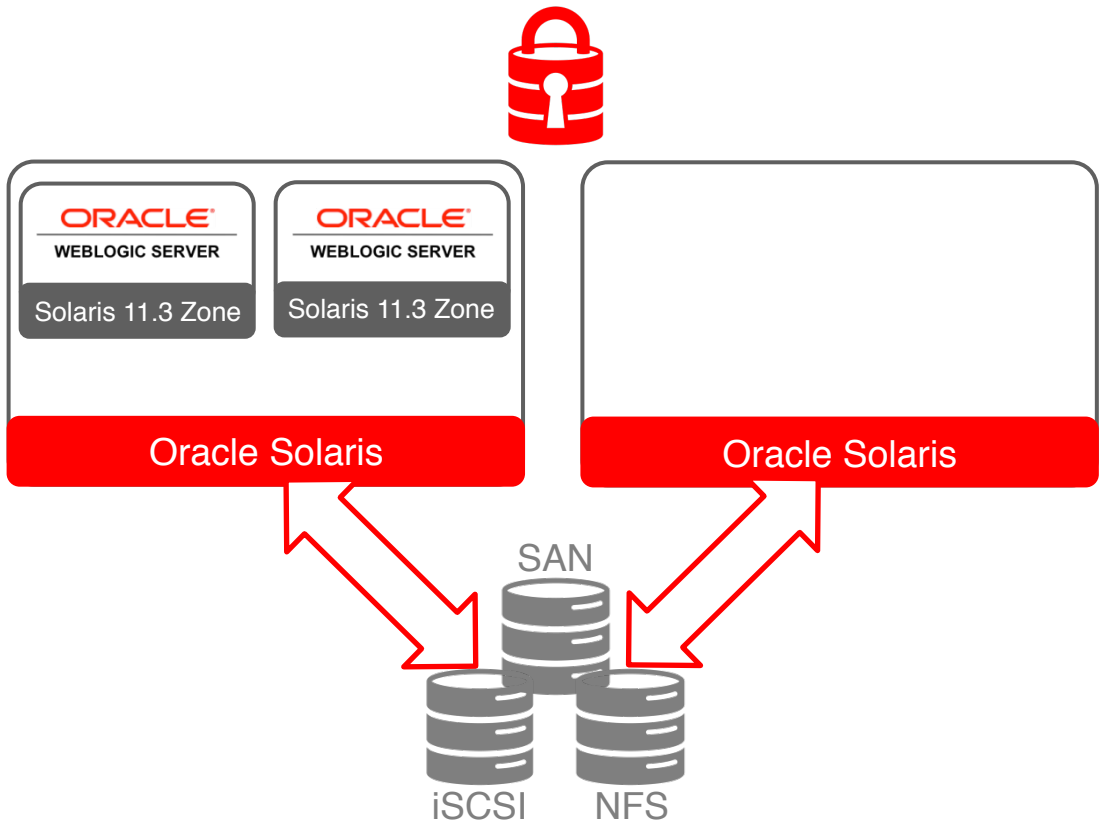
- Zones as SMF services
  - boot/shutdown throttling; boot priorities
  - FMA reporting
  - Inter-zone dependencies via goals
  - works across all zone brands
- Zone state shared across boot environments
  - previously, a zone in each BE had its own state

11.4: Management Improvements (cont.)

- Better live zone reconfiguration
  - **`virtual-cpu`** for Kernel Zones
  - datasets for native zones
- Simpler **`zonecfg info`** output
- Direct **`beadm`** of native zone BEs
  - **`beadm list -z <zone-name>`**
  - see **`fmri(7)`**, "SCHEME zbe VERSION 0" section

Secure Live Migration with Kernel Zones

- Live Migration since 11.3
- Move KZs without outage
- No downtime host maintenance
- Load balance across infrastructure
- Forward and backward compatibility for LM moves
- Migration classes for SPARC (11.3)
  - Via "**`cpu-arch`**" zone config property

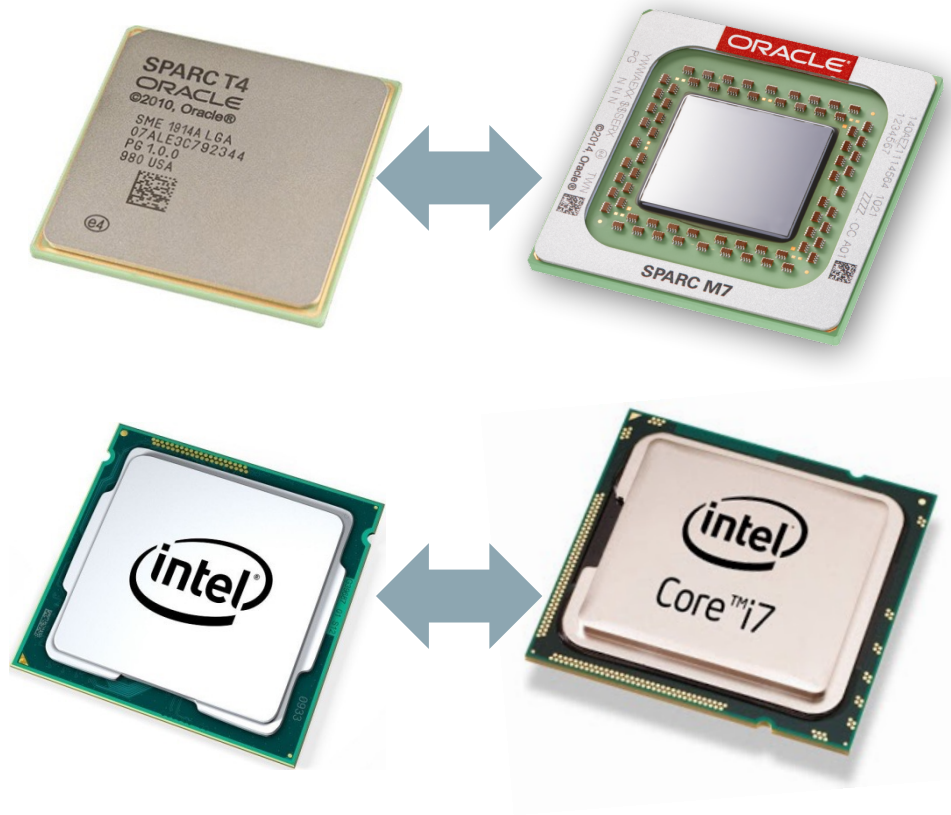


11.4: (Migration) Management Improvements

- RAD migration API
  - Finer-grained API with progress reporting
- Cold migration
  - Transfer config, automate detach/attach
  - Via **`zoneadm migrate`** (and the API)
- Improved **`virtinfo(8)`** support
  - Explicit kernel zone support info

11.4: (Migration) Management Improvements (cont.)

- Kernel zone migration flexibility improved
- Migration classes for x86
- New **`host-compatible`** setting
  - Software equivalent of **`cpu-arch`**
  - Choose feature/flexibility trade-off
  - Eg. migrating from a host supporting ADI to one that does not



11.4: Zone Evacuation

- A single command to evacuate running Kernel Zones because of HW maintenance or failure
- Must manually specify targets
- **`sysadm(8)`** to facilitate maintenance state and evacuation capabilities
- Each KZ with a configured target is migrated to that destination
  - Installed NGZs can be evacuated as well
- Evacuate “return” to migrate back

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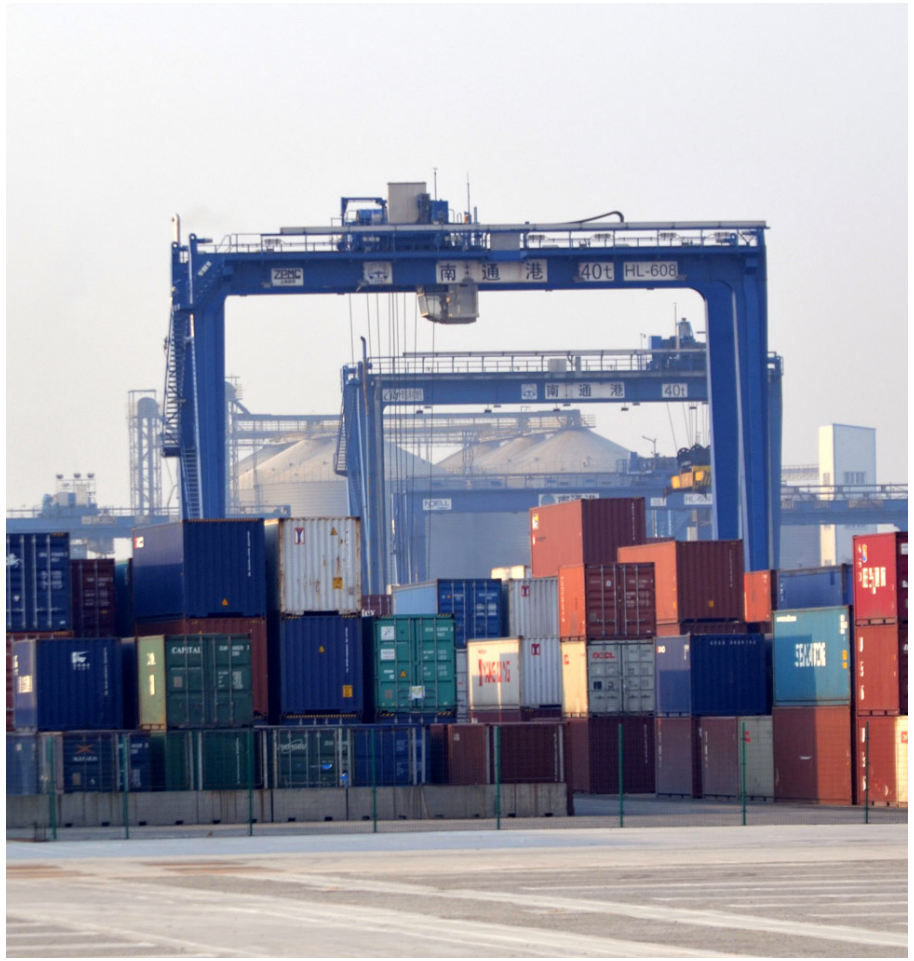
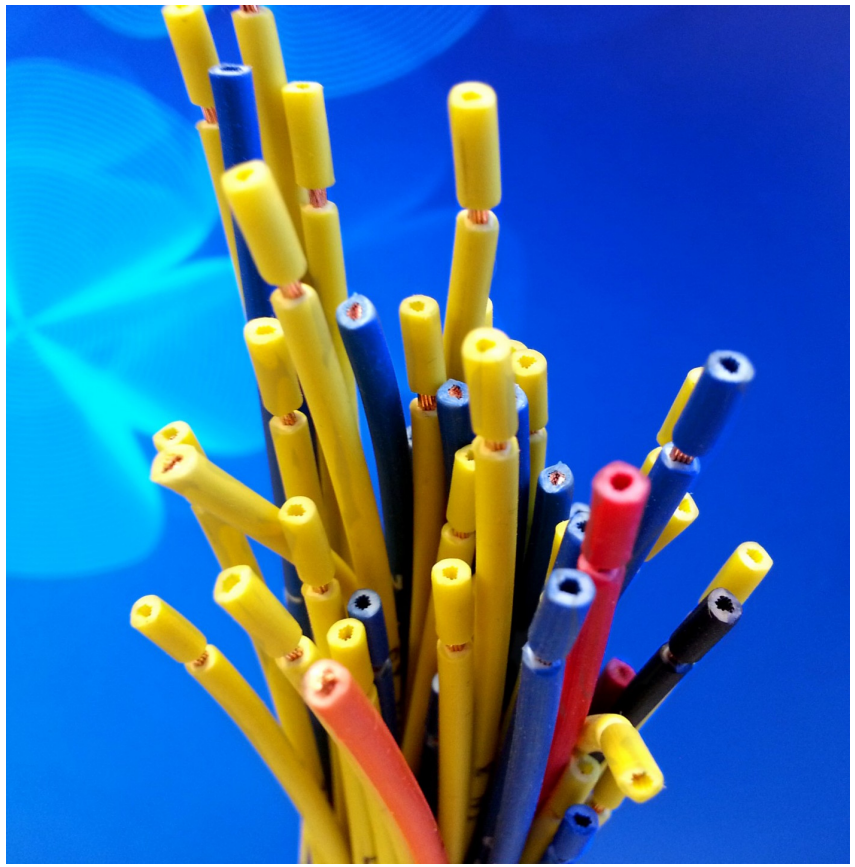
11.4: Storage

- SCSI-3 Persistent Group Reservation support for Kernel Zones boot disks
- NPIV support for Kernel Zones
- **`zoneadm move`**
  - Migrate native zones to/from Zones on Shared Storage (ZOSS)



11.4: Networking



- Live migration of SR-IOV Kernel Zones
  - Automatic switchover to PV interface via DLMP
  - Switch back on destination, if SR-IOV available
- VNICs over paravirtualized IPoIB datalinks for Kernel Zones
  - allows creation a NGZ inside a KZ using IPoIB PV as a lower-link

11.4: Security

- Immutable GZ management improvements
  - Avoids intermediate reboots on reconfiguration
- Per-zone RNG pools
- Comprehensive auditing of kernel (and native) zone operations
  - Auditing the lifecycle of NGZs/KZs
  - look for **`AUE_zone_*`** events

11.4: Resource management

- Per-zone statistics (kstats)
  - subset of system CPU stats
  - also memory and usage cap stats
- Improved **`zonestat(1)`** scalability
- Multi-CPU binding for projects
- Side-by-side pools and psets
- Allocation by cores/sockets

Demos

- Throughout the presentation, demos were shown.
- Those were collected and put in the following slides with short explanations for each.
- They are not meant to be complete due to limited space.

Demos (cont.)

- To show how to move between Solaris virtualization types, we created a solaris branded Zone clone archive and used it to install a Kernel Zone on NFS (see `suri(7)` for more on storage URIs).

```
# archiveadm create -z tzone1 --root-only /data/uar/tzone1.uar

# zonecfg -z kz-nfs info device
device:
        storage: nfs://pechanec:staff@bjork/data/kz-nfs.image
        create-size: 16G
        id: 0
        bootpri: 0

# zoneadm -z kz-nfs install -x storage-create-missing -a /data/uar/tzone1.uar
```

Demos (cont.)

- To assign Zone CPU resources by Cores and Sockets, you can do it like this:

```
# psrinfo -t
socket: 0
  core: 0
    cpus: 0,28
  core: 1
    cpus: 1,29
  core: 2
    cpus: 2,30
  core: 3
…….

# zonecfg -z tzone1 "add dedicated-cpu; set cores=0-2,4; end"
```

Demos (cont.)

- After the hosts were configured for the Live Migration, the installed KZ could be migrated to another host like this:

```
# zoneadm -z kz-nfs migrate ssh://pechanec@bjork
zoneadm: zone 'kz-nfs': Using existing zone configuration on destination.
zoneadm: zone 'kz-nfs': Attaching zone.
zoneadm: zone 'kz-nfs': Booting zone in 'migrating-in' mode.
zoneadm: zone 'kz-nfs': Checking live migration compatibility.
zoneadm: zone 'kz-nfs': Performing initial copy (total 4096MB).
zoneadm: zone 'kz-nfs': 0.00% done: 0MB copied @ 0.0MB/s, skipped 0MB
zoneadm: zone 'kz-nfs': 36.29% done: 512MB copied @ 102.4MB/s, skipped 974MB
zoneadm: zone 'kz-nfs': 75.19% done: 1024MB copied @ 102.4MB/s, skipped 2055MB
zoneadm: zone 'kz-nfs': 98.01% done: 1600MB copied @ 115.2MB/s, skipped 2414MB
zoneadm: zone 'kz-nfs': 100.00% done: 1681MB copied @ 16.2MB/s, skipped 2414MB
zoneadm: zone 'kz-nfs': Performing copy of recently modified memory.
zoneadm: zone 'kz-nfs': Suspending zone on source host.
zoneadm: zone 'kz-nfs': Waiting for migration to complete.
zoneadm: zone 'kz-nfs': Migration successful.
zoneadm: zone 'kz-nfs': Halting and detaching zone on source host.
```

Demos (cont.)

- Direct beadm with solaris branded Zones

```
# beadm list -z tzone1
FMRI                    Parent BE FMRI      Flags Mountpoint                Space
---------------------- ------------------- ----- ------------------------- -------
zbe://tzone1/solaris-0  -                   O     -                         271.50K
zbe://tzone1/solaris-1  be://rpool/st_012_1 -     -                         130.09M
zbe://tzone1/solaris-10 be://rpool/st_012_1 -     -                         157.50K
zbe://tzone1/solaris-12 be://rpool/st_012_1 NR    /system/zones/tzone1/root 1.97G
zbe://tzone1/solaris-2  -                   RO    -                         274.50K
zbe://tzone1/solaris-8  be://rpool/st_012_1 -     -                         523.00K
```

- To remove orphaned ZBEs (O), you can re-attach with an -x option:

```
# zoneadm -z tzone1 detach
# zoneadm -z tzone1 attach -x destroy-orphan-zbes
```

Demos (cont.)

- Solaris branded Zones can be cold migrated now, if they are installed on shared storage. Cold means in the installed state.

```
# zoneadm -z tzone1 list -v
  ID NAME             STATUS      PATH                         BRAND      IP
   - tzone1           installed   /system/zones/tzone1         solaris    excl

# zonecfg -z tzone1 info rootzpool
rootzpool:
        storage: iscsi://xstorage/luname.naa.600144f0dbf8af1900005582f1c90007

# zoneadm -z tzone1 migrate ssh://jpechane@bjork
zoneadm: zone 'tzone1': Using existing zone configuration on destination.
zoneadm: zone 'tzone1': Attaching zone.
zoneadm: zone 'tzone1': Migration successful.
```

Demos (cont.)

- Explicit kernel zone support info in `virtinfo(8)` may look like the following.

```
kz# virtinfo -c unsupported get status
NAME        CLASS       PROPERTY VALUE
kernel-zone unsupported status   not supported in kernel-zone

gz# virtinfo -c unsupported get status
NAME        CLASS       PROPERTY VALUE
kernel-zone unsupported status   cannot load the zvmm kernel module
```

Demos (cont.)

- To evacuate zones, you need to set the target first.

```
# svccfg -s system/zones/zone:evac1 listprop evacuation/target
evacuation/target astring     ssh://root@bjork
# : …set evacuation/target for other zones as well

# zoneadm list -cv
  ID NAME             STATUS      PATH                         BRAND      IP
   0 global           running     /                            solaris    shared
  44 evac1            running     -                            solaris-kz excl
  45 kz-nfs           running     -                            solaris-kz excl
   - tzone1           installed   /system/zones/tzone1         solaris    excl
   - evac3            installed   -                            solaris-kz excl
   - evac4            configured  -                            solaris-kz excl
```

Demos (cont.)

- Then, start the maintenance mode, and evacuate running zones (default), and installed zones as well (-a).

```
# sysadm maintain -s -m "Evacuation demo"
# sysadm evacuate -av
sysadm: preparing 4 zone(s) for evacuation ...
sysadm: initializing migration of tzone1 to bjork ...
sysadm: initializing migration of evac3 to bjork ...
sysadm: initializing migration of kz-nfs to bjork ...
sysadm: initializing migration of evac1 to bjork ...
sysadm: evacuating 4 zone(s) ...
sysadm: migrating tzone1 to bjork ...
sysadm: migrating evac1 to bjork ...
sysadm: migrating evac-nfs to bjork ...
sysadm: migrating evac3 to bjork ...
sysadm: evacuation completed successfully.
sysadm: evac-nfs: evacuated to ssh://root@bjork
sysadm: evac1: evacuated to ssh://root@bjork
sysadm: evac3: evacuated to ssh://root@bjork
sysadm: tzone1: evacuated to ssh://root@bjork
```

Demos (cont.)

- After the maintenance is done, end it and return the zones.

```
# sysadm maintain -e
# sysadm evacuate -rav
sysadm: preparing 4 zone(s) for return ...
sysadm: initializing return of tzone1
sysadm: initializing return of evac3
sysadm: initializing return of evac-nfs
sysadm: initializing return of evac1
sysadm: returning 4 zone(s) ...
sysadm: migrating evac3
sysadm: migrating evac-nfs
sysadm: migrating tzone1
sysadm: migrating evac1
sysadm: return completed successfully.
sysadm: evac-nfs: returned
sysadm: evac1: returned
sysadm: evac3: returned
sysadm: tzone1: returned
```

Demos (cont.)

- We can move solaris branded Zones to and out of shared storage.

```
# zoneadm -z zlocal move \
    -p iscsi://10.99.99.75/luname.naa.600144f0dbf8af19000055d2653b0001
Configured storage resource(s) from:
        iscsi://10.99.99.75/luname.naa.600144f0dbf8af19000055d2653b0001
Created zpool: zlocal_rpool
Copying from rpool/VARSHARE/zones/zlocal to zlocal_rpool: please be patient
# zonecfg -z zlocal info rootzpool
rootzpool:
        storage: iscsi://10.99.99.75/luname.naa.600144f0dbf8af19000055d2653b0001
# : now move it back out of shared storage back to a local dataset
# zoneadm -z zlocal move -x remove-rootzpool -x force-storage-destroy-all
The following ZFS file system(s) have been created:
    rpool/VARSHARE/zones/zlocal
Copying from zlocal_rpool to rpool/VARSHARE/zones/zlocal: please be patient
Exported zpool: zlocal_rpool
Unconfigured storage resource(s) from:
        iscsi://10.99.99.75/luname.naa.600144f0dbf8af19000055d2653b0001
```

Any Questions?

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