

Oracle Solaris 11 Overview and Design Guide

December 2016 (Edition 1.0)
Fujitsu Limited

■ Purpose

- This document provides an overview of Oracle Solaris 11 and introduces the new functions.

■ Audience

- People who want to study Oracle Solaris 11
- People who already understand an overview of Oracle Solaris

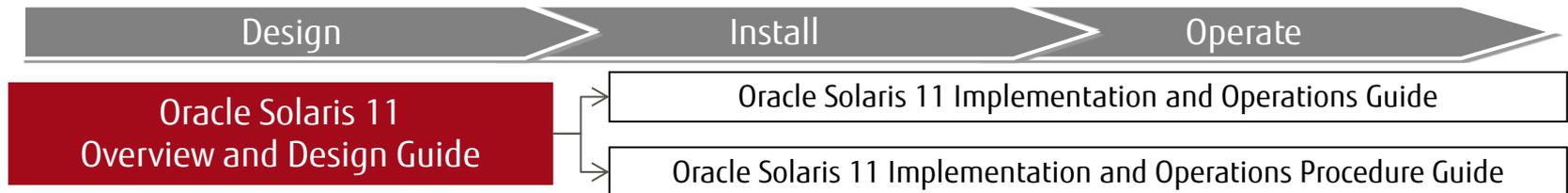
■ Notes

- The contents of this document are based on Oracle Solaris 11.3. For the latest information on Oracle Solaris 11, see the manuals from Oracle.
- Fujitsu M10 is sold as SPARC M10 Systems by Fujitsu in Japan. Fujitsu M10 and SPARC M10 Systems are identical products.

■ Positioning of documents

- Oracle Solaris 11

<http://www.fujitsu.com/global/products/computing/servers/unix/sparc/downloads/documents/>



■ Descriptions in this document

- The section numbers of commands are omitted.

Example:

- ls(1) => ls command
- shutdown(1M) => shutdown command

- The following table lists terms that may be abbreviated.

Abbreviation	Formal Name
Solaris	Oracle Solaris
Solaris zone	Oracle Solaris zone
Oracle VM	Oracle VM Server for SPARC

1. Overview of Oracle Solaris 11
2. Installation of Oracle Solaris 11
3. Image Packaging System (IPS) - Oracle Solaris Package Management -
4. ZFS - Oracle Solaris File System -
5. Boot Environment (BE) - Oracle Solaris Boot Environment -
6. Virtualization of Oracle Solaris - Oracle Solaris Zones -
7. Security
- Appendix

1. Overview of Oracle Solaris 11

This chapter describes Solaris 11 features.

Oracle Solaris 11 Features

■ OS with enhanced virtualization technology, meeting the demands of the cloud age

Operability

- Unified system archive function [Unified Archives] **Enhanced**
- Improved work efficiency in OS installation and update [Image Packaging System (IPS)] **Enhanced** -> See [Chapter 3](#)
- Greatly reduced downtime that is scheduled for maintenance such as to apply a patch [Boot Environment (BE)] **Enhanced**
-> See [Chapter 5](#)

Security

- Management of the process management and execution privileges [RBAC]
- Safety evaluation function for system settings [Security diagnosis function] **Enhanced** -> See [Chapter 7](#)
- Encryption function provided [ZFS] **Enhanced** -> See [Chapter 4](#)

Virtualization and Cloud

- Server virtualization functions with very low performance overhead [Oracle Solaris zone, Oracle VM]
- Network virtualization functions implemented [Oracle Solaris zone, Elastic Virtual Switch (EVS)] **Enhanced**
-> See [Chapter 6](#)
- Oracle Solaris zone function expanded [Kernel zone] **Enhanced** -> See [Chapter 6](#)
- Support of the cloud-based software "OpenStack" [Openstack] **Enhanced**

Reliability

- Automated repair function designed to improve system availability by automatically diagnosing hardware failures that are predicted in advance [Predictive self-healing]
- Easy tuning of OS performance and software debugging [DTrace]
- Secure data protection using a highly reliable file system [ZFS]

Low Cost

- Protection of application assets through binary compatibility
- Helping to increase the longevity of customer assets through long-term OS support
- Server and storage virtualization functions available without charge

Enhanced : Enhanced points in Solaris 11

■ Memory

- 2 GB or more

■ Disk

- 13 GB or more

■ Supported models

- SPARC M10 (M10-1, M10-4, and M10-4S) [sun4v]
- SPARC Enterprise M series [sun4u]
- SPARC Enterprise T series and Sun Fire T1000/T2000 [sun4v]

2. Installation of Oracle Solaris 11

This chapter describes the Solaris 11 installation flow and related functions.

Install Oracle Solaris 11 by using OS media (DVDs) or from a network boot using a repository server.

* The functions that are installed (package groups) vary depending on the installation method.

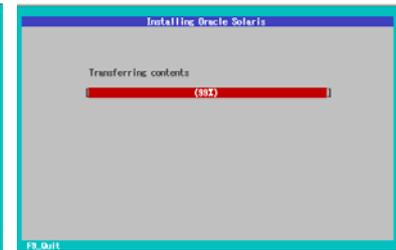
-> For details on package groups, see "[3. Image Packaging System \(IPS\) - Oracle Solaris Package Management](#)."

■ Installation from OS media (DVDs)

- Text install

- Install it interactively using a text-based installer.
- Install the **solaris-large-server group** package.

✓ Text install screen



■ Installation from a network boot

- Text install

- Install it interactively using a text-based installer.
- Install the **solaris-auto-server group** package.

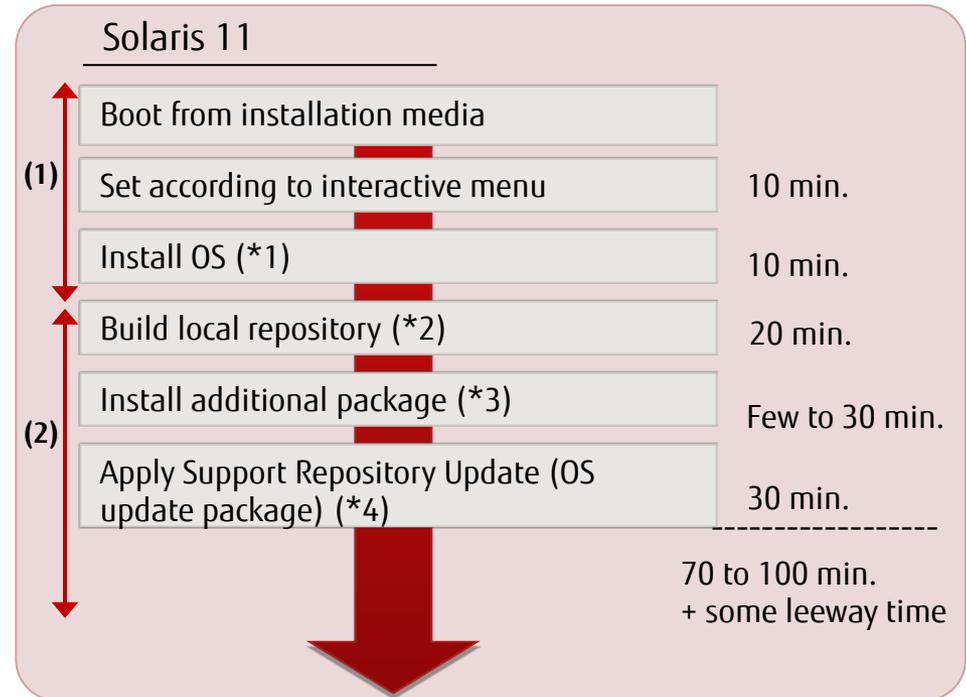
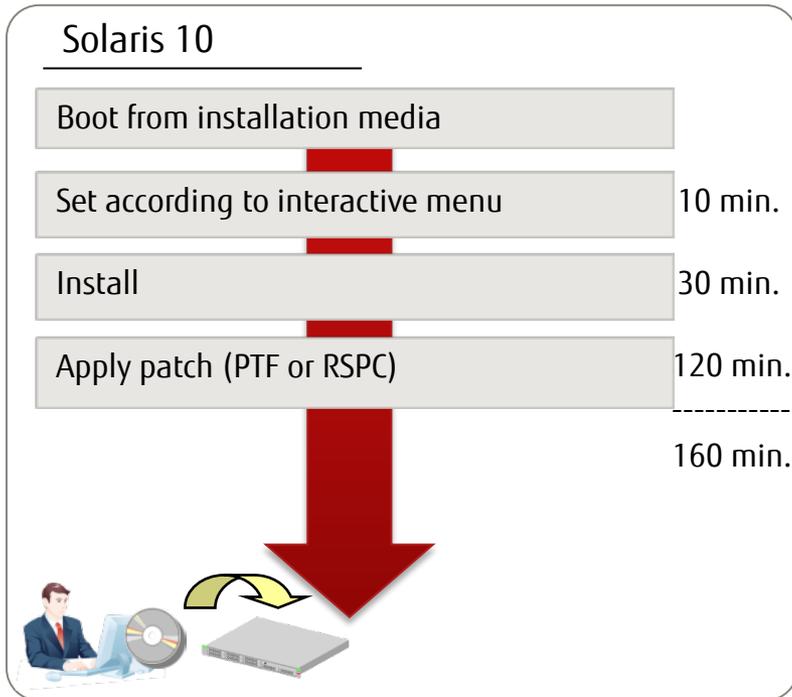
- Automated install (AI)

- The automated install uses an AI manifest and repository.
- AI automatically installs Solaris on multiple servers on a network. The technology is similar to JumpStart in Solaris 10.
- Install the **solaris-large-server group** package.



- For building multiple servers or virtual servers, such as in a cloud environment, we recommend automated install.

Environment Build Flow Using Text Install



(1) Text install

-> See Chapter 1 in the *Oracle Solaris 11 Implementation and Operations Guide*.

(2) Various settings and additional installation

-> See Chapters 2 to 7 in the *Oracle Solaris 11 Implementation and Operations Guide*.

* The above operation times are examples. They will vary depending on the environment.

*1 Only ZFS supports the root file system.

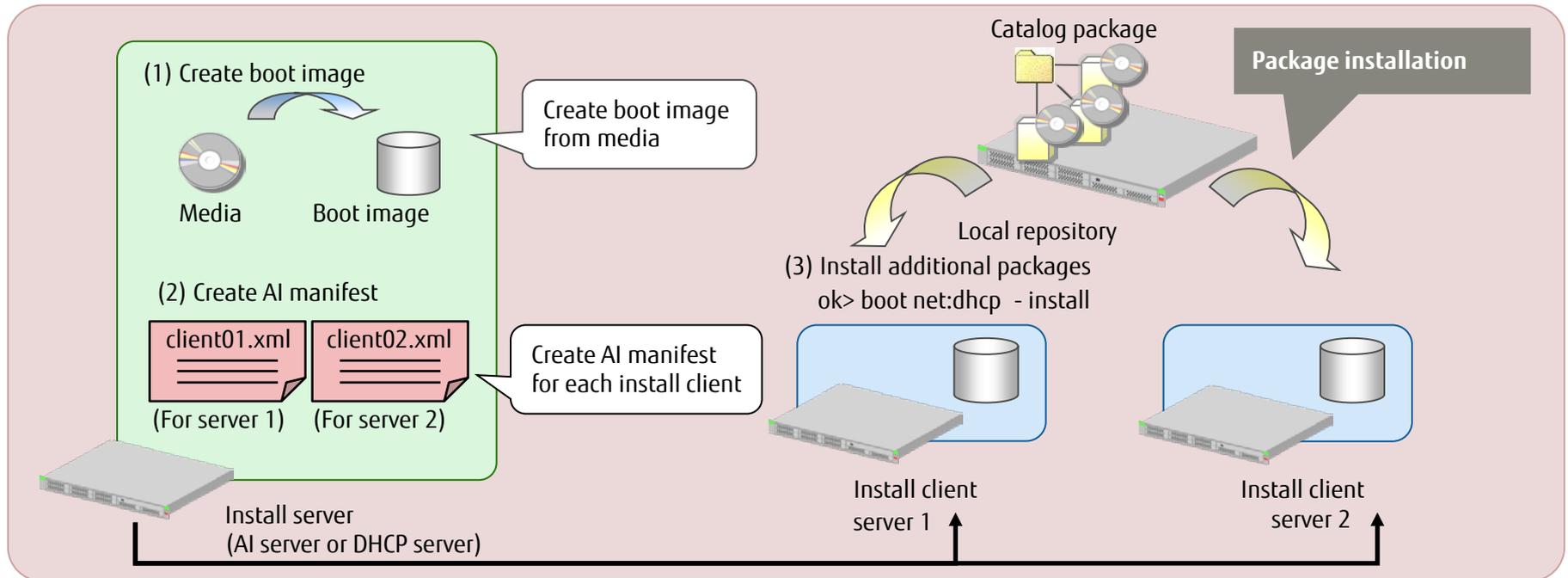
*2 You can also use the Oracle release repository. In this case, you do not need to build the local repository.
An Internet connection is required for using the release repository.

*3 You can install only the packages necessary for your environment.
The packages can be collectively installed using a package group.
Use the pkg commands to install and centrally manage the packages.

*4 In Solaris 11, Support Repository Update (SRU) replaces PTF and RSPC. SRUs are provided by My Oracle Support.

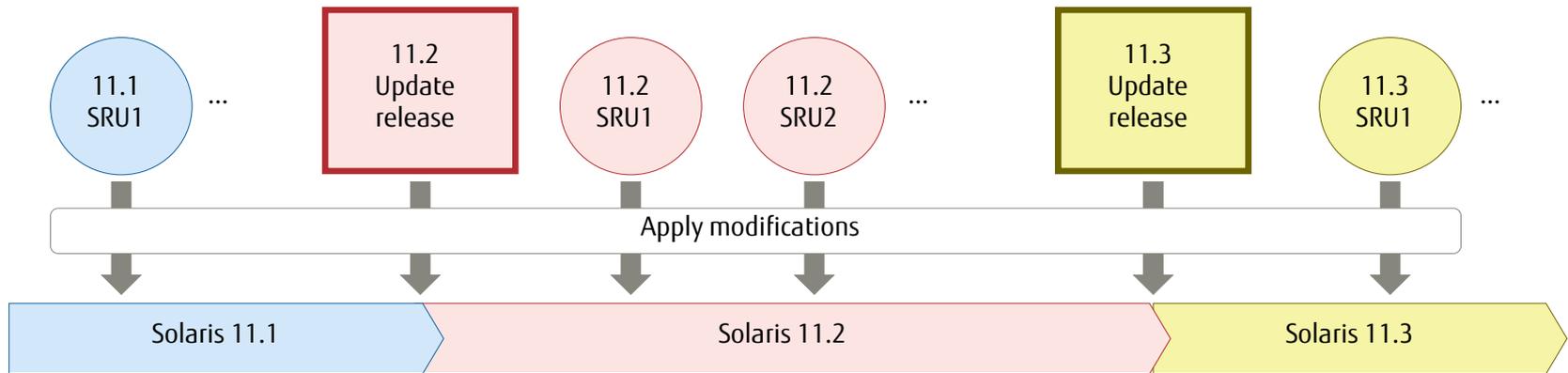
Environment Build Flow Using Automated Install

- (1) Create a boot image.
Create a boot image on the install server to build the AI server and DHCP server functions.
- (2) Create an AI manifest (install the OS).
Install the OS on the install client by using the boot image and AI manifest.
- (3) Install additional packages.
Connect to the release repository or local repository to install additional packages.



Upgrading the OS Version

- When you upgrade the OS version (such as from 11.2 to 11.3), you need to apply an update using an update release instead of an SRU.
 - Like with an SRU, you can continue using the OS without reinstalling it.
 - An update is applied in the same way as an SRU. However, the OS is updated not from the SRU archive but from the IPS repository (full repository) of the update release, as the publisher (issuer of the package).
 - An update release is provided as an Oracle Solaris 11 media pack.



- The Oracle Solaris 11 media pack is available for free for those registered with My Oracle Support.
- After the latest update version is released, the old SRU version is no longer released. To apply the latest SRU on an old OS version, you need to update to the latest version.

Support Repository Update (SRU) 1/2

■ What is an SRU?

- The SRU is a collection of update packages for Solaris 11.
- The SRU is released on a regular basis (about once a month).
- Solaris 11 does not have the concept of "update patch." The process to apply modifications is integrated into a package management system, which applies modifications as a "package."



Modification application differences between Solaris 10 or earlier and Solaris 11

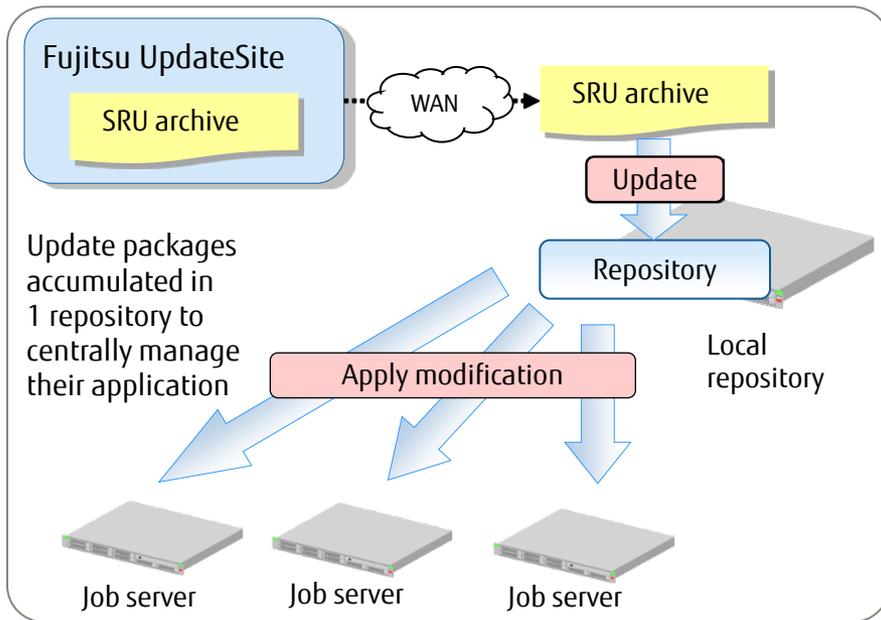
Item	Solaris 10 or Earlier	Solaris 11
How modifications are managed	Patch	Package
Form of provision	- Recommended & security patches (RSP/RSPC) - Program temporary fix (PTF)	Support Repository Update (SRU)
Command to apply modifications	patchadd command	pkg commands
Modification dependency	Need to select/apply patches while taking patch dependency into account	Package dependencies automatically processed *You can prevent human error because the operations to select modifications can be greatly reduced, which also helps to shorten the working hours.
How to restore modifications	Remove applied patches (patchrm command)	Switch to original boot environment (BE) * Since modifications can be applied to the system in operation, you can greatly reduce the business downtime. * System recovery is easy.

■ How to apply an SRU

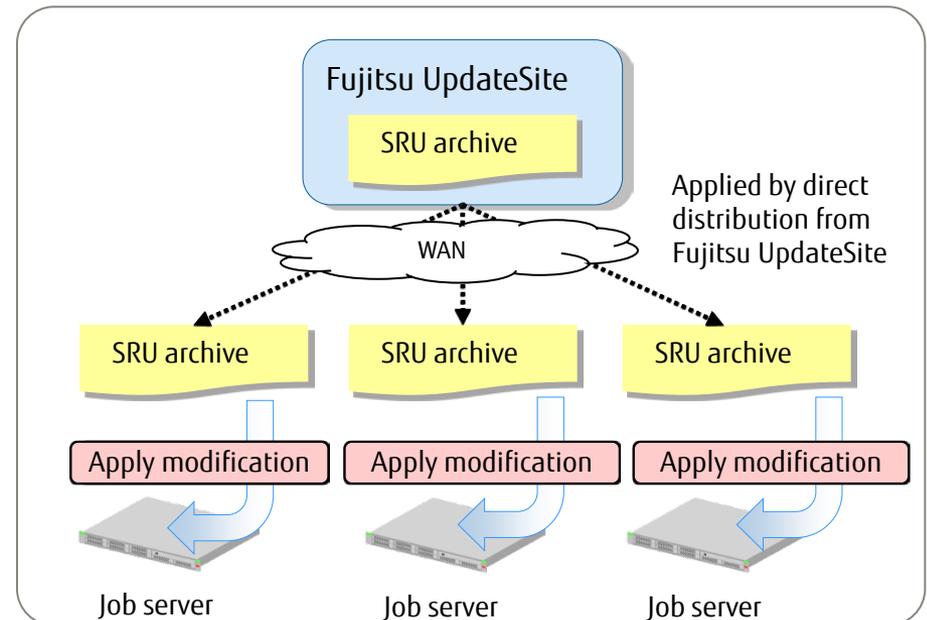
- Apply modifications from a repository or SRU archive.

-> For details on repositories, see "[3. Image Packaging System \(IPS\) - Oracle Solaris Package Management](#) -."

Applying an update from a repository



Applying an update from an SRU archive



* You can also apply modifications to a server built as the local repository.

* If you might add a package after applying an SRU, we recommend using the method of applying an update from a repository.



- For details, see the following URL:

My Oracle Support <https://support.oracle.com>

* You will need to register with My Oracle Support to use the service.

■ Media configuration

- The main media consists of the following four DVDs (for Solaris 11.3):
 - Oracle Solaris 11.3 Interactive Text Install ISO (SPARC)
 - This media is used with a DVD boot for the text install of the OS.
 - Oracle Solaris 11.3 IPS Repository Installation Guide / IPS Repository (1/2)
 - Oracle Solaris 11.3 IPS Repository (2/2)
 - This media is used to create the local repository. It consists of two DVDs.
 - Oracle Solaris 11.3 Automated Installer Boot Image ISO
 - This media stores AI install images for building an install server.

■ Package group

- A package group cannot be selected at installation.
- The functions that are installed (package groups) vary depending on the installation method.
 - > For details, see "[3. Image Packaging System \(IPS\) - Oracle Solaris Package Management -](#)"

■ Obsolete functions

- GUI installation
- Upgrade installation and Flash installation
- JumpStart installation (-> changed to automated install)
 - The js2ai command (a command to convert a JumpStart file to an AI manifest) is provided.



- GUI installation is obsolete only in the SPARC version.

■ Boot with the EFI (GPT) label

- The default disk label at installation is the EFI label.
- You can create a file of 2 TiB or larger on a disk with the EFI label.
- Hardware with the following firmware versions support the EFI label:
 - SPARC M10: XCP 2230 or later
 - SPARC T series: System firmware 8.4 or later

 - To install Solaris on a disk that has the SMI label, which is a format used in Solaris 10 and earlier, you need to change the label of the disk with the `format -e` command in advance. In addition, you need to select [Use a slice on the disk] on the [Solaris Slices] screen from the Solaris installation menu.

3. Image Packaging System (IPS)

- Oracle Solaris Package Management -

This chapter provides an overview of the IPS, which is the package management framework of Solaris 11, and describes the features, package distribution mechanism, and more.

■ What is the IPS?

- The IPS is a new package management framework for downloading packages over a network.
 - Packages can be installed/uninstalled/searched/updated via a network.
- The method to apply modifications has changed from patch application to package exchange.
 - There is no need to search for the necessary patches.
 - Use the pkg update command to execute the updates necessary for the current environment.
 - Package dependency does not need to be taken into account.

■ IPS features

- Feature 1: Distributes packages over a network
- Feature 2: Automatically resolves package dependencies
- Feature 3: Minimizes downtime

OS update and package installation can be done easily without using physical media

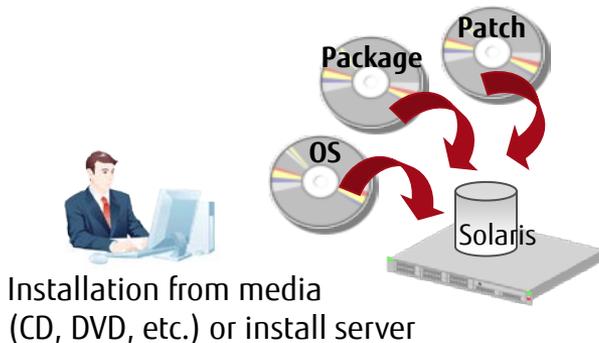


- Only the minimum required packages are installed from media.
- Patch-related commands (patchadd, patchrm, showrev, etc.) are not supported in Solaris 11.

■ Procure the necessary packages from a repository server

- Since packages can be installed via a network, you do not need to prepare physical media.
- You can manage an operation such as installing, uninstalling, or updating a package, only with the pkg commands.

Solaris 10



Solaris 11



- You can use the following two types of repository servers from which to install packages:
 - Release repository: Repository server (connected via the Internet) published by Oracle
 - Local repository: Repository server built by a user
- In Solaris 11, you can use SVR4 package-related commands (pkgadd, pkgrm, pkginfo, etc.) used in Solaris 10 or earlier.

■ Package dependencies managed with a repository

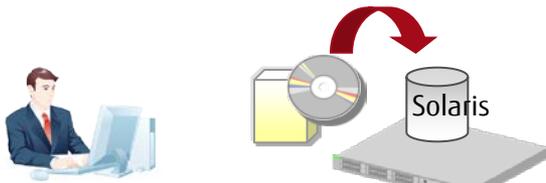
- Batch installation can automatically resolve package dependencies.
- Package dependency does not need to be taken into account.

Packages A, B, and C with a dependency on each other



Solaris 10

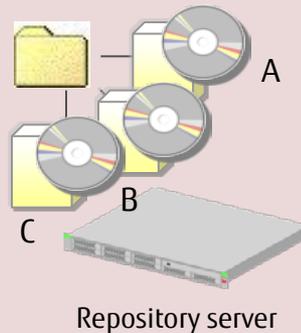
Packages C, B, A



```
# pkgadd -d . C B A
```

Solaris 11

Catalog package



Packages C, B, A



```
# pkg install A
```

IPS Features 3/3 - Minimizes Downtime -

■ System stopped to apply OS modifications, only for as long as the OS restart time

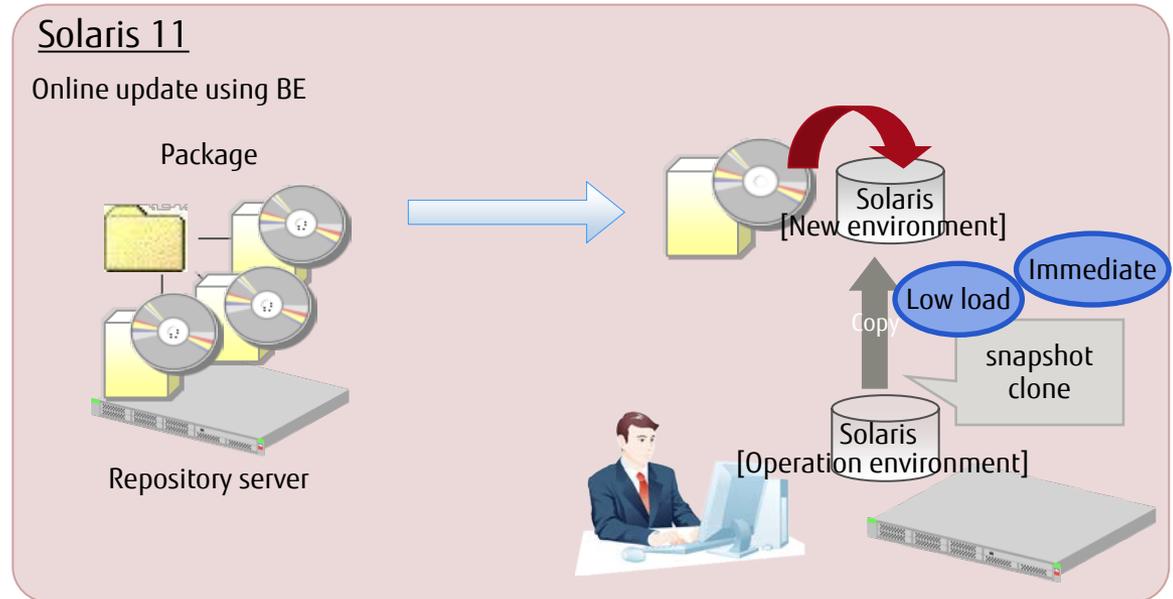
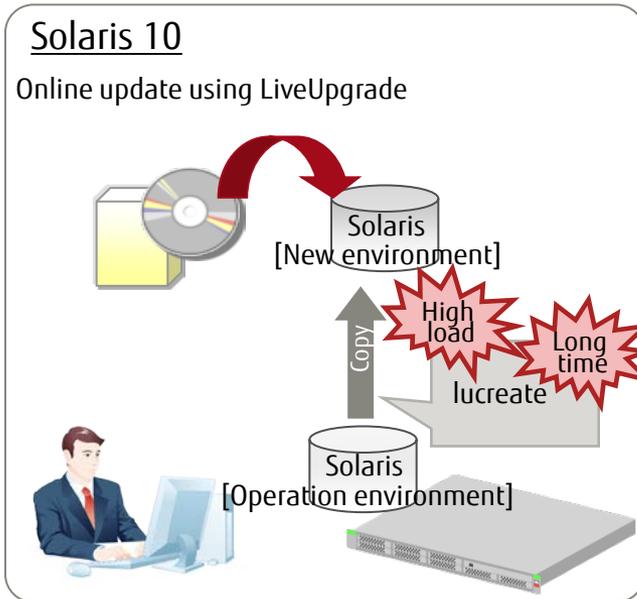
- The method to apply modifications is as follows. * Boot Environment (BE) used

- (1) Create a copy of the existing environment.
- (2) Apply a package to the copied environment in the background.
- (3) Restart the OS, which starts the environment of the applied modifications.

-> For details on BE, see "[5. Boot Environment \(BE\) - Oracle Solaris Boot Environment -](#)."

*The switch to the OS environment of the applied modifications occurs only at the OS restart described in (3).

Business downtime for OS maintenance (update or modification application) drops dramatically compared to Solaris 10



- The OS environment can be copied instantly (in a few seconds) because BE uses the ZFS snapshot function.

-> For details on ZFS, see "[4. ZFS - Oracle Solaris File System -](#)."

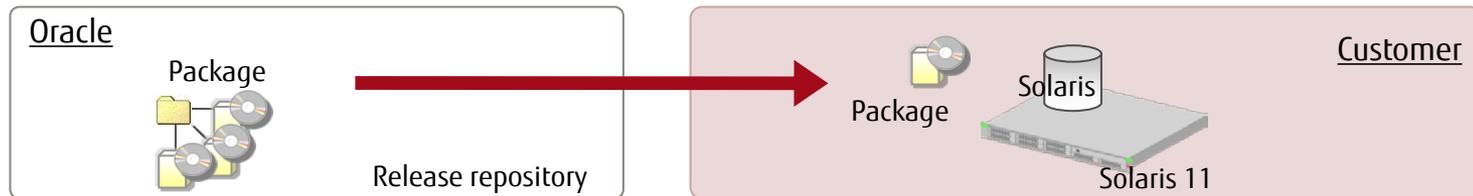
■ What is a repository?

- The repository is a location where packages are published.
- The repository is described using a URI (Uniform Resource Identifier).

■ Repository types

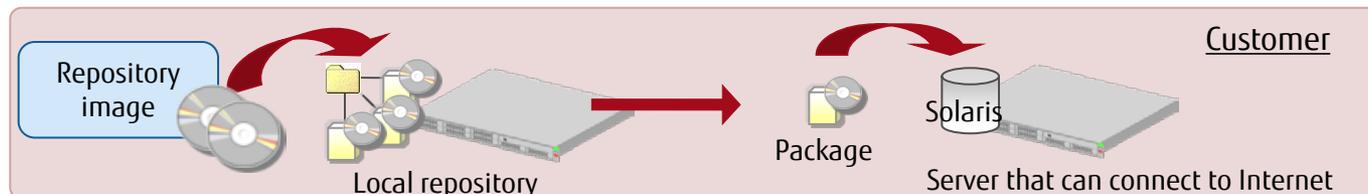
■ Release repository

- The release repository is provided by Oracle. A repository is provided for each minor version.
 - * The repository can be used without a support contract with Oracle.
- For a server that can connect to an external network, you can install/uninstall/search/update a package from a release repository .



■ Local repository

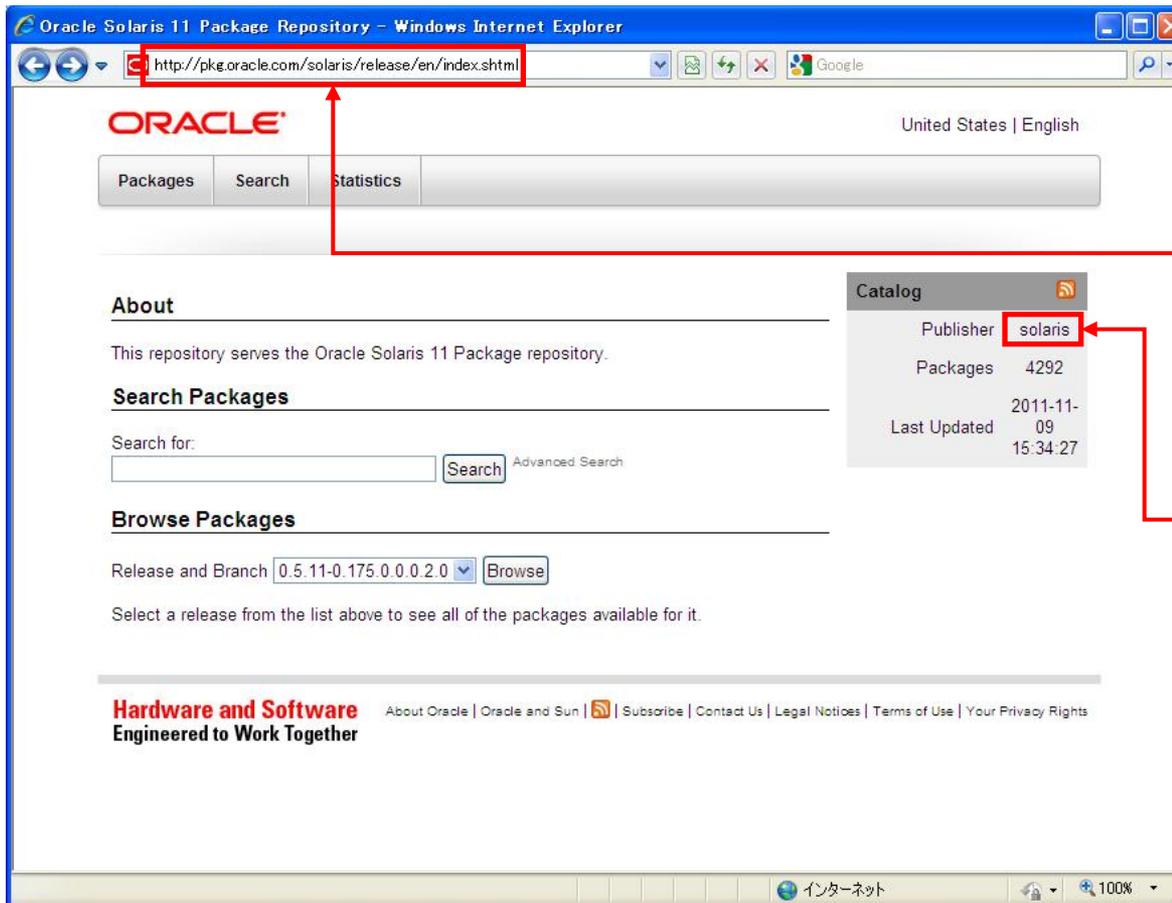
- The local repository provides packages in place of a release repository to a server that cannot connect to an external network. (Release repository copy)



Repository (Location to Publish Packages) 2/3

■ Package issuer (Publisher)

- Publisher is identification representing the person, group, or organization that publishes a package.
- The issuer corresponds to a repository.



Repository

(Example: Release repository)
<http://pkg.oracle.com/solaris/release/>

Issuer
solaris

■ Repository components

■ Catalog

- The catalog is a list of IPS packages managed in a repository.

■ IPS package

- The IPS package is shown as the name of a package managed in a repository.

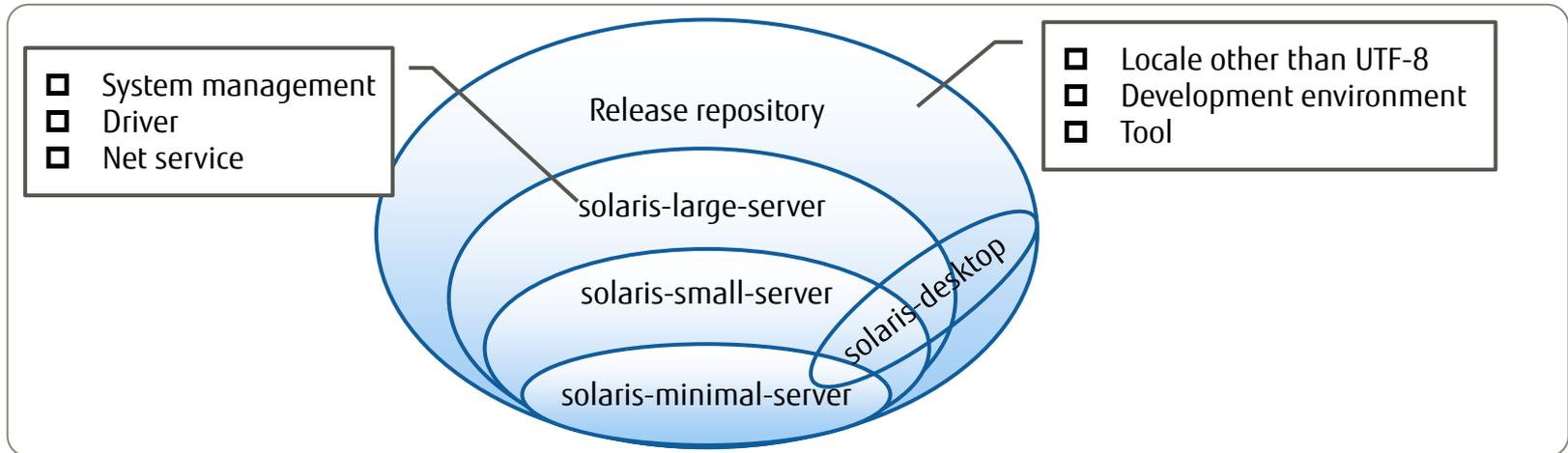
The screenshot shows the Oracle Package Catalog web interface. The browser window title is "Package Catalog - Windows Internet Explorer". The address bar shows the URL: [http://pkg.oracle.com/solaris/release/en/catalog.shtml?version=0.5.11%](http://pkg.oracle.com/solaris/release/en/catalog.shtml?version=0.5.11%20). The page features the Oracle logo and navigation tabs for "Packages", "Search", and "Statistics". A "Release and Branch" dropdown menu is set to "0.5.11-0.151.0.1". Below the menu is a "Browse" button and a checkbox for "Show all versions". The main content is a table of packages:

Name	Version	Install	Manifest
SUNWcodeina	0.5.11.5.11-0.151.0.1:20101105T060725Z	Install	Manifest
SUNWcs	0.5.11.5.11-0.151.0.1:20101105T001108Z	Install	Manifest
SUNWcsd	0.5.11.5.11-0.151.0.1:20101105T001142Z	Install	Manifest
archiver/gnu-tar	1.23.5.11-0.151.0.1:20101105T053308Z	Install	Manifest
archiver/unrar	3.8.5.11-0.151.0.1:20101105T053319Z	Install	Manifest
audio/audio-utilities	0.5.11.5.11-0.151.0.1:20101104T230534Z	Install	Manifest
audio/sox	14.3.0.5.11-0.151.0.1:20101105T053321Z	Install	Manifest

A red box highlights the "Name" column, and a red arrow points from the label "Catalog" to the table. A blue box highlights the bottom of the page, and a blue arrow points from the label "IPS packages" to the table.

■ Package group

Package Group	Description	Situation Where Installed by Default
solaris-large-server	Server environment (excluding development environment)	<ul style="list-style-type: none"> • Text install using OS media • Automated install (AI) from network boot
solaris-small-server	Default package group when creating zone	<ul style="list-style-type: none"> • Installation of non-global zone by zoneadm install command
solaris-minimal-server	Minimum package (added in Solaris 11.2)	<ul style="list-style-type: none"> • None
solaris-auto-install	AI network boot environment	<ul style="list-style-type: none"> • Text install from network boot
solaris-desktop	Desktop environment (excluding development environment)	<ul style="list-style-type: none"> • None



- A package group is a collection of packages corresponding to a software group of Solaris 10.
- Only the solaris-minimal-server and solaris-large-server groups include the shell/tcsh and shell/zsh packages.
- Each package group can be installed individually by the pkg install command.

■ Packages required for additional installation

■ Locale other than UTF-8

- system/locale/extra * When using a character code such as SJIS (ja_JP.PCK)
- text/locale * When using a product that supports the gettext command

■ Desktop GUI

- group/system/solaris-desktop

■ Development environment

- system/header

■ iSCSI target

- system/storage/iscsi/iscsi-target

■ MySQL 5.x, GNU emacs, perl/python/apache expansion, PHP



- If the above packages are necessary, you need to install them individually after installing the OS.

■ Command used for package management

- You can manage packages only with the pkg commands (access to a repository server is required when applying packages).

■ Support Repository Update (SRU)

- PTF and RSPC in Solaris 10 have been changed to SRU.
- An SRU is a collection of update packages. SRUs are released regularly (about once a month) and used to apply modifications to an OS package.

■ SVR4 package

- Compatibility for the SVR4 package (pkgadd/pkgrm/pkginfo) is supported.
- The /var/sadm/install/contents file is empty at initial installation.

■ Obsolete functions

- Oracle Solaris patch format (-> changed to SRU)
- Patch commands - patchadd, patchrm, and showrev (-> changed to the pkg commands)
- LiveUpgrade and lu commands (-> changed to the beadm command)

■ Comparison between IPS package commands and SVR4 package commands

- SVR4 package-related commands (pkgadd, pkgrm, pkginfo, etc.) in Solaris 10 can also be used in Solaris 11.

Function	SVR4 Package Command (Solaris 10)	IPS Package Command (Solaris 11)
Apply package	pkgadd	pkg install
Apply modification	patchadd	pkg update
Remove package	pkgrm	pkg uninstall
Certify package	pkgadm addcert, pkgadm removecert	pkg set-publisher -k -c ...
Display package information	pkginfo, pkgchk -l	pkg info, pkg list, pkg contents, pkg search
Check package integrity	pkgchk	pkg verify, pkg fix, pkg revert

■ IPS command example 1/2

■ pkg list [*option*] [*package_name* (FMRI)]

- This example displays the current package list with status and other information.

```
# pkg list system/kernel
NAME (PUBLISHER)          VERSION          IFO
system/kernel            0.5.11-0.175.3.1.0.3.0  i--
```

■ pkg search [*option*] query

- This example searches for and displays the package that the specified file or command was created from.

```
# pkg search /usr/sbin/format
INDEX      ACTION VALUE          PACKAGE
path      file   usr/sbin/format  pkg://system/core-os@0.5.11-0.175.2.1.0.4.2
```

■ pkg info [*option*] [*package_name* (FMRI)]

- This example displays information for the specified package name.

```
# pkg info system/kernel
Name: system/kernel
Summary: Core Kernel
Description: Core operating system kernel, device drivers and other modules.
Category: System/Core
State: Installed
Publisher: solaris
Version: 0.5.11
Build Release: 5.11
Branch: 0.175.3.1.0.3.0
Packaging Date: September 25, 2015 04:43:31 PM
Size: 17.04 MB
FMRI: pkg://solaris/system/kernel@0.5.11,5.11-0.175.3.1.0.3.0:20150925T164331Z
```

■ IPS command example 2/2

■ How to check package groups

- This example displays a package group list.

```
# pkg info -r *group*
```

* If the -r option is not specified, the command displays only package groups in the current installation environment.

■ How to check the packages included in a package group

- This example displays the packages included in the specified package group.

```
# pkg contents -o fmri -r -t depend solaris-large-server
```

* Specify the -o or -t option to display only specific attributes or action types, respectively.

■ How to check the current package group

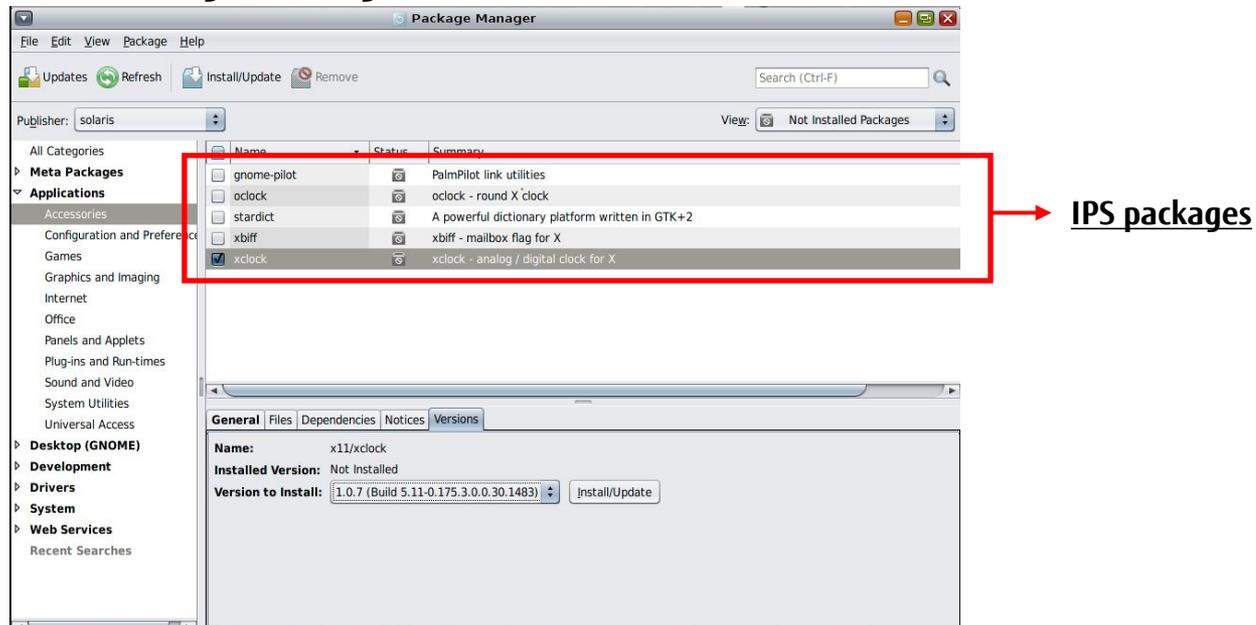
- This example displays the package group installed in the current system.

```
# pkg list group/system/¥*  
NAME (PUBLISHER)                VERSION                IFO  
group/system/solaris-large-server 0.5.11-0.175.2.0.0.42.0  i--
```

■ Package manager

- The package manager is a GUI-based package management tool.
- By using the package manager, you can configure IPS, search and manage IPS packages, and manage the boot environment using the boot environment management tool.
- The GNOME desktop environment is required.
The GNOME desktop environment is not installed at initial installation. You will need to install the environment to use the package manager.

✓ Package manager screen



4. ZFS - Oracle Solaris File System -

This chapter provides an overview of ZFS, which is a file system provided in Solaris 11, and describes the features.

■ What is ZFS?

- ZFS is a next-generation file system that is standard in Solaris 11.
- ZFS combines extensibility, manageability, and data robustness.

■ ZFS features

■ Extensibility

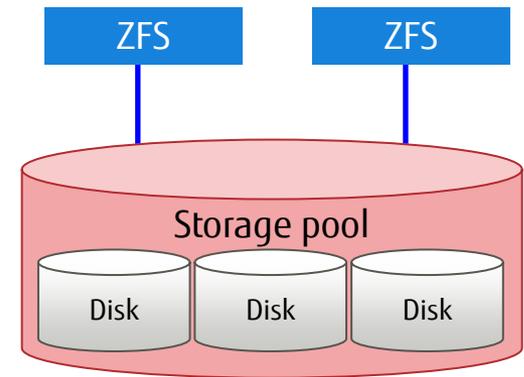
- You can build a file system with practically unlimited capacity.

■ Manageability

- The management system is simple, and volume management is easy.
- You can reduce disk usage by compressing data.

■ Data robustness

- The checksum and auto recovery functions can ensure data integrity.
- ZFS implements a RAID function as standard.

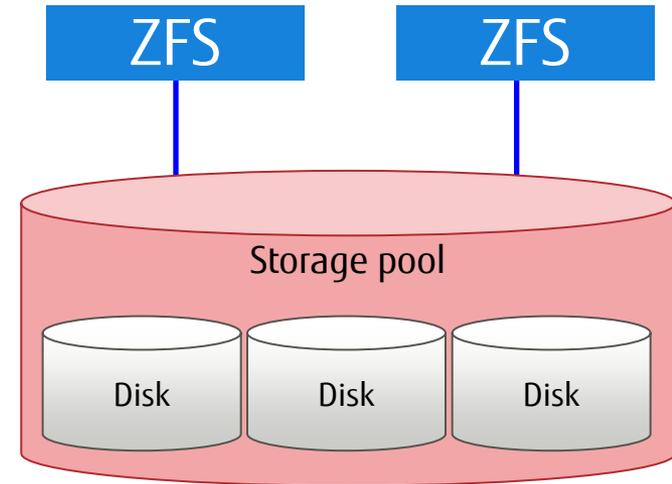
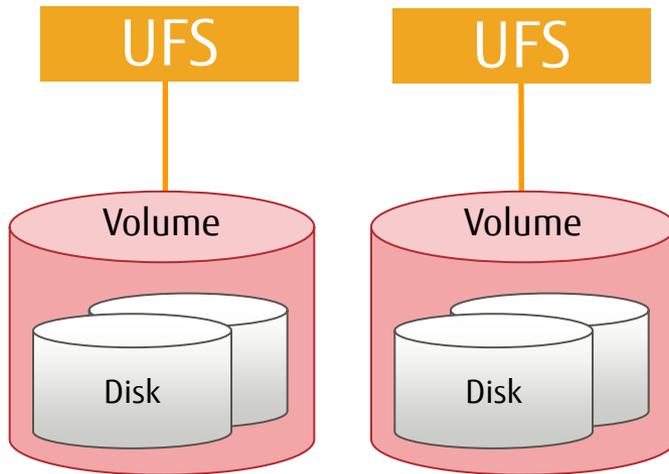


- For details on ZFS, see the *ZFS* manuals.

<http://www.fujitsu.com/global/products/computing/servers/unix/sparc/downloads/documents/>

■ Differences between UFS and ZFS file system configurations

UFS is a file system mainly used in Solaris 10 or earlier.



- Settings for each file system must be **configured using volume management software (SVM)**.
- To change the size of the file system, **the OS must be stopped to back up/restore data**.
- A sudden system shutdown **may cause data inconsistencies**.

- Disks can be managed as a single storage pool. **Volume management software is not required**.
- The file system can be expanded while online, **without stopping the OS**.
- A sudden system shutdown **does not cause data inconsistencies**.

■ Root file system

- The system area (root file system) is only ZFS.
- UFS can be used only as a user area.

■ ZFS encryption

- Data is encoded with a data encryption key.
(The data encryption key uses a wrapping key for encryption.)
- The encryption policy is set when the data set is created.
(The policy cannot be set for the root file system.)
- NFSv2/v3/v4 and CIFS (SMB) can share the data set.

■ ZFS deduplication

- Data is checked for duplication in each block in the pool as data is written.
- This function can be used with compression and encryption (in units of data sets).

■ ZFS shadow migration

- You can migrate existing file systems (UFS, NFS, and ZFS) to ZFS without stopping the system.

■ Data migration from UFS to ZFS

- The data created with the `ufsdump` command can be transferred to ZFS (`ufsrestore` command).

■ Data migration between ZFS and ZFS

- ZFS storage pools on Solaris 10 can be connected to Solaris 11 (`zpool import` command).

■ Obsolete functions

- CacheFS file system
- UFS root file system
- SVM (Solaris Volume Manager) root file system

5. Boot Environment (BE)

- Oracle Solaris Boot Environment -

This chapter provides an overview of the boot environment (BE) provided in Solaris 11, and describes the features.

■ What is BE?

- BE is a function for managing multiple boot environments.
- BE is used to change OS settings and easily perform maintenance, such as an upgrade or package update.

■ BE features

■ Function upgraded by extending LiveUpgrade of Solaris 10

- Operation is simple, which can make system upgrades easy.

* The beadm command replaces lu* commands, such as lucreate.

- Since BE works together with the ZFS snapshot and clone functions, you can copy your boot environment in a short time.
- A snapshot and clone can be created while online. The disk consumption is only the amount used for the update.
- If an error occurs during a package update, you can restore the original boot environment by just restarting the OS.

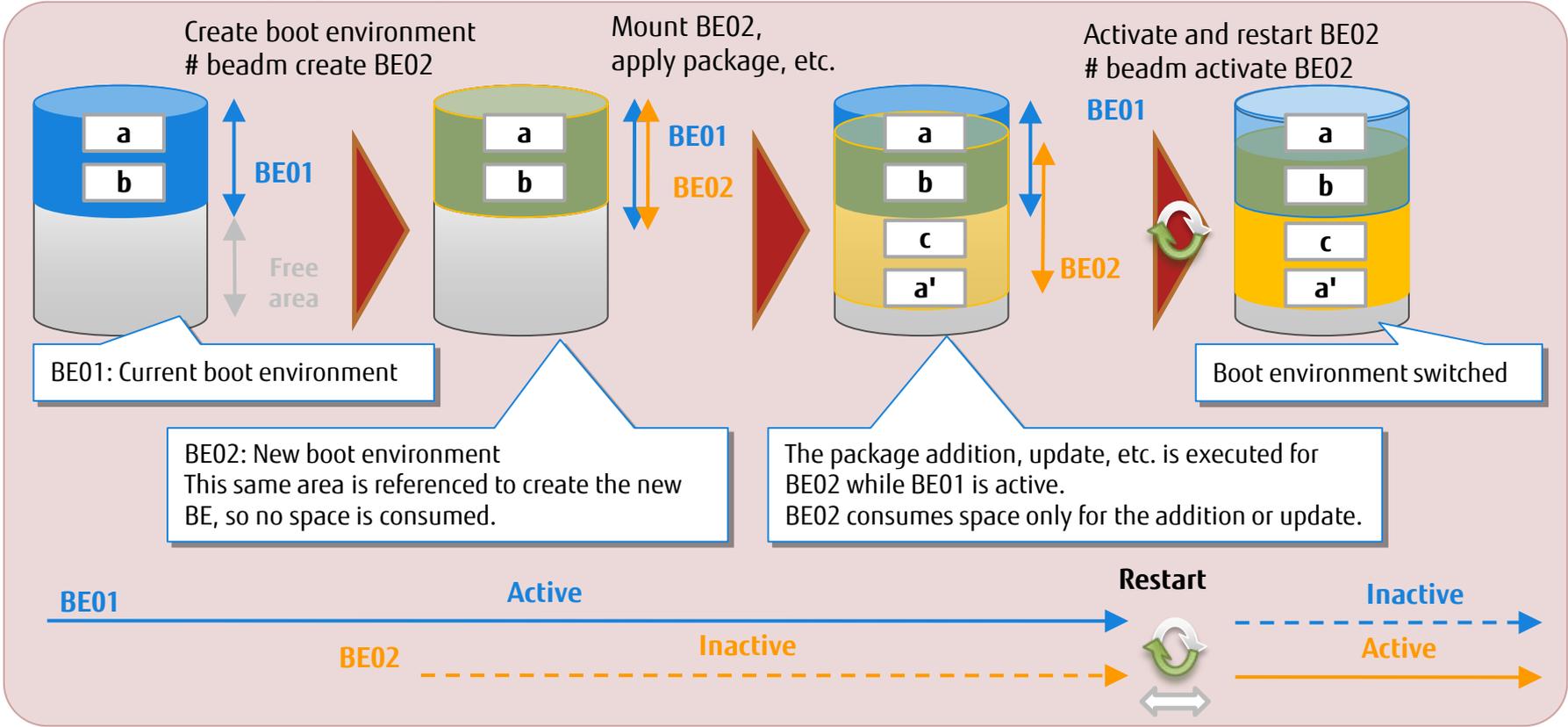


The operation management load decreases because multiple boot environments, such as development and maintenance environments, can be easily managed.

BE Mechanism and Effects

■ Comparison of how update programs are applied (Solaris 11 and Solaris 10)

Solaris 11 (Package update using BE)



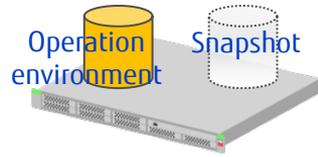
Solaris 10 (Patch application on UFS)



Conceptual Images of BE Operations

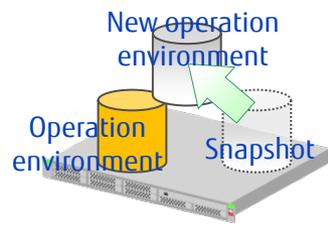
■ Obtaining a snapshot before executing a test

Use it if there is no problem

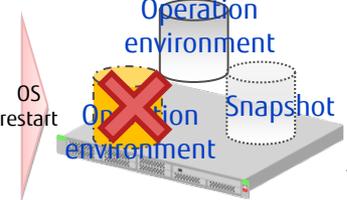


* If unnecessary, the snapshot can be discarded.

If any problems, restore original environment by creating BE from snapshot

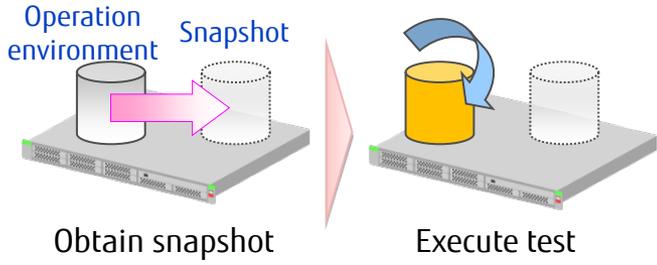


Create BE from snapshot

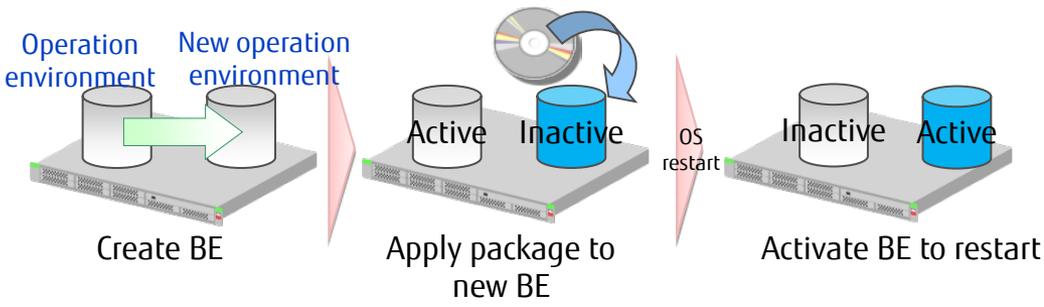


Activate BE to restart

* If unnecessary, the snapshot and original operation environment can be discarded.



■ Obtaining a snapshot when applying a package (modifications)



* If there is a bug in the new environment, the operation environment can be switched again.
 * If unnecessary, the original operation environment can be discarded.

- The new environment created from BE is only the boot environment area. For areas other than the boot environment and in case of physical disk damage, a backup is required. Be sure to consider disk redundancy and also the backup.

■ File system areas managed by BE

- BE can manage the areas of the file system under rpool/ROOT (the mountpoints are / (root) and /var).

* Some OS file systems are not managed by BE. Be sure to note this point.

```
# beadm list -a
BE/Dataset/Snapshot      Flags  Mountpoint Space  Policy Created
-----
solaris-1
rpool/ROOT/solaris-1     NR     /         4.65G  static 2014-10-30 16:29
rpool/ROOT/solaris-1/var -      /var      910.51M static 2014-10-30 16:29
rpool/ROOT/solaris-1/var@install -      -         58.75M  static 2014-10-30 15:55
rpool/ROOT/solaris-1@install -      -         493.49M static 2014-10-30 15:55
```

```
# zfs list
NAME                USED  AVAIL  REFER  MOUNTPOINT
rpool                36.9G  510G   74.5K  /rpool
rpool/ROOT           4.65G  510G    31K   legacy
rpool/ROOT/solaris-1 4.65G  510G   3.28G  /
rpool/ROOT/solaris-1/var 911M   510G   852M  /var
rpool/VARSHARE       3.31G  510G   3.31G  /var/share
rpool/dump           6.19G  511G   6.00G  -
rpool/export         222K   510G    32K   /export
rpool/export/home    190K   510G    33K   /export/home
--<omit>--
```

BE manages the file systems displayed in the Mountpoint column by the beadm command.



- To manage an area not managed by BE, create a snapshot of the file system with ZFS. The ZFS rollback function can restore the state at the time of the created snapshot.

6. Virtualization of Oracle Solaris

– Oracle Solaris Zones –

This chapter provides an overview of Solaris zones, which make Solaris 11 server virtualization a reality, and describes network virtualization of Solaris zones.

■ What is a Solaris zone?

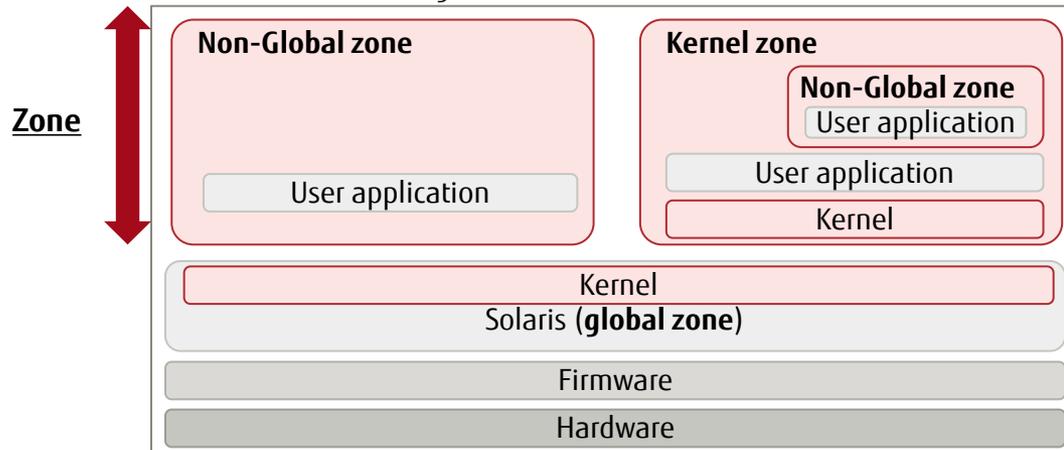
- The Solaris zone is a server virtualization function that provides a virtual Solaris environment (zone).
 - A maximum of 8,191 zones can be built on a physical server.
 - You can easily add/delete zones in a short time.
 - Hardware resources, including CPUs and memory, can be flexibly allocated to the zones.

Two types of zone

Zone Type	Description
Non-Global zone (Basic)	A kernel (OS core) is shared among multiple zones.
Kernel zone	Each zone has an independent kernel. * This type has been supported since Solaris 11.2.

■ Structure of a Solaris zone

* The zone is built on the global zone.



What is a global zone?

- It is an OS environment operating on a physical server.
- It can access all physical devices.
- It can obtain hardware information.
- It can configure and control zones.

■ Network virtualization of a Solaris zone

- Network virtualization can be achieved with a combination of a Solaris zone and the following components of the network virtualization function:
 - Virtual network interface card (VNIC)
 - etherstub
 - Virtual switch
 - Elastic Virtual Switch (EVS)
 - Virtual router, firewall, and NAT
- > For details, see "[Network Virtualization of Oracle Solaris Zones.](#)"

■ Migration from Solaris 10

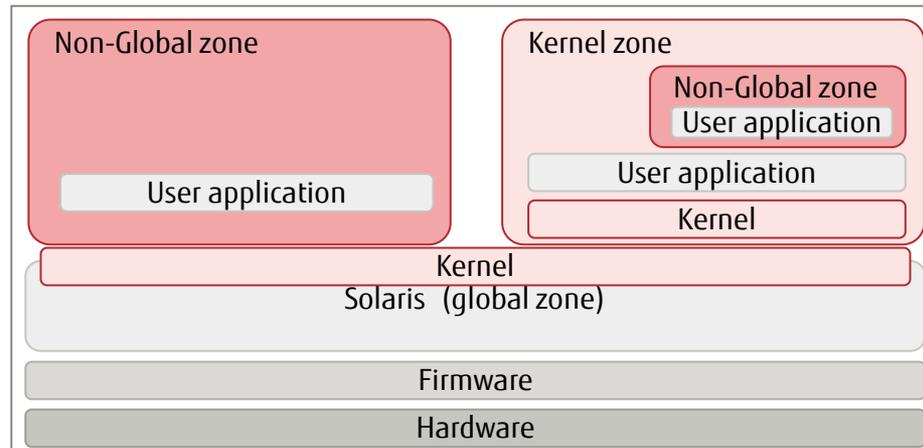
- Both Solaris 10 zones and Solaris 11 zones can be built on Solaris 11.
- You can migrate physical servers and virtual server (zones) on Solaris 10 to Solaris 10 zones (P2V or V2V) built on Solaris 11.
- > For details, see "[Migration from Oracle Solaris 10.](#)"

■ What is a non-global zone?

- The non-global zone is a virtual Solaris environment where a kernel is shared among multiple zones.

■ Non-Global zone features

- A unique IP address is set for each zone.
- A different manager (root) can be assigned to each zone.
- The zones can be individually started, stopped, or restarted (boot, shutdown, or reboot command, respectively).
- Each zone is independent. Even if a problem occurs in one zone, it does not affect the other zones.
- The zones can be accessed only from an authorized physical device.

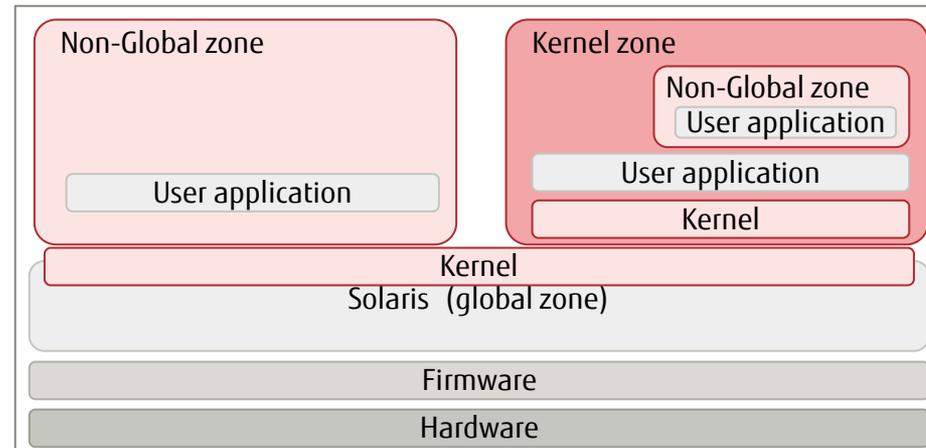


■ What is a kernel zone?

- The kernel zone is an independent, virtual Solaris environment with a kernel in the zone.
 - * This function has been supported since Solaris 11.2.

■ Kernel zone features

- The separate kernel and OS environments provide greater independence and enhanced security for the OS and applications.
- You can build an environment where a different OS version (Solaris 11.2 or later) and different SRU are applied to the global zone and each kernel zone.
- You can manage storage for a zone, create and discard a ZFS pool, and configure iSCSI and CIFS.
- You can create a non-global zone inside a kernel zone to configure a hierarchical zone environment.



■ Components of the network virtualization function

■ Virtual network interface card (VNIC)

- A VNIC is a virtual network interface created on a data link.
- You can create as many VNICs over a datalink as required, and can manage them as physical NICs.
- You can reduce the number of necessary physical NICs by using a VNIC when assigning a NIC to a Solaris zone.

■ etherstub

- An etherstub is a pseudo network interface that is used to configure a network between zones without using a physical NIC.
- You can configure a private virtual network by creating a VNIC over an etherstub.

■ Virtual switch

- When you create a VNIC on a physical NIC or over an etherstub, a virtual switch is automatically created between the VNIC and the physical NIC/etherstub. Each VNIC is implicitly connected to the virtual switch.

■ Elastic Virtual Switch

- A virtual switch that spans physical servers can be created.
- * This function has been supported since Solaris 11.2.

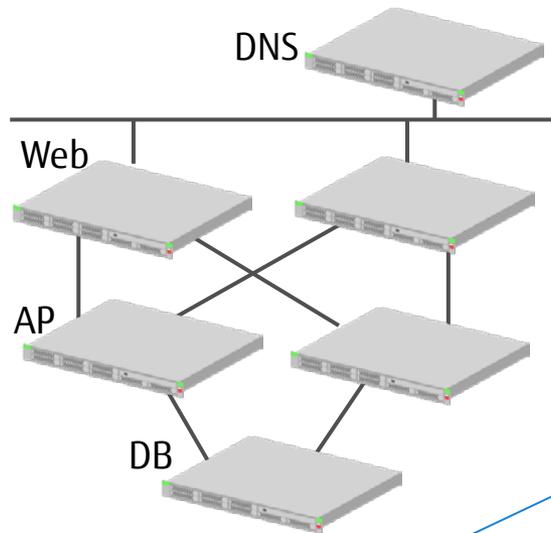
■ Virtual router, firewall, and NAT

- You can implement a router, a firewall, and NAT by using a Solaris zone and ipfilter, which are standard functions of Solaris.

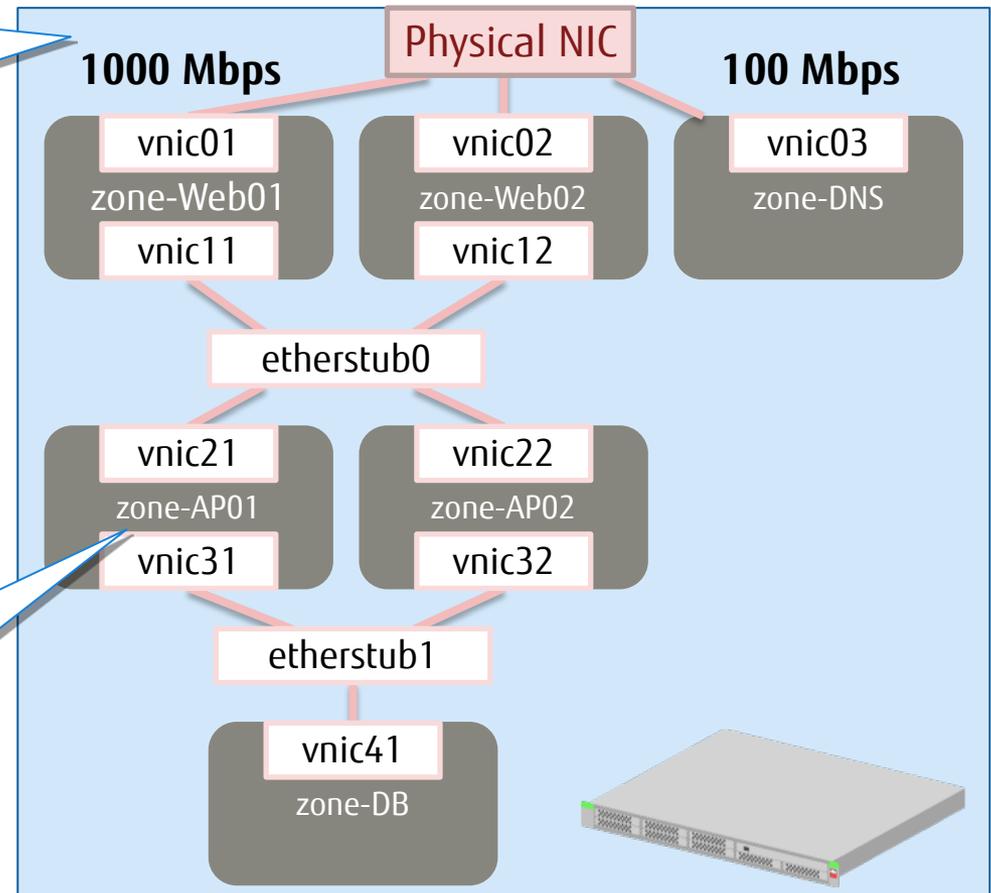
■ Configuration using the network virtualization function

- The example implements a model with three layers in a single server with Solaris zones.

- The VNICs created from virtualizing the physical NIC can each be used as an independent NIC in each zone.
- The bandwidth can be limited by VNIC.



- The internal network uses etherstubs.
- Each VNIC can be used as an independent NIC.



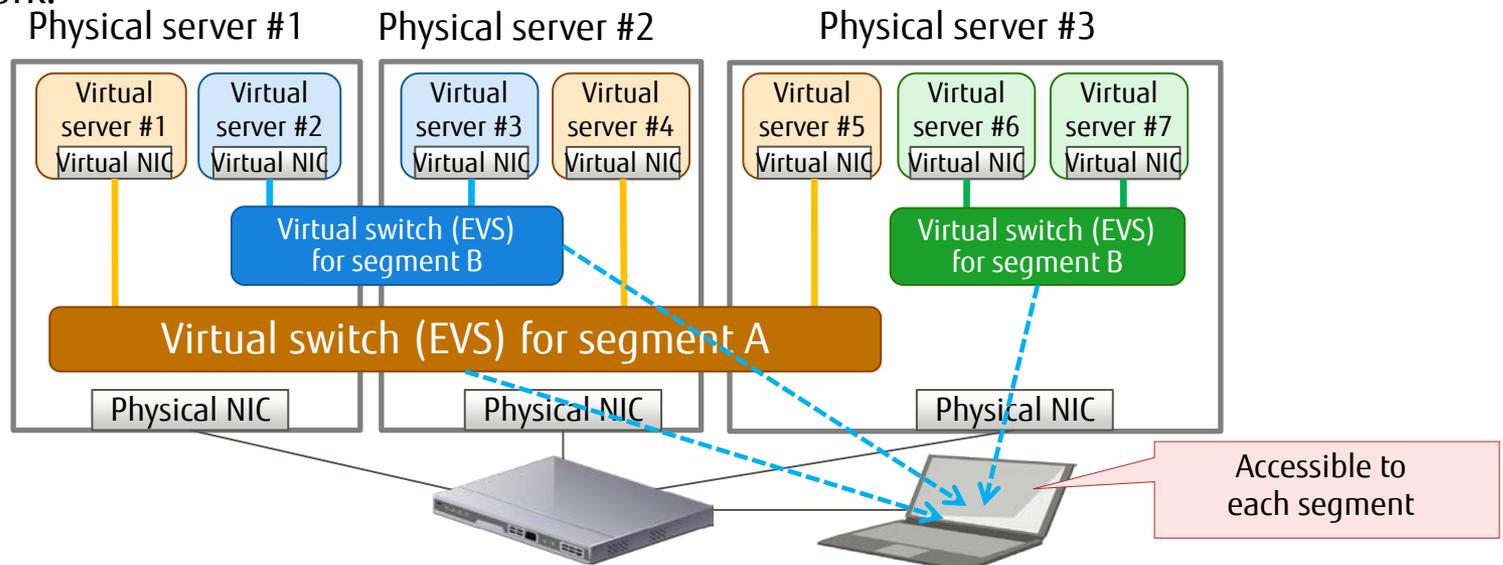
■ What is Elastic Virtual Switch (EVS)?

- EVS is a function for creating a virtual switch that spans the physical servers in each segment and for centrally managing the servers.

* This function has been supported since Solaris 11.2.

■ Elastic Virtual Switch (EVS) features

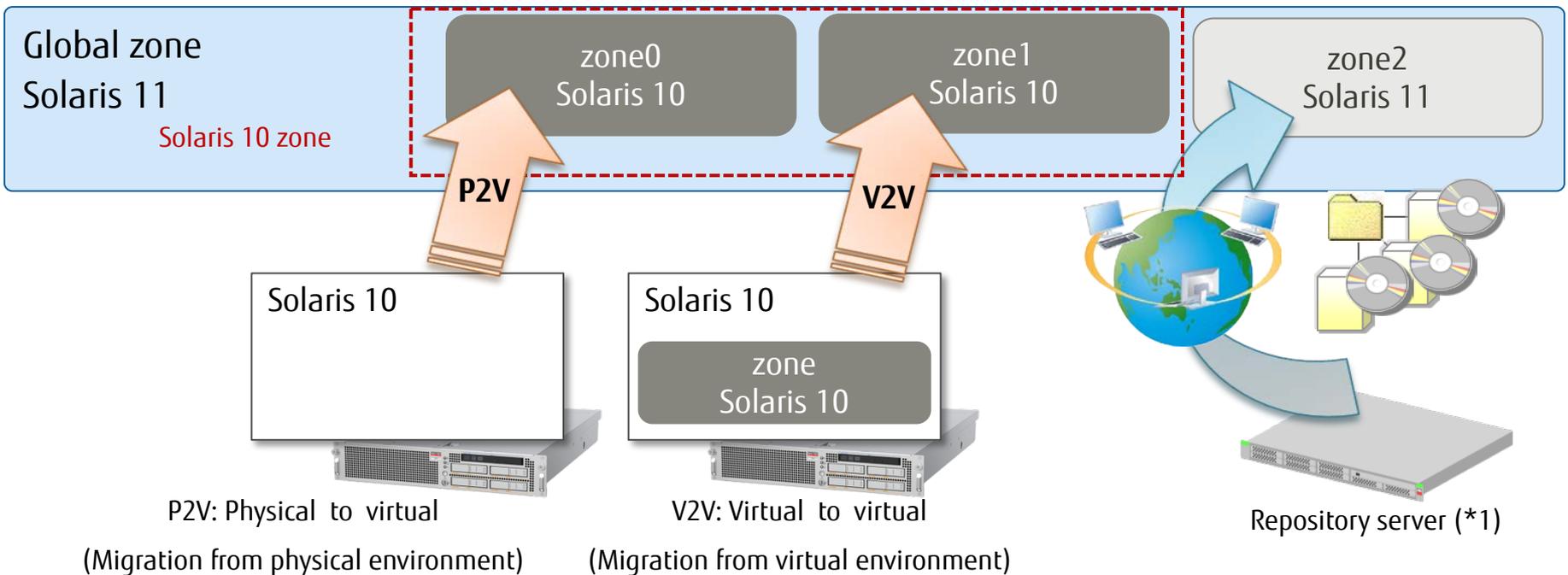
- Networks are isolated between segments.
- Virtual network information (MAC address, IP address, static information, bandwidth, priority, etc.) can be centrally managed.
- Moving virtual servers can be supported flexibly.
- After a physical environment is built, an OS operation can add a virtual server to the network.



Migration From Oracle Solaris 10

■ Migration and integration using the Solaris 10 zone function

- The function of Solaris 10 zones, which are virtual environments in Solaris 10, is implemented as a standard function.
- The Solaris 10 zone function enables migration of a Solaris 10 environment to Solaris 11, and also enables integration of Solaris 10 and Solaris 11.
- Both physical-to-virtual and virtual-to-virtual (P2V and V2V) migrations are possible.



P2V: Physical to virtual

V2V: Virtual to virtual

Repository server (*1)

(Migration from physical environment)

(Migration from virtual environment)

*1 Installation for non-global zones and kernel zones in Solaris 11 use a repository server.

■ Zone configuration

- In Solaris 11, a zonepath is created in a ZFS data set.
- By default, an exclusive-IP zone and VNIC (anet) are defined.
- OS installation for non-global zones and kernel zones use a repository server.
- The solaris-small-server group package is used to install a non-global zone and kernel zone. It does not contain packages related to system management, drivers, and network services.
- A package that is added to a non-global zone or kernel zone can be selected from a repository server.
 - > For details on repository servers and package groups, see "[3. Image Packaging System \(IPS\) - Oracle Solaris Package Management](#) -."

■ Read-Only zone

- You can create a write-prohibited zone in Solaris 11.

■ Network virtualization function (Crossbow)

- You can assign a VNIC to a zone using the network virtualization function (Crossbow).
- An exclusive IP can be set to more than one zone on a physical NIC.

■ Security

- You can enhance security by granting the management privileges of each zone to the general users specified in advance.
- The monitoring function using the zonestat command (CPU utilization, memory usage, and static information on network transmission/reception) has been enhanced.

■ Obsolete functions

- Non-Global zone with an inherited directory
- Oracle Solaris Legacy Containers

7. Security

This chapter describes the security function expanded in Solaris 11 from Solaris 10.

■ Enhanced safety in the default settings

- Immediately after OS installation, some network services (telnet, ftp, NFS, etc.) are disabled.
 - Select the services to be used, and manually activate them.
- Normally, root is set as the role, not as the user account.
 - At that time, you cannot directly log in as root to the OS.
After logging in as a general user, assume the root role with the su command.
 - You can set root as the user account.

■ Time-specified user account

- You can create a user account with a specified network service, day of the week, time slot, etc. for connecting to the OS.
(Example) A user account that can establish an ssh connection from 9:00 to 17:00 on weekdays

■ ZFS encryption

- You can encrypt data on each file system by using a data encryption key.

■ Security diagnosis function

- You can evaluate the safety of OS settings with the newly added compliance command, which presents a report about points for improvement.

■ Changes to the shell and path (PATH) in the default settings

- By default, the interactive shell is bash.
- The system shell is ksh93 (extended Korn shell).

	Solaris 11	Solaris 10
Default login shell	bash	Bourne Shell
Default shell (<code>/usr/bin/sh</code> link destination)	ksh93 * <code>sh</code> is in <code>/usr/sunos/bin/sh</code> .	sh
Default character code	UTF-8	EUC
How to set time zone and locale	SMF service - Set them in the SMF properties. (The <code>/etc/default/init</code> file is automatically rewritten.) - The <code>/etc/default/init</code> file is a read-only file.	Edit the <code>/etc/default/init</code> file directly.

Appendix

Installing Oracle Solaris 11.3 Systems (Oracle)

http://docs.oracle.com/cd/E53394_01/html/E54756/index.html

Copying and Creating Package Repositories in Oracle Solaris 11.3 (Oracle)

http://docs.oracle.com/cd/E53394_01/html/E54747/index.html

Creating and Administering Oracle Solaris 11.3 Boot Environments (Oracle)

http://docs.oracle.com/cd/E53394_01/html/E54749/index.html

Revision History

Edition	Date	Description
First	December 2016	First edition created

■ Terms of Use

■ Copyrights, trademarks, and other intellectual property rights

- The contents (text, images, audio, etc.) are protected by copyrights, trademarks, and other intellectual property rights. The contents can be printed or downloaded for personal use only. The contents may not be otherwise used (reused on a personal webpage, uploaded to another server, etc.) without the prior permission of Fujitsu or the rights holder.

■ Limitation of warranties

- Fujitsu does not warrant the accuracy, merchantability, fitness of use, etc. of the contents. Fujitsu assumes no liability for any damages arising from use of the contents. The contents may be modified or deleted without any prior notice.

■ Export or provision to another party

- Before exporting this product or providing it to another party, check the applicable export control regulations such as the Foreign Exchange and Foreign Trade Act of Japan and the Export Administration Regulations of the United States, and follow the necessary procedures.

■ Trademarks

- UNIX is a registered trademark of The Open Group in the United States and other countries
- SPARC Enterprise, SPARC64, SPARC64 logo, and all other SPARC trademarks are trademarks or registered trademarks of SPARC International, Inc. in the United States and other countries and used under license.
- Oracle and Java are registered trademarks of Oracle Corporation and/or its affiliates in the United States and other countries.
- All other product names mentioned herein may be product names, trademarks, or registered trademarks of their respective owners.



FUJITSU

shaping tomorrow with you