What's New in Oracle® Solaris 11.3

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This document summarizes features that are new or have been enhanced in the Oracle Solaris 11.3 release.

Oracle Solaris 11.3 – Security, Speed, Simplicity

Oracle Solaris is a secure, integrated and open platform engineered for a large-scale enterprise cloud environment that enables you to deploy your mission-critical enterprise applications simply and securely with no compromise. It combines security and compliance capabilities with OpenStack, zero overhead virtualization, and an agile application deployment environment in a single integrated cloud platform.

Key Features in Oracle Solaris 11.3

The advanced, easy-to-use, built-in security features in Oracle Solaris help protect your applications against malware from installation through runtime.

Oracle's Software in Silicon technology with the next-generation SPARC processor enables application developers to take advantage of the Silicon Secured Memory (SSM) features of the chip and help prevent against buffer overflows or other external attacks. Integrated compliance tools enable you to tailor compliance benchmarks to rapidly save time, money, and ensure constant compliance in your IT operations.

Oracle Solaris virtualization technologies give you all the flexibility of a hypervisor with the performance and density of a container, enabling you to deploy your enterprise workloads safely and securely, in traditional or OpenStack-based cloud environments. Increase your agility during planned maintenance windows with live migration of Oracle Solaris Kernel Zones across the cloud.

This release also includes a new version of OpenStack (Juno) with several new enhancements including support of additional network topologies, console access through the dashboard, and new services.

Simplified management provides for large gains in productivity and lower cost of operations, enabling you to build new products and services and deliver on your business strategy faster. New REST APIs enable administrators and developers to quickly query and configure systems with a programmatic interface.

OpenStack

This section describes the OpenStack update in this release.

Updated OpenStack Software

Oracle Solaris 11.3 includes Juno, an updated version of OpenStack. OpenStack is a popular, open-source cloud platform that provides comprehensive, self-service environments for sharing and managing compute, network, and storage resources in a data center through a centralized web-based portal. The updated version, OpenStack Juno, contains over 300 feature enhancements for administrators and self-service cloud users.

Apart from various enhancements, OpenStack Juno supports the following new services:

- *Heat* – The template component of OpenStack. Heat simplifies the orchestration of applications in the cloud by enabling administrators to describe a tiered application deployment across multiple virtual machines (VMs) in a template language.
- *Ironic* – A bare-metal provisioning service within an OpenStack environment. Ironic complements the existing Nova service that creates VM environments. Ironic takes advantage of the automated installer (AI) to provision new systems within the cloud.

Oracle OpenStack for Oracle Solaris 11.3 has been extended to support a number of new features through driver enhancements including source network address translation (SNAT) (many-to-one NAT/port NAT), flat networks, IPv6, and also VM console support within Horizon.

You can seamlessly update to OpenStack Juno using IPS. OpenStack can be evaluated through an all-in-one preconfigured Unified Archive for use in a single-node OpenStack environment.

For more information, see `https://community.oracle.com/docs/DOC-910993`.

Installation and Software Management Features

This section describes the installation and software management features in this release. These features enable fast updates and deployments through software installation and software management tools.

Automated Installer CLI Manifest Editor

Administrators can edit AI manifests without any knowledge of XML by using enhancements to the existing `installadm(1M)` command. This interface provides the ability to interactively create and edit new manifests that can be associated with AI services. Similarly, existing functionality is also available through the Automated Installer Interactive Wizard, a web-browser based interface.

For more information, see the `installadm(1M)` man page.

Boot Pools

Oracle Solaris 11.3 now supports a new boot model called Boot Pools that does not depend on the base capabilities of the firmware-based boot loader. This model allows root filesystems to be loaded on storage that is not accessible to firmware, or provide other storage and network related enhancements without having to modify OpenBoot PROM (OBP) on SPARC or GRUB on x86-based system.

For more information, see the `bootadm(1M)`, `ai_manifest(4)`, `beadm(1M)`, `ibadm(1M)`, and `eeprom(1M)` man pages.

Virtualization Features

This section describes the virtualization features in this release. These features provide efficient cloud virtualization with no loss in performance and enable the running of large scale applications on cloud with the optimized use of resources.

Live Migration for Oracle Solaris Kernel Zones

Users of Oracle Solaris Kernel Zones can now move kernel zone instances around their cloud infrastructure without causing an outage to the kernel zone. Live migration means kernel zone environments can now be moved with ease, enabling administrators to perform updates at the global zone level without an impact on applications or end users. In addition, you can move kernel zone instances to achieve load-balanced workloads across the data center without interrupting the end user or application.

Kernel Zone live migration is available on SPARC and x86 platforms, and is automatically done in a secure manner protecting the migration at several levels. An initial check ensures that you are allowed to migrate

the kernel zone. The resulting connection is not only encrypted but also includes integrity protection, which protects the enclosed data and prevents man-in-the-middle attacks. With Kernel Zone live migration on SPARC, you can also perform cross-CPU migration to enable the adoption of newer systems and later OS versions quickly, without interrupting kernel zone operations.

When using the Kernel Zone live migration feature, you only need to identify a zone and the target system.

```
# zoneadm -z zone-name migrate ssh://destination-host/
```

For more information, see the zoneadm(1M) and zonecfg(1M) man pages.

Oracle Solaris Zones on Shared Storage

The Oracle Solaris Zones on shared storage feature allowed zones to be placed on fiber channel storage area network (FC-SAN) and internet small computer system interface (iSCSI) devices. In this release, zones on shared storage support has been extended to network file system (NFS) for kernel zones storage devices. Administrators now have the flexibility to choose the appropriate storage for their environment while maintaining the ability to benefit from zone boot environments, and quick snapshots and instant cloning. Zones on shared storage greatly simplifies the administration of kernel zones on storage devices, making configuration straight forward thereby reducing the number of configuration steps. This administration simplification also has the benefit of assisting the migration of kernel zones and eliminating configuration mistakes.

For example, to create the NFS URI and also set the size of the kernel zone's root file system:

```
# zonecfg -z kernelzone1
>add device
>set storage=nfs://amy:staff@west/eng/zones/kernelzone1
>set create-size=4g
>end
>exit
```

For more information, see the zonecfg(1M) man page. You can also see *Creating and Using Oracle Solaris Zones* and *Oracle Solaris Zones Configuration Resources*.

Live Zone Reconfiguration for Oracle Solaris Kernel Zones

The Oracle Solaris 11.3 release introduces the Live Zone Reconfiguration feature for Oracle Solaris Kernel Zones. With this feature, you can reconfigure the network and the attached devices of a running kernel zone. Because the configuration changes are applied immediately without requiring a reboot, there is zero downtime service availability within the zone. You can use the standard zone utilities such as `zonecfg` and `zoneadm` to administer the Live Zone Reconfiguration.

For more information, see Chapter 6, “Live Zone Reconfiguration” in *Creating and Using Oracle Solaris Zones*. You can also see the zonecfg(1M) and zoneadm(1M) man pages.

NPIV Support With Oracle Solaris Zones

N_Port ID virtualization (NPIV) technology support enables Oracle Solaris Zones to enhance the management of fibre channel devices and take advantage of several NPIV benefits. From the virtual instance perspective, NPIV helps to address the problem of how multiple VM instances can get access to the storage area network (SAN). NPIV enables multiple virtual instances to gain single or multiple virtual port access through a single physical port ID. This capability enables associated savings by reducing physical connections and allowing virtual instances to scale out, and also simplifies administration overhead

by allowing multiple virtual port instances to be allocated to a single virtual instance quickly and easily. You can create a secure virtual fabric using this technology by sharing out only the resources that virtual instances need to access.

For more information, see the `zonecfg`(1M) man page and *Oracle Solaris Zones Configuration Resources*.

SR-IOV Support for Oracle Solaris Kernel Zones

In Oracle Solaris 11.3, the networking performance in Oracle Solaris Kernel Zones has been enhanced with the support for single root I/O virtualization (SR-IOV). The support enables the kernel zone to use the SR-IOV virtual function (VF) of a network interface card (NIC). You need to specify the `zonecfg anet` property, `iov`, to configure the kernel zone with the SR-IOV VF. When you create or modify the kernel zone, you can specify the `iov` property for the `anet` resource by using the `zonecfg` command.

For more information, see the `zonecfg`(1M) man page and *Managing Network Virtualization and Network Resources in Oracle Solaris 11.3*.

Kernel Zone Cross-CPU Migration

The native cross-CPU migration class support for Oracle Solaris Kernel Zones helps a kernel zone to migrate across different CPU types. The new zone configuration property, `cpu-arch`, enables you to specify the migration class on which the kernel zone will be run. The kernel zone can be migrated across all CPU types that support the specified migration class.

For more information, see *Oracle Solaris Zones Configuration Resources*. You can also see the `zonecfg`(1M) and `solaris-kz`(5) man pages.

Memory Capping Performance Enhancements for Oracle Solaris Zones

Resource management in Oracle Solaris Zones includes the control of memory caps assigned to Oracle Solaris Native Zones. With Oracle Solaris 11.3, the memory cap's capability is enhanced to perform its memory checking three times faster and also identify hot or cold memory, working to recover “cold” memory first. With memory capping enabled, applications are less affected while the process of identifying the memory to reclaim is much more effective.

For more information, see the `rcapd`(1M) man page and *Administering Resource Management in Oracle Solaris 11.3*.

Oracle Solaris Zones Creation From Inside an Immutable Global Zone

Immutable Zones enable the Global Zone administrator to lock down an individual zone into a read-only mode in which the applications within the zone can only read but not write, or only write into certain directories. This mode can greatly limit the impact of intrusions, especially for Internet-facing applications. Immutable global zones support extends the immutable zone capability to the global zone. If a system is configured to have an immutable global zone, files in the root file system are read-only. However, as this environment was previously locked down, you could not create Oracle Solaris Zone instances. As of Oracle Solaris 11.3, you can choose a profile that allows zone creation in this locked down environment.

To select and activate the profile, use the following command:

```
# zonecfg -z global set file-mac-profile=dynamic-zones
```

For more information, see the zonecfg(1M) man page and *Creating and Using Oracle Solaris Zones*.

Orphan Zone Boot Environment Management

Oracle Solaris non-global zones that are migrated from host to host can accumulate zone boot environments that are not associated with any global zone. Oracle Solaris 11.3 now allows failsafe zone migration and destruction of zone boot environments that become orphaned during zone migration. The changes are implemented through the following commands:

- `zoneadm attach`
- `beadm list`
- `beadm destroy`

`zoneadm attach -x` consists of three new options to manage Oracle Solaris zone boot environments during attach.

The `beadm list` output indicates that a boot environment is orphaned with the help of a new active flag `O`. Orphaned boot environments shown in `beadm list` output can be destroyed.

The new `beadm destroy -O` option destroys all orphaned boot environments.

For more information, see *Creating and Administering Oracle Solaris 11.3 Boot Environments* and *Creating and Using Oracle Solaris Zones*. You can also see the beadm(1M) and solaris(5) man pages.

Virtualized Clocks for Oracle Solaris Zones

Oracle Solaris Native Zones now have virtualized clocks to support applications that need to run in different times or to test specific time-related scenarios, for example, how an environment might respond to a leap second.

You can set time values in non-global zones that are different from the value in the global zone. The ability to set different time values in non-global zones is still dependent on the time changes in the global zone. If you change the time in the global zone, the non-global zone time is offset by the same amount.

For example, to set the time value in a non-global zone:

```
# zonecfg -z myzone
zonecfg:myzone> set limitpriv=default,sys_time
zonecfg:myzone> set global-time=false
zonecfg:myzone> exit
```

For more information, see *Oracle Solaris Zones Configuration Resources* and *Creating and Using Oracle Solaris Zones*. You can also see the zonecfg(1M) and date(1) man pages.

Increased Oracle Solaris Kernel Zone Defaults

The default CPU and memory configuration for kernel zones has been increased to 4 vCPUs and 4 GB of memory to provide a better out-of-the-box experience. A new zone template, `SYSsolaris-kz-minimal`, provides the minimal supported kernel zone configuration of 1 vCPU and 2 GB of memory.

For more information, see *Oracle Solaris Zones Configuration Resources* and *Creating and Using Oracle Solaris Kernel Zones*.

Virtual HBA

The Oracle VM Server for SPARC 3.3 software introduces the virtual SCSI host bus adapter (vHBA) feature, which enables you to virtualize any type of SCSI device (such as disk, tape, CD, and DVD). The virtualized SCSI device can be accessible from a guest domain.

The vHBA feature leverages other Oracle Solaris I/O interfaces such as MPxIO multipathing, which enables a virtual logical unit number (LUN) to have the same behavior as a physical LUN. vHBA also enables you to easily configure virtual SANs, which can contain an unbounded number of SCSI devices.

For more information, see the *Oracle VM Server for SPARC 3.3 Administration Guide* and *Oracle VM Server for SPARC 3.3 Reference Manual*.

Whole-Core Dynamic Reconfiguration Management

Whole-core dynamic reconfiguration management (DRM) provides an adaptive mechanism to increase or decrease CPU core resources based on domain utilization. This feature means that dynamic reconfiguration can now be performed at the unshared core level in addition to the strand, or vCPU, level of granularity.

For more information, see the *Oracle VM Server for SPARC 3.3 Administration Guide* and *Oracle VM Server for SPARC 3.3 Reference Manual*.

I/O Domain Resiliency

I/O Domain Resiliency is a high availability feature for Oracle VM Server for SPARC on `sun4v` platforms. This feature enables an I/O domain to continue running even when the root domain that provides the I/O domain with virtual function devices is interrupted. When the root domain is restored, the affected virtual function devices are restored automatically to service.

To use this functionality, you must set up the multipath I/O configurations. These configurations enable the I/O domain to fail over to alternate device paths, when one of the root domains is interrupted. This feature is currently supported only when the I/O domain is configured with SR-IOV virtual function devices.

For more information, see the *Oracle VM Server for SPARC 3.3 Administration Guide*.

InfiniBand Support for Oracle Solaris Kernel Zones

InfiniBand is a network architecture for the large-scale interconnection of computing and I/O nodes through a high-speed switched fabric. To operate InfiniBand on an Oracle server, you need an InfiniBand HCA (the adapter) and an InfiniBand software stack. As of Oracle Solaris 11.3, InfiniBand support is available for Oracle Solaris Kernel Zones including improved observability and paravirtualized support for the IPoIB protocol.

For more information, see the `dladm`(1M), `zonecfg`(1M), and `solaris-kz`(5) man pages. You can also see *Oracle Solaris Zones Configuration Resources* and *Creating and Using Oracle Solaris Zones*.

Data Management Features

This section describes the data management features in this release. These features enable you to scale out design with unlimited capacity for future growth and also provide enhanced data integrity.

Review ZFS Snapshot Differences Recursively

In Oracle Solaris 11.3, you can recursively display ZFS snapshots differences within the descendent file system. For example, in the following command output, one snapshot is compared to another snapshot. You can also see that multiple files are added to the second snapshot, including a snapshot that does not exist in the first snapshot.

```
# zfs diff -r west@snap1 west@snap4
D /west/users/ (west/users)
+ /west/users/file.a
+ /west/users/reptar
west/users/reptar@snap1: snapshot does not exist
D /west/data/ (west/data)
+ /west/data/file.1
+ /west/data/file.2
+ /west/data/file.3
```

In the output, the `+` sign indicates an entry in the given file system and `D` indicates an existing file system.

For more information about ZFS snapshots, see *Managing ZFS File Systems in Oracle Solaris 11.3*.

ZFS LZ4 Compression

Enabling LZ4 compression on your ZFS file systems can reduce storage, power, and cooling in the 2x to 5x range. Oracle Solaris 11.3 adds support for the LZ4 compression algorithm that generally provides a 2x compression ratio with reduced CPU overhead.

For example, to set the LZ4 compression on your ZFS file system:

```
# zfs set compression=lz4 east/data
```

For more information about ZFS compression, see *Managing ZFS File Systems in Oracle Solaris 11.3*.

SMB 2.1

Previous Oracle Solaris 11 releases provide server message block (SMB) protocol support, which allows you to share data between Microsoft Windows and Oracle Solaris systems. Oracle Solaris 11.3 provides support for SMB 2.1, which provides the following enhancements:

- Reduces the previous number of SMB 1.0 commands and subcommands from over a hundred to just 19 commands.
- Supports a new caching model called Lease. This model enables the SMB client to have multiple opens on a single file which helps in holding on to the cache.
- Provides more scalable performance for high-speed networks and includes the following performance benefits:
  - SMB payload requests can scale up to 1MB instead of 64K.
  - Reduces CPU utilization on the SMB server and the SMB client.
  - SMB clients gain the performance benefit of not losing local caching when the same file is opened multiple times.

For more information about the commands and subcommands, see the `smb`(4), `smbd`(1M), and `smbfs`(7FS) man pages. For more information, see *Managing SMB File Sharing and Windows Interoperability in Oracle Solaris 11.3*.

ZFS Default User or Group Quotas

You can simplify the management of large user deployments and more easily allocate storage resources by setting a default user or group quota.

If a large ZFS file system has default quota for all users of 25 GB, you can still set an individual user quota of 50 GB, if required. For example:

```
# zfs set defaultuserquota=25gb sandbox/bigfs
# zfs set userquota@marks=50gb sandbox/bigfs
```

For more information, see *Managing ZFS File Systems in Oracle Solaris 11.3*.

ZFS Scalable Performance Improvements

ZFS performance scales to enterprise-class systems with large amounts of memory and includes the following enhancements in the Oracle Solaris 11.3 release:

- ZFS adaptive replacement cache (ARC) has been redesigned to provide scalability for large memory systems.
- Persistent L2ARC means that important data is cached after the system reboots to avoid long cache warm-up time. As a bonus, compressed data remains compressed in the L2ARC cache, which reduces the processing time.
- Local directory access lock performance now scales with an increasing number of threads or CPUs.
- Improved block allocation means that pool capacity can reach 90% and more.

For more information, see *Managing ZFS File Systems in Oracle Solaris 11.3*.

Monitoring ZFS Operations

Oracle Solaris 11.3 provides improved visibility into ongoing ZFS file systems and pool operations.

You can monitor ongoing pool and file system operations by using the `zpool monitor` command. For example, ZFS `send` stream time estimates are provided for all in progress `send` stream operations.

```
# zpool monitor -t send west 5 5

pool                    provider  pctdone  total speed  timeleft  other

west                    send      36.3     17.2G 74.1M  2m31s     west/fs1@snap1
west                    send      38.7     17.2G 74.7M  2m24s     west/fs1@snap1
west                    send      41.3     17.2G 75.5M  2m16s     west/fs1@snap1
west                    send      43.8     17.2G 76.2M  2m09s     west/fs1@snap1
```

For more information about using the `zpool monitor` command, see *Managing ZFS File Systems in Oracle Solaris 11.3*.

Better Handling of ZFS Spare Devices

Configuring hot spares for your ZFS storage pool is a best practice and you should continue to do so. Starting with Oracle Solaris 11.3, unused spare disks are checked automatically to determine if they are still operational when configuring hot spares for your ZFS storage pool. ZFS reports when a spare disk fails and fault management architecture (FMA) generates a fault report if ZFS cannot open the spare device.

For more information about using spares, see *Managing ZFS File Systems in Oracle Solaris 11.3*.

Networking Features

This section describes the networking features in this release. These features enhance the existing networking technology and software defined networking to build services that meet organizational performance requirements and to provide greater application agility and the flexibility you demand.

Support for Private VLANs

Oracle Solaris 11.3 provides support for Private Virtual LANs (PVLANs). PVLANs enable you to segment VLANs into an arbitrary number of sub-VLANs and provide the ability to meet network isolation requirements within a data center while using a shared network infrastructure. This support is useful to administrators, for example, when managing backups where all systems can reach the backup servers through PVLANs but no direct host-to-host communication is possible.

The advantage of using a PVLAN over simply creating another VLAN is administrative. You do not have to assign a new subnet for each PVLAN, and do not have the maintenance overhead (in some situations) of creating new Access Control Lists (ACLs).

Administrators can either create a PVLAN or configure a PVLAN VNIC to host the PVLAN traffic by using the `dladm` command.

To create a PVLAN, use the following command:

```
# dladm create-vlan pvlan-properties
```

To configure a PVLAN VNIC to host the PVLAN traffic, use the following command:

```
# dladm create-vnic pvlan-properties
```

For more information, see *Managing Network Virtualization and Network Resources in Oracle Solaris 11.3* and the `dladm`(1M) man page.

Support for Hardware SLAs for VNICs

A new resource management capability, bandwidth shares, applies to Oracle Solaris Kernel Zones running on a system using a NIC that supports SR-IOV PCIe virtual functions (VFs), for example, Intel's Fortville NIC.

Bandwidth shares are a better bandwidth management strategy than the traditional Oracle Solaris ability to set bandwidth limits, offered since the release of Oracle Solaris 11. Bandwidth limits prevent one connection from taking all the available bandwidth of a link, but the limits do not necessarily provide the best utilization of the link. Bandwidth limits limit how much bandwidth to use, even in the situation where bandwidth is available. In comparison, bandwidth shares allow specifying, for example, that a connection gets at least 30% of the bandwidth of the link. Assuming one other connection only is using the same link and it has a share of 70%, both connections then get at least what their share specifies, and can get more bandwidth if it is available. Bandwidth shares increase the utilization of the communications link while still ensuring utilization fairness through the allocation of shares by the administrator.

The capability is administered through the `dladm(1M)` command.

```
# dladm set-linkprop -p bwshare=1 vnic1
```

```
# dladm set-linkprop -p bwshare=2 vnic2
```

This example shows how to allocate 1/3 (at minimum) of the bandwidth to `vnic1` and the rest (at minimum) to `vnic2`. If either of the VNICs used less than its minimum, the other could use the excess capacity.

For more information, see the `dladm`(1M) man page.

`My Traceroute` Utility

`My Traceroute` (`mtr`) is a network diagnostic tool that combines the information from the `ping` and `traceroute` commands in a single utility. `mtr` sends exploratory packets towards the requested host at regular intervals similar to `ping -s`. `mtr` can see each network hop between the current and the target host, similar to `traceroute`.

`mtr` maintains a record of the timings and displays the record on screen, constantly updating the display as new packets are sent out and the responses are returned.

For more information, see the `mtr` man page.

Large Receive Offload for Datalinks

Network TCP performance, particularly for kernel zones, shows substantial performance improvements with the enhanced support for Large Receive Offload (LRO). LRO provides the capability to aggregate packets with similar source, destination, and port characteristics, and therefore more efficiently handle inbound traffic. Oracle Solaris 11.3 introduces LRO processing in the MAC layer without the need for direct support from the underlying NIC. The default is to turn LRO off.

For more information, see the `dladm`(1M) and `zonecfg`(1M) man pages. You can also see *Managing Network Virtualization and Network Resources in Oracle Solaris 11.3*.

EVS Enhancements and EVS Controller, IPnet, and VPort Enhancements

The Oracle Solaris Elastic Virtual Switch (EVS) feature enables you to create and administer a virtual switch that spans one or more compute nodes. These compute nodes are the physical machines that host VMs. An elastic virtual switch is an entity that represents explicitly created virtual switches that belong to the same Layer 2 (L2) segment. An elastic virtual switch provides network connectivity between VMs connected to it from anywhere in the network. EVS has been enhanced in Oracle Solaris 11.3 to support a new flat (untagged) Layer 2 network type, multiple uplink ports per compute node, allocation pools, and also the ability to explicitly set link protection per port.

For more information, see *Managing Network Virtualization and Network Resources in Oracle Solaris 11.3* and the `evsadm`(1M) man page.

Data Center Bridging Extensions for CEE

Oracle Solaris 11.3 supports converged enhanced ethernet (CEE) data center bridging exchange (DCBX) in addition to IEEE. This enables Oracle Solaris fibre channel over ethernet (FcoE) to be deployed in environments with a diverse set of switches using data center bridging (DCB). Oracle Solaris CEE DCBX also supports priority-based flow control (PFC) and application type-length-value (TLV). You can set the

`dcbx-version` property by using the `lldpadm` command to configure the DCBX protocol on a Link Layer Discovery Protocol (LLDP) agent to `ieee`, `cee`, or `auto` modes.

For more information, see the `lldpadm`(1M) man page and *Managing Network Datalinks in Oracle Solaris 11.3*.

Flows Support for DSCP Marking

The `flowadm(1M)` command has been enhanced to support setting a differentiated services code point (DSCP) field within network packets to help achieve quality of service (QoS) goals. This enhancement is an integral part of successfully prioritizing end-to-end communications when the source, destination, and intermediate switches and routers support DSCP.

For example, for a latency-sensitive connection, set the priority and the EF class DSCP value. Use EF class (DSCP 46) for latency-sensitive flows.

```
# flowadm add-flow -l net0 -a transport=tcp,local_port=123 -p priority=high,dscp=46 ntp-flow
```

In this example, `ntp-flow` is used for time protocol traffic.

For more information, see the `flowadm`(1M) man page.

Networking Flows Enhancements

The `flowadm(1M)` command has been enhanced to enable additional flexibility in flow configurations. Prior to this release, applications that created multiple flows were constrained in the variations that could be used. With this release, you can have concurrent flows with the following characteristics that allow:

- Inbound-only or outbound-only flows
- Any combination of flow attributes when creating a flow
- Multiple flow classifiers and flow ranking

Multiple flow classifiers provide support for overlapping flows, where a single packet could be classified under different flows. To resolve that conflict, flow ranking is used.

For more information, see the `flowadm`(1M) man page.

Global Enabling or Disabling of VRRP Router

Oracle Solaris 11.3 supports global enabling or disabling of virtual router redundancy protocol (VRRP) routers on the system or zone at the same time. This feature minimizes the internal delays and difference between the time for each VRRP router's state change, which might be critical in some circumstances.

For more information, see the `vrrpadm`(1M) man page. You can also see *Configuring an Oracle Solaris 11.3 System as a Router or a Load Balancer*.

Vanity Naming for Netboot Environment

Oracle Solaris 11.3 adds support for providing vanity names for datalinks during provisioning of a network boot environment through Ethernet and iSCSI. This feature greatly simplifies administration during pre-

installation and post-installation, and also in iSCSI boot environments. This feature also facilitates moving application environments by removing dependencies on specific physical network devices.

For more information, see the `dladm`(1M) man page. You can also see *Configuring and Managing Network Components in Oracle Solaris 11.3*.

VNIC Support for IPoIB

Oracle Solaris 11.3 enables administrators to create IPoIB VNICs by using an assigned partition key. This feature enables support for IPoIB VNIC migration and a consistent administrative experience for Ethernet and IP over InfiniBand datalinks.

Related Information

"MD5 Signature Option for TCP" on page 15.

System Management Features

This section describes the system management features in this release. These new features enable you to configure services with seamless configuration management, automate configuration enforcements across systems, and also provide secure, remote administrative access.

Resource Capping Daemon

The resource capping daemon provides a simplified configuration, more responsive `rcapd` performance, and more effective cap enforcement. The command options have been simplified, and the interface for the `rcapd` administrative utility `rcapadm(1M)` has been updated. A more efficient method of selecting available memory pages for use in `rcapd` operations has been introduced to improve system performance.

Two `rcapadm` parameters, `sample` and `mode`, now enable administrators to control all `rcapd` operations. In addition, functionality to address unenforced memory caps is now available. If a collection of processes is found to be over its memory cap for an extended period of time, `rcapd` determines whether memory caps should continue to be enforced for that collection. If a memory cap is no longer enforced, `rcapd` logs a detailed error message reporting the cause.

For more information, see *Administering Resource Management in Oracle Solaris 11.3*. You can also see the `rcapd`(1M) and `rcapadm`(1M) man pages.

REST-based Administrative Interfaces With RAD

Oracle Solaris 11.3 includes a new set of remote administration daemon (RAD) modules that provide support for administering ZFS, IPS, datalinks and flow management, and AI servers. RAD provides administrators with programmatic access to system configuration through a set of interfaces that include C, Java, and Python.

Oracle Solaris 11.3 adds preliminary support for developing REpresentational State Transfer (REST) based APIs by using RAD. Developers can now add REST interfaces in addition to standard interfaces such as C, Python, and Java when developing RAD modules for various system components.

For more information, see the rad(1M) man page.

Improved Device Management

You can use the diskinfo command to display information about different types of devices and their topology on a system with a common /dev/chassis path. This command has been enhanced to include NVM Express (NVMe) and Sun Flash Accelerator PCIe devices.

For example, the following output shows enumeration of SAS internal storage, NVMe and USB devices:

```
# diskinfo -A SYS -o Rcs
R:receptacle-name   c:occupant-compdev     s:occupant-serial
------------------  --------------------  ----------------------------
/SYS/HDD0           c0t5000C5000EBC7FAFd0  083997JTVE--------3NM7JTVE
/SYS/HDD1           c0t5000C5000EBDF45Fd0  083897MAEJ--------3NM7MAEJ
/SYS/HDD2           c0t5000CCA012CFADFCd0  001143PP6R1B--------PPKP6R1B
/SYS/HDD3           c0t5000C5003AFFB6E3d0  001122P147CD--------6XR147CD
/SYS/HDD4           -                      -
/SYS/HDD5           -                      -
/SYS/HDD6           c0t5001E82002653B00d0  40188672
/SYS/HDD7           -                      -
/SYS/MB/PCIE3/NVME  c16t1d0                CVMD416600591P6DGN
/SYS/MB/USB0        c2t0d0                 2BF0022700021243
/SYS/MB/USB1        -                      -
```

Periodic and Scheduled Services

SMF provides the ability to define and configure services to run on a specific schedule, in addition to the capability to run the services periodically. This capability provides similar functionality to a cron entry but with additional SMF advantages such as built-in dependencies management and simplified life-cycle management. A scheduled service can now be delivered in an IPS package, configured, enabled, and removed from the scheduling list together with all the components of the service, making it very easy to deploy.

For more information, see *Managing System Services in Oracle Solaris 11.3*.

Multi-CPU Binding for Oracle Solaris Projects

Multi-CPU Binding (MCB) for projects enables you to control the MCB of an Oracle Solaris project by using the existing control utilities projmod(1M) and project(4). For other resources that are controlled by a project, you can modify the MCB of a project as an attribute of the project.

For more information, see *Administering Resource Management in Oracle Solaris 11.3*. You can also refer to the projadd(1M), projdel(1M), projmod(1M), setproject(3PROJECT), project(4), and resource-controls(5) man pages.

Hiera

Hiera is a lookup tool for viewing configuration data. When Hiera is used in conjunction with Puppet, Hiera keeps site-specific data out of Puppet manifests, which enables you to use more generic manifests for multiple systems. Puppet classes request any data the classes need, and the Hiera data acts as a site-wide configuration file. Configuration data in Hiera can be in YAML or JSON formats. Oracle Solaris 11.3 has been updated to include Puppet 3.6.2.

USB FMA

Oracle Solaris 11.3 includes the USB FMA hardened feature that makes USB client drivers fault-management capable. New USB FMA faults have been defined for both hardware and software failures which enables more software and hardware errors to be captured, diagnosed, and documented.

For more information, see the `usb_fm_error_log(9F)` man page.

Security and Compliance Features

This section describes the security and compliance features in this release. These new features help prevent new threats through anti-malware protection and enable you to meet the strictest compliance obligations.

Silicon Secured Memory Support

The next generation SPARC platform offers new co-engineered hardware and software capabilities that enable applications to run with the highest levels of security, reliability, and speed. This functionality is known as Oracle's "Software in Silicon". Oracle Solaris 11.3 introduces a key Software in Silicon feature called Silicon Secured Memory (SSM). SSM detects common memory access errors including buffer overflows, unallocated or freed memory access errors, “double free” memory access errors, and stale pointer memory access errors. With SSM enabled, an error is likely to be raised if an application tries to access memory it should not have access to. Because SSM is a hardware implementation, it incurs minimal overhead and can be used in production to detect potential memory corruption issues. You can use SSM during application development to ensure such errors are caught during application testing and certification.

Oracle Solaris 11.3 supports SSM for both applications and observability tools. For example, applications and administrators can now control enabling or disabling SSM to start guarding memory access. Once enabled, SSM is transparently handled by Oracle Solaris. To monitor SSM, Oracle Solaris 11.3 includes new extensions for `mdb` and DTrace.

For more information about Software in Silicon, see: `https://www.oracle.com/technetwork/server-storage/softwareinsilicon/swinsi-faq-2407450.html`.

MD5 Signature Option for TCP

Oracle Solaris 11.3 supports MD5 hash signatures, which enable the authentication of TCP packets and ensure their integrity. TCP-based protocols that cannot use IPsec or do not the have the ability to authenticate TCP packets between hosts, can now set up keys and use these MD5 hash signatures on the TCP packets. The MD5 hash signature is intended primarily for the border gateway protocol (BGP). Note that there is a performance penalty associated with signing each packet.

For more information, see the `tcpkey(1M)` man page.

Verified Boot for Kernel Zones

Oracle Solaris Verified Boot now provides support for Oracle Solaris Kernel Zones. This anti-malware and integrity feature reduces the risk of introducing malicious or accidentally modified critical boot and kernel components. This feature checks the cryptographic signatures of the firmware, boot system, and kernel and kernel modules.

The three policy options are `ignore`, `warn and continue`, and `refuse to load the component`.

For more information, see the `zonecfg`(1M) man page. You can also see *Securing Systems and Attached Devices in Oracle Solaris 11.3* and *Creating and Using Oracle Solaris Kernel Zones*.

SSH Mediators

Oracle Solaris 11.3 now offers a choice of SSH implementations. A new OpenSSH implementation based on OpenSSH 6.5pl co-exists with SunSSH. You can choose either of the implementations, using the `pkg mediator` mechanism. The default SSH implementation is SunSSH.

To switch between them, you would run the following commands:

```
# pkg mediator ssh
MEDIATOR     VER. SRC. VERSION IMPL. SRC. IMPLEMENTATION
ssh          vendor            vendor     sunssh
# pkg install network/openssh
# pkg mediator -a ssh
MEDIATOR     VER. SRC. VERSION IMPL. SRC. IMPLEMENTATION
ssh          vendor            vendor     sunssh
ssh          system            system     openssh
# pkg set-mediator -I openssh ssh
# pkg mediator ssh
MEDIATOR     VER. SRC. VERSION IMPL. SRC. IMPLEMENTATION
ssh          system            local      openssh
```

The SSH packages have been refactored to provide a more seamless transition between SSH implementations.

For more information, see *Managing Secure Shell Access in Oracle Solaris 11.3*.

GRUB Menu Password Protection

Oracle Solaris 11.3 provides a feature that adds optional boot environment protection in a shared system. It also allows the GRUB menu to have a password protection option for menu loading, menu entry modification, and menu entry booting.

For more information, see the `bootadm`(1M) man page. You can also see *Oracle Solaris 11.3 Security and Hardening Guidelines*.

Compliance Tailoring

Oracle Solaris 11.3 adds the ability to refine the set of benchmarks used in assessing security compliance. This feature enables a better match to local security policies without modifying the base benchmark itself. The `compliance` command now includes a `tailor` subcommand, and a new interactive interface to support the creation of tailorings, enabling the individual inclusion or exclusion of benchmark rules used to assess a system.

The following example shows how you would create a new tailoring called `mytailoring` that adds two additional rules to the Baseline profile from the Oracle Solaris benchmark.

```
# compliance tailor -t mytailoring
tailoring: No existing tailoring: 'mytailoring', initializing
```

```
tailoring:mytailoring> set benchmark=solaris
tailoring:mytailoring> set profile=Baseline
tailoring:mytailoring> include rule=OSC-47501
tailoring:mytailoring> include rule=OSC-49501
tailoring:mytailoring> export
set tailoring=mytailoring
# version=2014-11-29T04:16:39.000+00:00
set benchmark=solaris
set profile=Baseline
# Passwords require at least one digit
include OSC-47501
# Passwords require at least one uppercase character include OSC-49501
tailoring:mytailoring> exit
```

For more information, see the `compliance-tailor(1M)` man page.

Packet Filter

Oracle Solaris 11.3 includes the OpenBSD 5.5 Packet Filter (PF) firewall for filtering TCP/IP traffic. PF provides an alternative to the existing IP Filter (IPF) already included in Oracle Solaris, enabling both bandwidth management and packet prioritization. To use the PF firewall, you install the `pkg:/network/firewall` package and enable the `svc:/network/firewall:default` service instance.

For more information, see the `pfctl(1M)`, `pf.conf(5)`, and `pf.os(5)` man pages.

Immutable Global Zone – New Dynamic Policy for Zone Creation

Oracle Solaris 11.3 includes a new read-only policy (`file-mac-profile`), `dynamic-zones`. This profile enable administrators to create and destroy kernel zones and non-global zones in an immutable global zone environment while still providing benefits similar to the existing `fixed-configuration` profile. This profile is valid only for the global zone, which includes the global zone of a kernel zone.

Platform and Performance Enhancements

This section describes the platform and performance enhancements in this release. These features help optimize Oracle Solaris for SPARC and x86 based systems thereby increasing performance, and also provide better diagnosis for your systems.

Optimized Shared Memory V2

Optimized Shared Memory (OSM) V2 brings up the system global area (SGA) of an Oracle Database 12c instance faster. The Oracle Database 12c instance is brought up twice as fast for a small SGA and 6.5 times faster for a large (28TB) SGA. Oracle Database shutdown times have also improved to nearly twice as fast for a small SGA and 6 times faster for large SGA.

Applications that lock down their memory for performance reasons are likely to experience even better start, stop, or restart times with the new OSM. It is an important improvement over earlier shared memory mechanisms like Intimate Shared Memory (ISM) and Dynamic Intimate Shared Memory (DISM).

For more information about the OSM API, see the `coreadm(1M)`, `proc(4)`, and `pmap(1)` man pages.

Oracle Solaris Kernel Dynamic Trap Trace Administrative Tool

Dynamic kernel-level trap trace enables you to collect information about trap activities on the system with no down time. The trap trace therefore can help reduce the impact down to the minimum level. You can enable and disable tracing dynamically, and configure the trace as needed by using the system administrative tool `ttrace`. This tool provides the dynamic kernel trap trace on both SPARC and x86 platforms.

For more information, see the `ttrace(1M)` man page.

Platform Firmware IPS Packages

Platform firmware updates for selected SPARC systems are now available in the Oracle Solaris IPS support repository in addition to the `.zip` file downloads from My Oracle Support. Installing or updating the firmware package delivers files to `/var/firmware/`*server-type*but does not automatically update the server's firmware. You still need to perform the manual steps as per the instructions in the README file.

To identify the firmware update packages for your platform, use the following command:

```
# pkg list -af 'firmware/system/*'
```

You can use the `pkg contents` and `pkg info` commands to get more information about the packages for your platform.

For example, the `firmware/system/T5-4` group package installs the `firmware/system/T5-4/sysfw9-4`, `firmware/system/T5-4/hbafw`, and `firmware/system/T5-4/hwprogrammables` packages. The `pkg info` command shows that the `firmware/system/T5-4/sysfw9-5` package provides Version 9.5.3 Patch 22270913. You would follow the instructions in `/var/firmware/system/T5-4/sysfw9-5/p22270913_953/README.html` to install the firmware update. After you install the firmware package, you could use the `pkg update` command to download newer firmware updates.

For more information about the `pkg list`, `pkg contents`, `pkg info`, `pkg install`, and `pkg update` commands, see *Adding and Updating Software in Oracle Solaris 11.3*. For more information about firmware updates, see *Oracle ILOM Feature Updates and Release Notes Firmware Release 3.2.x*.

Performance Improvement for High-Resolution Real Time Calculations

The performance of the `gethrtime` and `gettimeofday` routines that calculate and report time values has been improved on the SPARC (sun4v) platform. The code of these routines was refactored to be more efficient, boosting the overall calculation performance.

For more information, see the `gethrtime(3C)` and `gettimeofday(3C)` man pages.

Updated NVIDIA Drivers

The NVIDIA Graphics legacy driver has now been updated to version 346.35, and supports the newer family of NVIDIA GPUs. Support for older NVIDIA cards is provided by the R340 or R304 legacy drivers. The drivers are available in the repository as `driver/graphics/nvidiaR340` and `driver/graphics/nvidiaR304` packages.

To install the R340 legacy driver, use the following command:

```
$ sudo pkg install --reject driver/graphics/nvidia driver/graphics/nvidiaR340
```

To install the R304 legacy driver, use the following command:

```
$ sudo pkg install --reject driver/graphics/nvidia driver/graphics/nvidiaR304
```

For a complete list of legacy GPU support, see `https://www.nvidia.com/object/IO_32667.html`. For more information, see the `/usr/share/doc/NVIDIA/README.txt` file.

Scalable Read/Write Locks

Scalable read/write locks enable much faster acquisition of read/write locks, enhancing the performance of applications especially on larger systems. Modern systems use non-uniform memory access (NUMA) designs, which result in an increasing disparity between the speed of the processors and the speed of the interconnect to other processors.

Application performance is highly dependent on how well the operating system places the application and the data it needs on the same node (same processor or group of processors). The scalable read/write locks project distributes the locks and is NUMA-aware to facilitate placing a requested lock local to the application using it. Ensuring that a request lock is local to the application avoids high-latency internode communication and increases application performance.

For more information, see the `pthread_rwlockattr_setpshared`(3C) and `pthread_rwlock_init`(3C) man pages.

Oracle VTS 7.0 Patch Set 19.2

The Oracle Validation Test Suite (Oracle VTS) is a comprehensive hardware diagnostic tool that tests and validates the connectivity and functionality of most controllers and devices on Oracle platforms. The tests are targeted for each hardware component or function in a system. The tool supports three types of user interfaces (UIs): a graphical UI (GUI), a terminal-based UI, and a command-line interface (CLI).

Oracle VTS 7.0 Patch Set 19.2 includes the following significant enhancements to processor, power, disk, and power management diagnostics:

- Support added for Intel Haswell-EP 18-core CPU
- `ramtest` tuned for higher MCU bandwidth and memory power
- `dtlbtest/apat` subtest's VA generation logic improved
- `diskmediatest` modified to identify NVMe devices and new SAS3 HBAs
- `diskmediatest` modified for mixed workload support
- `vtsk` modified to dump data of the LT

For more information, see the VTS User Guide.

Deferred Dump

Oracle Solaris 11.3 now supports a deferred dump mechanism for collecting system crash dumps. This process is much faster, preserving the dump in memory until the system has rebooted, and can write the dump to the filesystem, bypassing any disk-based dump device entirely.

For more information, see the `dumpadm`(1M) man page and *Troubleshooting System Administration Issues in Oracle Solaris 11.3*.

ZFS Adaptive Replacement Cache and Kernel Cage Reduction

Oracle Solaris 11.3 includes new physical memory allocation mechanisms that benefit applications, especially databases and Java applications, when the system is under memory pressure. The mechanisms enable the kernel to reduce the ZFS ARC and free the kernel pages so that they can be used by other user processes. This enhancement is especially relevant when starting or restarting an application on a system with long uptime.

IOMMU Enhancement

Input output memory management unit (IOMMU) statistics support has been added to the `kstat` tool to report the following statistics:

- The number of successful and failed large page allocations
- The number of DMA mappings existing for supported page sizes such as 4k and 2M
- The number of IOTLB invalidations
- The number of bind and unbind DMA operations
- The amount of time spent on bind and unbind DMA operations
- The duration of the active large page mappings
- The comparison between the number of small page (4k) allocations and the use of pre-allocated pages

These statistics help in analyzing performance, determining the impact of DMA operations on the system, and the use of resources. Currently, this enhancement is available on the x86 platform. For more information, see the `kstat(1M)` man page.

Enhancements for Developers

This section describes enhancements for developers in this release that make developing applications on the Oracle Solaris platform easier with state of the art libraries and reliable frameworks.

SSM APIs for Application Development

Oracle Solaris includes new and updated C library SSM APIs. These APIs can be used, for example, to enable the detection of memory corruption issues when an application uses its own custom memory allocator.

For more information, see the `adi(3C)`, `adi(2)`, `memcntl(2)`, `mmap(2)`, and `siginfo(3HEAD)` man pages.

Silicon Secured Memory Management Library

A new user level memory management library, `libadimalloc` defines versions of the standard `libc-malloc(3C)` family of functions that make use of SSM. In addition, the `libadimalloc` library also provides extensive debugging support.

For more information, see the `libadimalloc(3LIB)` man page. For more information about debugging support, see the `adimalloc_debug(3MALLOC)` man page.

SSM Support in Oracle Solaris Studio

The Oracle Solaris Studio development tools include support for SSM and provide developers with additional diagnostics to quickly find and fix SSM runtime-related errors. The Code Analyzer is an advanced analysis tool in Oracle Solaris Studio and can detect coding errors using static analysis when you compile your application. Code Analyzer also protects your application from memory errors with runtime dynamic analysis. In addition, it dramatically increases code coverage with patented technology that ranks untested functions. The runtime dynamic analysis functionality of the Oracle Solaris Studio Code Analyzer, Discover, includes a library, `libdiscoverADI`, which enables Discover to understand and detect runtime-related memory errors identified by SSM. Any C or C++ application can preload this library to run with SSM error-checking enabled. If a memory error is detected, Discover prints a comprehensive error analysis report.

For information about how to use Oracle Solaris Studio development tools to find and fix memory access errors identified by SSM, see the article: `https://community.oracle.com/docs/DOC-912448`. For more information, see the `mdb(1)` and `dtrace(1M)` man pages.

Posix Spawn Function

The C library includes a new API that enables Java to run faster and more efficiently. The new API, `posix_spawn_file_actions_addchdir_np()`, enables you to specify a working directory for a process created by using the `posix_spawn()` function. Java uses the `posix_spawn()` function to create child processes that do not incur excessive memory overhead.

For more information, see the `posix_spawn(3C)` and `posix_spawn_file_actions_addchdir_np(3C)` man pages.

Enhanced Signal Delivery

The new interfaces added to the C library represent a change to the Oracle Solaris POSIX/UNIX multi-threaded process model. The interfaces allow processes to send signals not only to each other but also to threads within the process by interacting directly with any specific thread on a different process.

For more information, see the `proc_thr_kill(3C)` and `proc_thr_sigqueue(3C)` man pages.

New Event Sources

Signals are now added as an event source to the existing set of event sources that are defined for event ports. This enhancement enables event ports to have processes that wait for signal events along with the existing set of event sources.

For more information, see the `port_create(3C)`, `port_associate(3C)`, and `port_dissociate(3C)` man pages.

Random Number and Entropy Gathering System Calls

Oracle Solaris 11.3 includes two new system calls, `getentropy(2)` and `getrandom(2)`, which are provided for gathering entropy or random bits from the kernel. These system calls are a better choice than using `open(2)` and `read(2)` on `/dev/random` and `/dev/urandom` devices.

For more information, see the getentropy(2) and getrandom(2) man pages.

Named Threads

In Oracle Solaris 11.3, you can now label an application's threads to simplify debugging the application. Observability tools like ps, prstat, and, DTrace can display metrics based on the assigned names. This feature is especially useful for applications such as Java that have many threads.

For more information, see prstat(1M) and pthread_attr_setname_np(3C) man pages.

DTrace noresolve Runtime Option

DTrace now includes the ability to prevent the automatic resolution of userspace symbols through a new runtime option, -x noresolve. This option can be useful when symbol resolution takes a long time for large statically-linked binaries.

DTrace EoIB SDT probes

New DTrace SDT probes in the eoib and eibnx modules provide better observability of the Ethernet over InfiniBand (EoIB) implementation.

Related Information

"REST-based Administrative Interfaces With RAD" on page 13.

Software Features

This section describes the software features in this release. These new features and enhancements add to the existing exhaustive collection of utilities, services, and tools which facilitate enhanced productivity.

Mailman Mailing List Manager

Oracle Solaris 11.3 supports the Mailman mailing list manager, which enables you to manage email accounts and helps list-owners to administer mailing lists easily. Mailman is integrated with the web and supports built-in archiving, automatic bounce processing, content filtering, digest delivery, and spam filters.

For more information, see the documentation in the /usr/share/doc/mailman/ directory.

xmlto Shell Script Tool

You can use the xmlto(1) shell-script tool to convert XML files to various formats. The tool enables you to convert files in DocBook, XHTML 1.0, and XSL-FO formats to different output formats such as AWT, XSL-FO, HTML Help, JavaHelp, MIF, PDF, SVG, XHTML, DVI, HTML, HTML (no chunks), UNIX man, PCL, PostScript, TXT, XHTML (no chunks), and EPUB.

For more information, see the xmlto(1) man page.

Man Page Enhancements

The `man(1)` and `catman(1M)` commands now support `groff` dependent man pages. This enhancement helps in processing man pages delivered from third parties into Oracle Solaris by using the `nroff` extension available in `groff(1)`. This extension renders man pages with a different look and feel, and a width of 78 columns in single long page. Also, for better compatibility, the default pager program has now been changed to `less(1)`. The `-t` option now enables you to view man page output in PostScript format.

For more information, see the `man(1)` and `catman(1M)` man pages.

MySQL Server 5.6

The MySQL software delivers a very fast, multithreaded, multi-user, and robust SQL database server. MySQL Server is intended for mission-critical, heavy-load production systems as well as for embedding into mass-deployed software.

In Oracle Solaris 11.3, MySQL has been updated to version 5.6 which includes enhancements to security, InnoDB, partitioning, and the optimizer, which results in better performance.

For more information, see What's New in MYSQL 5.6 (`https://dev.mysql.com/doc/refman/5.6/en/mysql-nutshell.html`).

New IPS Packages

The following table lists the new packages added in Oracle Solaris 11.3. Many of the packages listed are a direct result of newer versions being included in the repository, along with necessary package refactoring to accommodate multiple Python versions.

TABLE 1 New IPS Packages in Oracle Solaris 11.3

Package Name	Package Description
`cloud/openstack/heat`	OpenStack Heat (Orchestration Service)
`cloud/openstack/openstack-common`	OpenStack Common Package
`compress/pigz`	Parallel implementation of gzip
`crypto/fips-140`	FIPS 140 Cryptographic Framework
`database/mysql-56`	MySQL 5.6 Database Management System
`database/mysql-56/client`	MySQL 5.6 Client Executables
`database/mysql-56/library`	MySQL 5.6 client libraries and plugins
`database/mysql-56/tests`	MySQL 5.6 testsuite
`developer/documentation-tool/help2man`	help2man - tools for creating man pages from help information
`developer/documentation-tool/xml2roff`	xml2roff xslt-stylesheet and script
`developer/documentation-tool/xmlto`	XML documentation format conversion tool
`developer/opensolaris/userland`	Dependencies required to build Userland consolidation
`developer/test/check`	Check is a unit testing framework for C
`diagnostic/nicstat`	nicstat - print network traffic statistics
`driver/crypto/n2rng`	SPARC HW Random Number Provider
`driver/crypto/ncp`	UltraSPARC-T1/T2/T3 Crypto Provider
`driver/graphics/nvidiaR304`	NVIDIA Graphics System Software

Package Name	Package Description
driver/graphics/nvidiaR340	NVIDIA Graphics System Software
driver/network/ethernet/i40e	Intel(R) 40GbE PCIE NIC Driver
driver/network/ethernet/oce	Emulex OneConnect 10GbE Network Driver
library/apr-15	Apache Portable Runtime (APR) 1.5 Shared Libraries
library/apr-util-15	Apache Portable Runtime Utility (APR-util) 1.5 development header files and libraries
library/apr-util-15/apr-ldap	Apache Portable Runtime Utility (APR-util) 1.5 LDAP's stub
library/apr-util-15/dbd-mysql	Apache Portable Runtime Utility (APR-util) 1.5 DBD Driver for MySQL
library/apr-util-15/dbd-sqlite	Apache Portable Runtime Utility (APR-util) 1.5 DBD Driver for SQLite
library/jansson	Jansson - C library for working with JSON data
library/libgsl	A numerical library for C and C++ programmers
library/libmicrohttpd	GNU Libmicrohttpd - C library to make it easy to run an HTTP server inside a process
library/python/alembic	A database migration tool for SQLAlchemy
library/python/alembic-26	A database migration tool for SQLAlchemy
library/python/alembic-27	A database migration tool for SQLAlchemy
library/python/alembic-34	A database migration tool for SQLAlchemy
library/python/amqp	Low-level AMQP client for Python
library/python/amqp-26	Low-level AMQP client for Python
library/python/amqp-27	Low-level AMQP client for Python
library/python/amqp-34	Low-level AMQP client for Python
library/python/anyjson	Python module wrapping the best available JSON implementation with a common interface
library/python/anyjson-26	Python module wrapping the best available JSON implementation with a common interface
library/python/anyjson-27	Python module wrapping the best available JSON implementation with a common interface
library/python/anyjson-34	Python module wrapping the best available JSON implementation with a common interface
library/python/argparse	Python argparse command-line parsing library
library/python/argparse-26	Python argparse command-line parsing library
library/python/babel	Internationalization Utilities for Python
library/python/babel-26	Internationalization Utilities for Python
library/python/babel-27	Internationalization Utilities for Python
library/python/babel-34	Internationalization Utilities for Python
library/python/barbicanclient	Python and command-line clients for the OpenStack Key Management API
library/python/barbicanclient-26	Python and command-line clients for the OpenStack Key Management API
library/python/barbicanclient-27	Python and command-line clients for the OpenStack Key Management API
library/python/beautifulsoup4	Screen-scraping library
library/python/beautifulsoup4-26	Screen-scraping library
library/python/beautifulsoup4-27	Screen-scraping library
library/python/beautifulsoup4-34	Screen-scraping library
library/python/boto	An Amazon Web Services library for Python

Package Name	Package Description
library/python/boto-26	An Amazon Web Services library for Python
library/python/boto-27	An Amazon Web Services library for Python
library/python/cffi-34	Foreign function interface for Python calling C code
library/python/cheetah	A template engine and code generation tool
library/python/cheetah-26	A template engine and code generation tool
library/python/cheetah-27	A template engine and code generation tool
library/python/cherrypy	Pythonic, object-oriented HTTP framework
library/python/cherrypy-26	Pythonic, object-oriented HTTP framework
library/python/cherrypy-27	Pythonic, object-oriented HTTP framework
library/python/cinderclient-34	Python and command-line clients for the OpenStack Block Storage API
library/python/cliff	Command-line interface formulation framework
library/python/cliff-26	Command-line interface formulation framework
library/python/cliff-27	Command-line interface formulation framework
library/python/cliff-34	Command-line interface formulation framework
library/python/cmd2	Extra features for Python cmd module
library/python/cmd2-26	Extra features for Python cmd module
library/python/cmd2-27	Extra features for Python cmd module
library/python/cmd2-34	Extra features for Python cmd module
library/python/cov-core	Plugin core for use by pytest-cov, nose-cov and nose2-cov
library/python/cov-core-26	Plugin core for use by pytest-cov, nose-cov and nose2-cov
library/python/cov-core-27	Plugin core for use by pytest-cov, nose-cov and nose2-cov
library/python/coverage	The coverage.py Python code coverage tool
library/python/coverage-26	The coverage.py Python code coverage tool
library/python/coverage-27	The coverage.py Python code coverage tool
library/python/cssutils	A Python package to parse and build CSS Cascading Style Sheets
library/python/cssutils-26	A Python package to parse and build CSS Cascading Style Sheets
library/python/cssutils-27	A Python package to parse and build CSS Cascading Style Sheets
library/python/d2to1	Allow distutils2-like setup.cfg files with Python 2
library/python/d2to1-26	Allow distutils2-like setup.cfg files with Python 2
library/python/d2to1-27	Allow distutils2-like setup.cfg files with Python 2
library/python/d2to1-34	Allow distutils2-like setup.cfg files with Python 2
library/python/decorator	Python decorator helper module
library/python/decorator-26	Python decorator helper module
library/python/decorator-27	Python decorator helper module
library/python/decorator-34	Python decorator helper module
library/python/django-appconf	Django App helper class
library/python/django-appconf-26	Django App helper class
library/python/django-appconf-27	Django App helper class
library/python/django-pyscss	Django PySCSS helper class
library/python/django-pyscss-26	Django PySCSS helper class
library/python/django-pyscss-27	Django PySCSS helper class
library/python/django_compressor	JavaScript / CSS compressor

Package Name	Package Description
library/python/django_compressor-26	JavaScript / CSS compressor
library/python/django_compressor-27	JavaScript / CSS compressor
library/python/django_openstack_auth	Django authentication backend for use with OpenStack Identity
library/python/django_openstack_auth-26	Django authentication backend for use with OpenStack Identity
library/python/django_openstack_auth-27	Django authentication backend for use with OpenStack Identity
library/python/dogpile.cache-34	A 'dogpile lock' based caching API
library/python/dogpile.core-34	A 'dogpile lock' based locking API
library/python/eventlet	Highly concurrent networking library for Python
library/python/eventlet-26	Highly concurrent networking library for Python
library/python/eventlet-27	Highly concurrent networking library for Python
library/python/eventlet-34	Highly concurrent networking library for Python
library/python/filechunkio	filechunkio represents a chunk of an OS-level file
library/python/filechunkio-26	filechunkio represents a chunk of an OS-level file
library/python/filechunkio-27	filechunkio represents a chunk of an OS-level file
library/python/filechunkio-34	filechunkio represents a chunk of an OS-level file
library/python/formencode	HTML form validation, generation, and conversion package
library/python/formencode-26	HTML form validation, generation, and conversion package
library/python/formencode-27	HTML form validation, generation, and conversion package
library/python/futures	A Java-style futures package for Python
library/python/futures-26	A Java-style futures package for Python
library/python/futures-27	A Java-style futures package for Python
library/python/glance_store	OpenStack Image Service Store Library
library/python/glance_store-26	OpenStack Image Service Store Library
library/python/glance_store-27	OpenStack Image Service Store Library
library/python/greenlet	Lightweight in-process concurrent programming
library/python/greenlet-26	Lightweight in-process concurrent programming
library/python/greenlet-27	Lightweight in-process concurrent programming
library/python/greenlet-34	Lightweight in-process concurrent programming
library/python/httplib2	A comprehensive HTTP client library for Python
library/python/httplib2-26	A comprehensive HTTP client library for Python
library/python/httplib2-27	A comprehensive HTTP client library for Python
library/python/importlib	Python importlib module
library/python/importlib-26	Python importlib module
library/python/iniparse	Accessing and Modifying INI files
library/python/iniparse-26	Accessing and Modifying INI files
library/python/iniparse-27	Accessing and Modifying INI files
library/python/ipaddr	Google's IP address manipulation library
library/python/ipaddr-26	Google's IP address manipulation library
library/python/ipaddr-27	Google's IP address manipulation library
library/python/ipython	Enhanced interactive Python shell
library/python/ipython-26	Enhanced interactive Python shell

Package Name	Package Description
library/python/ipython-27	Enhanced interactive Python shell
library/python/iso8601-34	Simple Python module to parse ISO 8601 dates
library/python/jinja2-34	Full featured template engine for Python
library/python/jsonpatch	Python module for creating and applying JSON Patches
library/python/jsonpatch-26	Python module for creating and applying JSON Patches
library/python/jsonpatch-27	Python module for creating and applying JSON Patches
library/python/jsonpatch-34	Python module for creating and applying JSON Patches
library/python/jsonpointer	Python module for resolving JSON Pointers
library/python/jsonpointer-26	Python module for resolving JSON Pointers
library/python/jsonpointer-27	Python module for resolving JSON Pointers
library/python/jsonpointer-34	Python module for resolving JSON Pointers
library/python/jsonrpclib	Python implementation of JSON-RPC v2.0
library/python/jsonrpclib-26	Python implementation of JSON-RPC v2.0
library/python/jsonrpclib-27	Python implementation of JSON-RPC v2.0
library/python/jsonschema	An implementation of JSON-Schema validation for Python
library/python/jsonschema-26	An implementation of JSON-Schema validation for Python
library/python/jsonschema-27	An implementation of JSON-Schema validation for Python
library/python/jsonschema-34	An implementation of JSON-Schema validation for Python
library/python/keystonemiddleware	Middleware for OpenStack Identity
library/python/keystonemiddleware-26	Middleware for OpenStack Identity
library/python/keystonemiddleware-27	Middleware for OpenStack Identity
library/python/kombu	Messaging framework for Python
library/python/kombu-26	Messaging framework for Python
library/python/kombu-27	Messaging framework for Python
library/python/lcms-26	Python 2.6 bindings for the Little Color Management System
library/python/lcms-27	Python 2.7 bindings for the Little Color Management System
library/python/ldappool	A connection pool for python-ldap
library/python/ldappool-26	A connection pool for python-ldap
library/python/ldappool-27	A connection pool for python-ldap
library/python/lesscpy	Python LESS Compiler
library/python/lesscpy-26	Python LESS Compiler
library/python/lesscpy-27	Python LESS Compiler
library/python/librabbitmq	Python bindings for AMQP Client
library/python/librabbitmq-26	Python bindings for AMQP Client
library/python/librabbitmq-27	Python bindings for AMQP Client
library/python/libxml2-26	The XML library - Python 2.6 bindings
library/python/libxml2-27	The XML library - Python 2.7 bindings
library/python/libxml2-34	The XML library - Python 3.4 bindings
library/python/libxsl-26	The XSLT library - Python 2.6 bindings
library/python/libxsl-27	The XSLT library - Python 2.7 bindings
library/python/locale-services	Locale services library
library/python/locale-services-26	Locale services library
library/python/locale-services-27	Locale services library

Package Name	Package Description
library/python/lockfile	File locking module for Python
library/python/lockfile-26	File locking module for Python
library/python/lockfile-27	File locking module for Python
library/python/lockfile-34	File locking module for Python
library/python/logilab-astng	logilab-astng - Python Abstract Syntax Tree New Generation
library/python/logilab-astng-26	logilab-astng - Python Abstract Syntax Tree New Generation
library/python/logilab-astng-27	logilab-astng - Python Abstract Syntax Tree New Generation
library/python/logilab-common	Common python libraries for logilab applications
library/python/logilab-common-26	Common python libraries for logilab applications
library/python/logilab-common-27	Common python libraries for logilab applications
library/python/lxml	Pythonic bindings for the libxml2 and libxslt libraries
library/python/lxml-26	Pythonic bindings for the libxml2 and libxslt libraries
library/python/lxml-27	Pythonic bindings for the libxml2 and libxslt libraries
library/python/lxml-34	Pythonic bindings for the libxml2 and libxslt libraries
library/python/m2crypto	Python interface for OpenSSL
library/python/m2crypto-26	Python interface for OpenSSL
library/python/m2crypto-27	Python interface for OpenSSL
library/python/mako	Template library written in Python
library/python/mako-26	Template library written in Python
library/python/mako-27	Template library written in Python
library/python/mako-34	Template library written in Python
library/python/markdown	Python implementation of John Gruber's Markdown
library/python/markdown-26	Python implementation of John Gruber's Markdown
library/python/markdown-27	Python implementation of John Gruber's Markdown
library/python/markdown-34	Python implementation of John Gruber's Markdown
library/python/markupsafe	Python HTML string module
library/python/markupsafe-26	Python HTML string module
library/python/markupsafe-27	Python HTML string module
library/python/markupsafe-34	Python HTML string module
library/python/mock	A unittest library for creating mock objects
library/python/mock-26	A unittest library for creating mock objects
library/python/mock-27	A unittest library for creating mock objects
library/python/net-snmp-26	The Net-SNMP - Python 2.6 bindings
library/python/net-snmp-27	The Net-SNMP - Python 2.7 bindings
library/python/netaddr	Python network address manipulation
library/python/netaddr-26	Python network address manipulation
library/python/netaddr-27	Python network address manipulation
library/python/netifaces	Portable access to network interfaces from Python
library/python/netifaces-26	Portable access to network interfaces from Python
library/python/netifaces-27	Portable access to network interfaces from Python
library/python/netifaces-34	Portable access to network interfaces from Python
library/python/networkx	Python language data structures for graphs, digraphs, and multigraphs

Package Name	Package Description
library/python/networkx-26	Python language data structures for graphs, digraphs, and multigraphs
library/python/nose	A unittest-based testing framework for python that makes writing and running tests easier
library/python/nose-26	A unittest-based testing framework for python that makes writing and running tests easier
library/python/nose-27	A unittest-based testing framework for python that makes writing and running tests easier
library/python/nose-34	A unittest-based testing framework for python that makes writing and running tests easier
library/python/nose-cover3	Coverage support for Nose
library/python/nose-cover3-26	Coverage support for Nose
library/python/nose-cover3-27	Coverage support for Nose
library/python/novaclient-34	Python and command-line clients for the OpenStack Compute API
library/python/oauthlib	Manage OAuth request-signing
library/python/oauthlib-26	Manage OAuth request-signing
library/python/oauthlib-27	Manage OAuth request-signing
library/python/oauthlib-34	Manage OAuth request-signing
library/python/openscap	Python $(PYVER) bindings for the Open implementation of SCAP
library/python/openscap-26	Python 2.6 bindings for the Open implementation of SCAP
library/python/openscap-27	Python 2.7 bindings for the Open implementation of SCAP
library/python/ordereddict	Python ordereddict library
library/python/ordereddict-26	Python ordereddict library
library/python/oslo.config-34	Oslo configuration library
library/python/oslo.context	Oslo context library
library/python/oslo.context-26	Oslo context library
library/python/oslo.context-27	Oslo context library
library/python/oslo.context-34	Oslo context library
library/python/oslo.db	The Oslo database handling library
library/python/oslo.db-26	The Oslo database handling library
library/python/oslo.db-27	The Oslo database handling library
library/python/oslo.i18n	Oslo internationalization utilities
library/python/oslo.i18n-26	Oslo internationalization utilities
library/python/oslo.i18n-27	Oslo internationalization utilities
library/python/oslo.i18n-34	Oslo internationalization utilities
library/python/oslo.messaging	Oslo messaging library
library/python/oslo.messaging-26	Oslo messaging library
library/python/oslo.messaging-27	Oslo messaging library
library/python/oslo.middleware	Oslo Middleware library
library/python/oslo.middleware-26	Oslo Middleware library
library/python/oslo.middleware-27	Oslo Middleware library
library/python/oslo.middleware-34	Oslo Middleware library
library/python/oslo.serialization	Oslo JSON serialization library
library/python/oslo.serialization-26	Oslo JSON serialization library
library/python/oslo.serialization-27	Oslo JSON serialization library

Package Name	Package Description
library/python/oslo.utils	Oslo utility library
library/python/oslo.utils-26	Oslo utility library
library/python/oslo.utils-27	Oslo utility library
library/python/oslo.vmware	Oslo VMware library
library/python/oslo.vmware-26	Oslo VMware library
library/python/oslo.vmware-27	Oslo VMware library
library/python/osprofiler	OpenStack Profiler Library
library/python/osprofiler-26	OpenStack Profiler Library
library/python/osprofiler-27	OpenStack Profiler Library
library/python/passlib	A comprehensive password hashing framework for Python
library/python/passlib-26	A comprehensive password hashing framework for Python
library/python/passlib-27	A comprehensive password hashing framework for Python
library/python/passlib-34	A comprehensive password hashing framework for Python
library/python/paste	Tools for using a Web Server Gateway Interface stack
library/python/paste-26	Tools for using a Web Server Gateway Interface stack
library/python/paste-27	Tools for using a Web Server Gateway Interface stack
library/python/paste.deploy	Load, configure, and compose WSGI applications and servers
library/python/paste.deploy-26	Load, configure, and compose WSGI applications and servers
library/python/paste.deploy-27	Load, configure, and compose WSGI applications and servers
library/python/pbr-34	Python Build Reasonableness
library/python/pep8	pep8 - Python style guide checker
library/python/pep8-26	pep8 - Python style guide checker
library/python/pep8-27	pep8 - Python style guide checker
library/python/pep8-34	pep8 - Python style guide checker
library/python/pip	A tool for installing and managing Python packages
library/python/pip-26	A tool for installing and managing Python packages
library/python/pip-27	A tool for installing and managing Python packages
library/python/pip-34	A tool for installing and managing Python packages
library/python/ply	Lex and yacc parsing tools for Python
library/python/ply-26	Lex and yacc parsing tools for Python
library/python/ply-27	Lex and yacc parsing tools for Python
library/python/posix_ipc	POSIX IPC primitives (semaphores, shared memory and message queues) for Python
library/python/posix_ipc-26	POSIX IPC primitives (semaphores, shared memory and message queues) for Python
library/python/posix_ipc-27	POSIX IPC primitives (semaphores, shared memory and message queues) for Python
library/python/posix_ipc-34	POSIX IPC primitives (semaphores, shared memory and message queues) for Python
library/python/prettytable	A simple Python library for displaying data in an ASCII table
library/python/prettytable-26	A simple Python library for displaying data in an ASCII table
library/python/prettytable-27	A simple Python library for displaying data in an ASCII table

Package Name	Package Description
library/python/prettytable-34	A simple Python library for displaying data in an ASCII table
library/python/py	Library with cross-python path, ini-parsing, io, code, log facilities
library/python/py-26	Library with cross-python path, ini-parsing, io, code, log facilities
library/python/py-27	Library with cross-python path, ini-parsing, io, code, log facilities
library/python/py-34	Library with cross-python path, ini-parsing, io, code, log facilities
library/python/pyasn1	Python ASN.1 implementation
library/python/pyasn1-26	Python ASN.1 implementation
library/python/pyasn1-27	Python ASN.1 implementation
library/python/pyasn1-34	Python ASN.1 implementation
library/python/pyasn1-modules	A collection of ASN.1-based protocols modules
library/python/pyasn1-modules-26	A collection of ASN.1-based protocols modules
library/python/pyasn1-modules-27	A collection of ASN.1-based protocols modules
library/python/pyasn1-modules-34	A collection of ASN.1-based protocols modules
library/python/pybonjour	Python bindings for Bonjour / DNS-SD
library/python/pybonjour-26	Python bindings for Bonjour / DNS-SD
library/python/pybonjour-27	Python bindings for Bonjour / DNS-SD
library/python/pybonjour-34	Python bindings for Bonjour / DNS-SD
library/python/pycadf	Python implementation of CADF data model
library/python/pycadf-26	Python implementation of CADF data model
library/python/pycadf-27	Python implementation of CADF data model
library/python/pycairo-27	Python 2.7 bindings for the Cairo graphics library
library/python/pycountry	ISO country, subdivision, language, currency and script definitions
library/python/pycountry-26	ISO country, subdivision, language, currency and script definitions
library/python/pycountry-27	ISO country, subdivision, language, currency and script definitions
library/python/pycountry-34	ISO country, subdivision, language, currency and script definitions
library/python/pycparser-34	Complete C99 parser in pure Python
library/python/pycups	Python bindings for CUPS
library/python/pycups-26	Python language bindings for CUPS
library/python/pycups-27	Python language bindings for CUPS
library/python/pycurl	Python bindings for libcurl
library/python/pycurl-26	Python bindings for libcurl
library/python/pycurl-27	Python bindings for libcurl
library/python/pydns	Python DNS library
library/python/pydns-26	Python DNS library
library/python/pydns-27	Python DNS library
library/python/pyflakes	Passive checker of Python programs
library/python/pyflakes-26	Passive checker of Python programs
library/python/pyflakes-27	Passive checker of Python programs
library/python/pyflakes-34	Passive checker of Python programs

Package Name	Package Description
library/python/pygments	A syntax highlighting package written in Python
library/python/pygments-26	A syntax highlighting package written in Python
library/python/pygments-27	A syntax highlighting package written in Python
library/python/pygments-34	A syntax highlighting package written in Python
library/python/pygobject-27	Python 2.7 bindings for the GObject library
library/python/pygtk2-27	Python 2.7 bindings for the Gtk+ library
library/python/pygtksourceview2-27	Python 2.7 bindings for the gtksourceview library
library/python/pyopenssl	Python interface to the OpenSSL library
library/python/pyopenssl-26	Python interface to the OpenSSL library
library/python/pyopenssl-27	Python interface to the OpenSSL library
library/python/pyopenssl-34	Python interface to the OpenSSL library
library/python/pyorbit-27	Python 2.7 bindings for ORBit
library/python/pyparsing	Python parsing module
library/python/pyparsing-26	Python parsing module
library/python/pyparsing-27	Python parsing module
library/python/pyparsing-34	Python parsing module
library/python/pyrabbit	Pythonic interface to the RabbitMQ Management HTTP API
library/python/pyrabbit-26	Pythonic interface to the RabbitMQ Management HTTP API
library/python/pyrabbit-27	Pythonic interface to the RabbitMQ Management HTTP API
library/python/pyscss	pyScss, a Scss compiler for Python
library/python/pyscss-26	pyScss, a Scss compiler for Python
library/python/pyscss-27	pyScss, a Scss compiler for Python
library/python/pysendfile	Python interface to sendfile(3EXT) library
library/python/pysendfile-26	Python interface to sendfile(3EXT) library
library/python/pysendfile-27	Python interface to sendfile(3EXT) library
library/python/pysendfile-34	Python interface to sendfile(3EXT) library
library/python/pytest	Python testing tool
library/python/pytest-26	Python testing tool
library/python/pytest-27	Python testing tool
library/python/pytest-34	Python testing tool
library/python/pytest-capturelog	A pytest plugin to capture log messages
library/python/pytest-capturelog-26	A pytest plugin to capture log messages
library/python/pytest-capturelog-27	A pytest plugin to capture log messages
library/python/pytest-capturelog-34	A pytest plugin to capture log messages
library/python/pytest-codecheckers	A pytest plugin to add source code sanity checks (pep8 and friends)
library/python/pytest-codecheckers-26	A pytest plugin to add source code sanity checks (pep8 and friends)
library/python/pytest-codecheckers-27	A pytest plugin to add source code sanity checks (pep8 and friends)
library/python/pytest-codecheckers-34	A pytest plugin to add source code sanity checks (pep8 and friends)
library/python/pytest-cov	A pytest plugin for coverage reporting
library/python/pytest-cov-26	A pytest plugin for coverage reporting

Package Name	Package Description
library/python/pytest-cov-27	A pytest plugin for coverage reporting
library/python/python-dbus-27	D-Bus Python 2.7 bindings
library/python/python-extra-27	Supplemental Python libraries and utilities
library/python/python-gnome-27	Python 2.7 support libraries for GNOME
library/python/python-gnome-desktop-27	Python 2.7 support desktop libraries for GNOME
library/python/python-gst-27	Python 2.7 bindings for the GStreamer streaming media framework
library/python/python-imaging	Python's own image processing library
library/python/python-imaging-26	Python's own image processing library
library/python/python-imaging-27	Python's own image processing library
library/python/python-ldap	LDAP client library for Python
library/python/python-ldap-26	LDAP client library for Python
library/python/python-ldap-27	LDAP client library for Python
library/python/python-mysql	MySQL database connector for Python
library/python/python-mysql-26	MySQL database connector for Python
library/python/python-mysql-27	MySQL database connector for Python
library/python/python-notify-27	Python 2.7 bindings for libnotify
library/python/python-twisted	Event-based framework for internet applications
library/python/python-twisted-26	Event-based framework for internet applications
library/python/python-twisted-27	Event-based framework for internet applications
library/python/python-twisted-web2	A HTTP/1.1 Server Framework
library/python/python-twisted-web2-26	A HTTP/1.1 Server Framework
library/python/python-twisted-web2-27	A HTTP/1.1 Server Framework
library/python/python-xdg-27	Python library to access freedesktop.org standards
library/python/python-zope-interface	Zope interfaces package for Python
library/python/python-zope-interface-26	Zope interfaces package for Python
library/python/python-zope-interface-27	Zope interfaces package for Python
library/python/pytz	Python time zone library
library/python/pytz-26	Python time zone library
library/python/pytz-27	Python time zone library
library/python/pytz-34	Python time zone library
library/python/pywbem	Python WBEM Client and Provider Interface
library/python/pywbem-26	Python WBEM Client and Provider Interface
library/python/pywbem-27	Python WBEM Client and Provider Interface
library/python/pyyaml	A YAML parser and emitter for the Python language
library/python/pyyaml-26	A YAML parser and emitter for the Python language
library/python/pyyaml-27	A YAML parser and emitter for the Python language
library/python/pyyaml-34	A YAML parser and emitter for the Python language
library/python/repoze.lru	A tiny LRU cache implementation and decorator for Python
library/python/repoze.lru-26	A tiny LRU cache implementation and decorator for Python
library/python/repoze.lru-27	A tiny LRU cache implementation and decorator for Python
library/python/repoze.lru-34	A tiny LRU cache implementation and decorator for Python

Package Name	Package Description
library/python/requests	Python HTTP for Humans
library/python/requests-26	Python HTTP for Humans
library/python/requests-27	Python HTTP for Humans
library/python/requests-34	Python HTTP for Humans
library/python/retrying	Apache Retry Library
library/python/retrying-26	Apache Retry Library
library/python/retrying-27	Apache Retry Library
library/python/retrying-34	Apache Retry Library
library/python/rfc3986	Validating URI References per RFC 3986
library/python/rfc3986-26	Validating URI References per RFC 3986
library/python/rfc3986-27	Validating URI References per RFC 3986
library/python/routes	A routing package for Python that matches URLs to dicts and vice versa
library/python/routes-26	A routing package for Python that matches URLs to dicts and vice versa
library/python/routes-27	A routing package for Python that matches URLs to dicts and vice versa
library/python/routes-34	A routing package for Python that matches URLs to dicts and vice versa
library/python/saharaclient	Python and command-line clients for the OpenStack Data Processing API
library/python/saharaclient-26	Python and command-line clients for the OpenStack Data Processing API
library/python/saharaclient-27	Python and command-line clients for the OpenStack Data Processing API
library/python/setuptools	Download, build, install, upgrade, and uninstall Python packages easily
library/python/setuptools-26	Download, build, install, upgrade, and uninstall Python packages easily
library/python/setuptools-27	Download, build, install, upgrade, and uninstall Python packages easily
library/python/setuptools-34	Download, build, install, upgrade, and uninstall Python packages easily
library/python/setuptools-git	Setuptools revision control system plugin for Git
library/python/setuptools-git-26	Setuptools revision control system plugin for Git
library/python/setuptools-git-27	Setuptools revision control system plugin for Git
library/python/setuptools-git-34	Setuptools revision control system plugin for Git
library/python/simplegeneric	Simple generic functions
library/python/simplegeneric-26	Simple generic functions
library/python/simplegeneric-27	Simple generic functions
library/python/simplegeneric-34	Simple generic functions
library/python/simplejson	JSON (JavaScript Object Notation) encoder/decoder for Python
library/python/simplejson-26	JSON (JavaScript Object Notation) encoder/decoder for Python
library/python/simplejson-27	JSON (JavaScript Object Notation) encoder/decoder for Python
library/python/simplejson-34	JSON (JavaScript Object Notation) encoder/decoder for Python
library/python/six-34	Python 2 and 3 compatibility utilities

Package Name	Package Description
library/python/sqlalchemy	The Python SQL toolkit and Object Relational Mapper
library/python/sqlalchemy-26	The Python SQL toolkit and Object Relational Mapper
library/python/sqlalchemy-27	The Python SQL toolkit and Object Relational Mapper
library/python/sqlalchemy-34	The Python SQL toolkit and Object Relational Mapper
library/python/sqlalchemy-migrate	Database schema migration for SQLAlchemy
library/python/sqlalchemy-migrate-26	Database schema migration for SQLAlchemy
library/python/sqlalchemy-migrate-27	Database schema migration for SQLAlchemy
library/python/stevedore	Manage dynamic plugins for Python applications
library/python/stevedore-26	Manage dynamic plugins for Python applications
library/python/stevedore-27	Manage dynamic plugins for Python applications
library/python/stevedore-34	Manage dynamic plugins for Python applications
library/python/subversion	Python bindings for the Subversion SCM
library/python/suds	Lightweight SOAP client
library/python/suds-26	Lightweight SOAP client
library/python/suds-27	Lightweight SOAP client
library/python/taskflow	A Python library that provides task execution insurance
library/python/taskflow-26	A Python library that provides task execution insurance
library/python/tempita	A very small text templating language
library/python/tempita-26	A very small text templating language
library/python/tempita-27	A very small text templating language
library/python/tempita-34	A very small text templating language
library/python/tkinter-26	Python bindings to tcl/tk
library/python/tkinter-27	Python 2.7 bindings to tcl/tk
library/python/tkinter-34	Python 3.4 bindings to tcl/tk
library/python/tox	virtualenv-based automation of test activities
library/python/tox-26	virtualenv-based automation of test activities
library/python/tox-27	virtualenv-based automation of test activities
library/python/tox-34	virtualenv-based automation of test activities
library/python/unittest2	Python unit testing framework
library/python/unittest2-26	Python unit testing framework
library/python/virtualenv	Virtual Python Environment builder
library/python/virtualenv-26	Virtual Python Environment builder
library/python/virtualenv-27	Virtual Python Environment builder
library/python/virtualenv-34	Virtual Python Environment builder
library/python/waitress	Waitress WSGI server
library/python/waitress-26	Waitress WSGI server
library/python/waitress-27	Waitress WSGI server
library/python/waitress-34	Waitress WSGI server
library/python/warlock	Python object model built on JSON Schema and JSON Patch
library/python/warlock-26	Python object model built on JSON Schema and JSON Patch
library/python/warlock-27	Python object model built on JSON Schema and JSON Patch
library/python/warlock-34	Python object model built on JSON Schema and JSON Patch

Package Name	Package Description
library/python/webob	WSGI request and response objects
library/python/webob-26	WSGI request and response objects
library/python/webob-27	WSGI request and response objects
library/python/webob-34	WSGI request and response objects
library/python/websockify-34	WebSocket to TCP proxy/bridge
library/python/webtest	Helper to test WSGI applications
library/python/webtest-26	Helper to test WSGI applications
library/python/webtest-27	Helper to test WSGI applications
library/python/wsme	Web Service Made Easy (WSME)
library/python/wsme-26	Web Service Made Easy (WSME)
library/python/wsme-27	Web Service Made Easy (WSME)
library/python/xattr-34	Python wrapper for extended filesystem attributes
library/ruby/hiera	Ruby hierarchical data store
library/ruby/hiera-19	Ruby hierarchical data store
mail/mailman	GNU Mailing List Manager
network/firewall	Solaris Firewall Driver
network/mtr	Graphical ping/traceroute tool
network/openssh	OpenSSH
network/ssh/ssh-utilities	Miscellaneous utilities for Secure Shell (SSH)
runtime/python-34	The Python interpreter, libraries and utilities
runtime/ruby	Ruby, RubyGems, and Rake
runtime/ruby-21	Ruby, RubyGems, and Rake
runtime/ruby-21/ruby-tk	Ruby Tk libraries
service/network/smtp/postfix	Postfix mail system
service/network/ssh-common	Secure Shell (SSH) service and configuration files
shell/watch	Watch - execute a program periodically, showing output full screen
system/io/infiniband/mlnx-tools	Solaris InfiniBand tools
system/io/infiniband/ovn-virtual-io	Oracle OVN virtual io service
system/kernel/crypto	Solaris Kernel Cryptographic Framework
system/library/fortran-runtime	Fortran runtime support libraries
system/library/security/crypto	Core Solaris, (Shared Libs)
system/library/security/pkcs11	Core Solaris, (Shared Libs)
system/library/security/pkcs11_kernel	Core Solaris, (Shared Libs)
system/library/security/pkcs11_softtoken	Core Solaris, (Shared Libs)
system/library/security/pkcs11_tpm	Core Solaris, (Shared Libs)
system/library/sunperf	Sun Performance libraries
system/management/facter-19	Facter - collect and display facts about the system
system/management/puppet-19	Puppet - configuration management toolkit
system/management/rad/module/rad-zfsmgr	RAD ZFS module
text/text-utilities	Additional text utilities
web/java-servlet/tomcat-8	Tomcat Servlet/JSP Container
web/java-servlet/tomcat-8/tomcat-admin	Tomcat Servlet/JSP Container - admin applications
web/java-servlet/tomcat-8/tomcat-examples	Tomcat Servlet/JSP Container - example applications
web/novnc	Browser based VNC client

Package Name	Package Description
web/server/apache-22/module/apache-wsgi-34	Python 3.4 mod_wsgi plugin for Apache Web Server v2.2
web/server/apache-24	Apache Web Server V2.4
web/server/apache-24/module/apache-dbd	SQL database connections plugin for Apache Web Server V2.4
web/server/apache-24/module/apache-dtrace	DTrace plugin for Apache Web Server V2.4
web/server/apache-24/module/apache-fcgid	FastCGI plugin for Apache Web Server V2.4
web/server/apache-24/module/apache-gss	Kerberos authenticating plugin for Apache Web Server V2.4
web/server/apache-24/module/apache-jk	Tomcat Connector plugin for Apache Web Server V2.4
web/server/apache-24/module/apache-ldap	LDAP support plugins for Apache Web Server V2.4
web/server/apache-24/module/apache-lua	Lua support plugin for Apache Web Server V2.4
web/server/apache-24/module/apache-security	Mod Security plugin for Apache Web Server V2.4
web/server/apache-24/module/apache-ssl	SSL (default) support plugin for Apache Web Server V2.4
web/server/apache-24/module/apache-ssl-fips-140	SSL FIPS 140-2 support plugin for Apache Web Server V2.4
web/server/apache-24/module/apache-wsgi-26	Python 2.6 mod_wsgi plugin for Apache Web Server v2.4
web/server/apache-24/module/apache-wsgi-27	Python 2.7 mod_wsgi plugin for Apache Web Server v2.4
web/server/apache-24/module/apache-wsgi-34	Python 3.4 mod_wsgi plugin for Apache Web Server v2.4
x11/modeline-utilities	Utilities for generating modelines
x11/session/dsession	dsession - Dynamic Session Manager

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Part No: E54847

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