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Solaris 11 Developer Webinar Series
Webinar #7

Publishing IPS Packages – Guide for Developers

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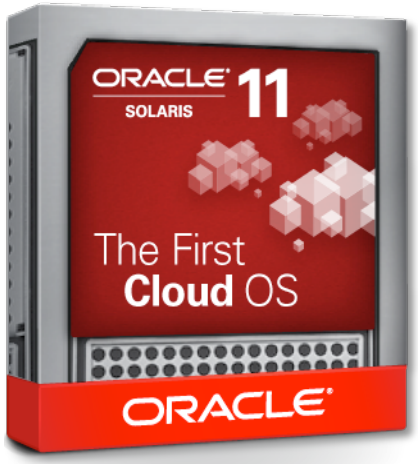

Solaris 11 for Developers Webinar Series

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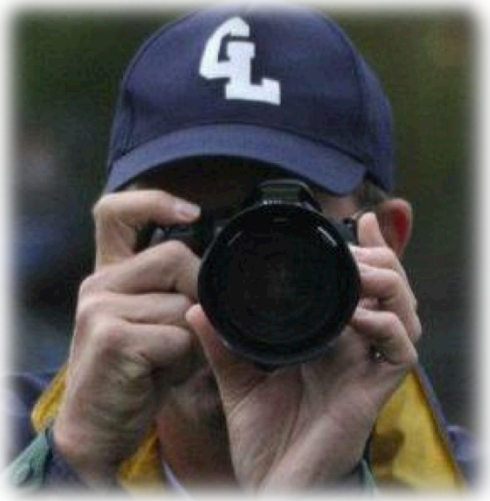
Webinar Series Topic	Date	Speaker
Modern Software Packaging for Enterprise Developers	03-27-12 @ 9am PT	Eric Reid
Simplify Your Development Environment with Zones, ZFS & More	04-10-12 @ 9am PT	Eric Reid & Stefan Schneider
Managing Application Services – Using SMF Manifests in Solaris 11	04-24-12 @ 9am PT	Matthew Hosanee
Optimize Your Applications on Solaris 11: The DTrace Advantage	05-08-12 @ 9am PT	Angelo Rajadurai
Maximize Application Performance and Reliability on Solaris 11	05-22-12 @ 9am PT	Vijay Taktar
Writing Solaris 11 Device Drivers	06-05-12 @ 9am PT	Bill Knoche
Publishing IPS Packages	06-19-12 @ 9am PT	Eric Reid & Brock Pytlik
The World of IPS, Part 2: Tools and Commands	07-17-12 @ 9am PT	Eric Reid & Brock Pytlik
Oracle Solaris Remote Lab	07-31-12 @ 9am PT	Ron Larson & Angelo Rajadurai

Eric Reid
Oracle Systems ISV Engineering

- 24-year Sun/Oracle employee
- Has worked with SunOS/ Solaris/OpenSolaris since 1985
- Home-based employee for Sun/ Oracle since 1996
- Oracle Systems ISV Engineering works closely with our most important Systems and Solaris partners



Yes, I enjoy digital photography…

Brock Pytlik
Oracle Solaris Engineering

- Started at Oracle in 2008
- Has worked on IPS for the last 4 years.

What You'll Learn Today

- IPS Concepts and Terms
- IPS Developer Tools and Commands
- Architectural Considerations when developing IPS Packages
- Creating a Simple IPS Package
- Publishing an IPS Package

Assumption for this Webinar: some knowledge of IPS concepts and consumer-level commands (`pkg(1)`, etc.)

Next webinar (17 July): Advanced IPS topics, including how to implement package 'scripting'

Best Resource for IPS Package Developers

- IPS technology page

http://www.oracle.com/technetwork/server-storage/solaris11/technologies/ips-323421.html

- Whitepaper: *Packaging and Delivering Software with the Image Packaging System: A developer's guide*

http://hub.opensolaris.org/bin/download/Project+pkg/files/ipsdevguide.pdf

- Oracle University Course (Instructor-led or Virtual): *Developing and Deploying Applications on Oracle Solaris 11*

http://education.oracle.com/pls/web_prod-plq-dad/db_pages.getCourseDesc?dc=D73486GC10

Why Should Developers Care About IPS?

- Supported, consistent installation mechanism
  - ...with tools!
- Dependency checking
  - Automatically integrated with OS and other 3rd party packages
- Transparent multi-architecture support
- Fast
- Secure
- Zone support
- Full Solaris Boot Environment support
- ~~Patch~~ Update support
- Standalone or repository (network) install
- One-click install from the web
- Integrated with Solaris Automated Installer
- Integrated with Oracle Enterprise Manager Ops Center

IPS Concepts and Terms - 1

- Action
  - The atomic units of software delivery into IPS
  - Types: `file, directory, link, set, driver, depend, license, user, legacy, signature`
- Manifest
  - A file which describes a collection of Actions
- Package
  - A set of Actions to be taken upon installation, upgrade or removal; described by a Manifest
- Repository
  - A collection of Packages, accessible via HTTP or local filesystem
- Publisher
  - An entity that develops and constructs Packages

IPS Concepts and Terms - 2

- Variant
  - Mechanism to allow a package to be used in multiple situations (multiple CPU architecture; debug/non-debug bits; Global Zone bits vs non-Global Zone bits)
- Facet
  - Mechanism to create optional portions of packages (for locales, man pages, etc.)
- Actuator
  - Tag applied to any action that causes a system change when that action is installed, removed or updated
- Package FMRI
  - Unique Fault Management Resource Identifer
  - Example:

```
pkg://solaris/system/library@0.5.11,5.11-0.175.0.0.0.2.1:20111019T082311Z
```

Publisher Category/Name Version Creation Timestamp

IPS Concepts and Terms - 3

- For Developers:
  - Actions + Manifest ➔ Package
  - Packages ➔ Repository
    Package ➔ Package Archive file (.p5p)
  - Multiple versions of Packages can coexist in Repositories

- For Consumers (target systems):
  - Only one version of a package may be installed at a time
  - Accessing Packages via Repositories:
    - Consumer System subscribes to one or more Publisher's Repositories
    - Packages are identified by use of pkg:// FMRIs
  - Installing Package Archive files:
    - Outside the bounds of Repositories

IPS Developer Tools and Commands - 1 (pkg:/package/pkg)

- `pkgsend(1)`: Publish/update packages
  - `generate` subcommand
    - Create manifest from files/paths/SVR4 package
  - `publish` subcommand
    - Publish package
- `pkgmogrify(1)`: Programmatically edit manifests
- `pkgdepend(1)`: Manage package dependencies
  - `generate` subcommand
    - Generate dependencies for a package by examining package content
  - `resolve` subcommand
    - Resolves package dependencies by examining other packages

IPS Developer Tools and Commands - 2 (pkg:/package/pkg)

- `pkgmerge(1)`: Create multi-variant packages
- `pkglint(1)`: 'Sanity check' one or more package manifests
- `pkgsign(1)`: Cryptographically sign a package
- `pkgrepo(1)`: Create and manage packages repositories
- `pkgfmt(1)`: Make more human-readable manifests

Package Dependencies

- Dependencies are not optional!
- Require: Causes another package to be installed
- Require-any: Installs one of a set of packages
- Conditional: If one package is installed, install a second
- Group: A require that a user can override
- Optional: Establishes a minimum version
- Origin: Establishes a minimum version in the current image
- Incorporate: Constrain the version of another package
- Parent: Incorporate enforced on non-global zones
- Exclude: Prevent another package from being installed

General guidelines

- Fixes or features (any change) means a new version of a package
- Package obsoletion – rarely a good idea
  - Upgrade is prevented if any packages depend on the package
  - Usually a better idea to let the package continue to exist
- Moving files between packages
  - Use an optional dependency to ensure that two packages don't think they both own a path at the same time.
  - If it's an editable file, set the original_name attribute
- Renaming packages – sometimes necessary
  - Old names persist and are mapped accordingly

How to distribute packages

- Network-based package repositories
  - Simplest for customers
  - Useful for diverse customer base
  - Put apache in front of pkg.depotd
- File-based package repositories
  - Typically faster than network-based repositories
  - Useful for internal deployment
- Package archives
  - Useful for disconnected customers
  - Require customers to retrieve archives manually

Creating a Simple IPS Package Planning

- The package creation and publication ‘assembly line’
  1. Lay out your package as you want it – the *proto area*
  2. Create initial manifest from *proto area* with `pkgsend generate`
  3. Modify generated manifest: `pkgmogrify` Step 2 manifest.
     - Add package name, facets, actuators, description, summary, …
     - Modify file layout, permissions, owners …
  4. Evaluate packages dependencies: `pkgdepend generate` on Step 3 manifest
  5. Resolve packages dependencies `pkgdepend resolve` on all Step 4 manifests
  6. Verify: `pkglint` Step 5 manifests to catch any errors
  7. (Optional) Merge: `pkgmerge` the package from different repositories to create multi-variant packages

Creating a Simple IPS Package Example

- We wish to create a package called *mysoftware,* which delivers files under `/opt`
- This package consists of a library, binary, and optional man page
- The library and the binary both depend on the system libc.so.1 library
- The *mysoftware* package will deliver the following files to the system:

```
/opt/mysoftware/lib/mylib.so.1
/opt/mysoftware/bin/mycmd
/opt/mysoftware/man/man1/mycmd.1
```

Creating a Simple IPS Package 'Assembly Line'

1. Lay out your package as you want it – the *proto area*

We'll be working in /proto as a non-privileged user

```
/proto/opt/mysoftware/lib/mylib.so.1
/proto/opt/mysoftware/bin/mycmd
/proto/opt/mysoftware/man/man1/mycmd.1
```

Creating a Simple IPS Package 'Assembly Line'

2. Create initial manifest from *proto area* with `pkgsend generate`

We use `pkgfmt` to make things more readable.

```
$ pkgsend generate proto | pkgfmt > mypkg.p5m.gen
```

This first intermediate file looks like this:

```
dir path=opt group=bin mode=0755 owner=root
dir path=opt/mysoftware group=bin mode=0755 owner=root
dir path=opt/mysoftware/bin group=bin mode=0755 owner=root
dir path=opt/mysoftware/lib group=bin mode=0755 owner=root
dir path=opt/mysoftware/man group=bin mode=0755 owner=root
dir path=opt/mysoftware/man/man1 group=bin mode=0755 owner=root
file opt/mysoftware/bin/mycmd path=opt/mysoftware/bin/mycmd group=bin \
    mode=0755 owner=root
file opt/mysoftware/lib/mylib.so.1 path=opt/mysoftware/lib/mylib.so.1 \
    group=bin mode=0644 owner=root
file opt/mysoftware/man/man1/mycmd.1 path=opt/mysoftware/man/man1/mycmd.1 \
    group=bin mode=0644 owner=root
```

Creating a Simple IPS Package 'Assembly Line'

3. Generate required metadata: `pkgmogrify` Step 2 manifest

We create `mypkg.mog` with metadata to be integrated into the manifest:

```
set name=pkg.fmri value=mypkg@1.0,5.11-0
set name=pkg.summary value="This is our example package"
set name=pkg.description value="This is a full description of \
all the interesting attributes of this example package."
set name=variant.arch value=$(ARCH)
set name=info.classification \
    value=org.opensolaris.category.2008:Applications/Accessories
link path=usr/share/man/index.d/mysoftware target=opt/mysoftware/man
<transform dir path=opt$->drop>
<transform dir file link hardlink path=opt/.+/man(/.+)? -> \
    default facet.doc.man true>
```

We then use pkgmogrify to pull it all together:

```
$ pkgmogrify -DARCH=`uname -p` mypkg.p5m.gen mypkg.mog  | pkgfmt >
mypkg.p5m.mog
```

Creating a Simple IPS Package 'Assembly Line'

4. Evaluate packages dependencies: `pkgdepend generate` on Step 3 manifest

5. Resolve packages dependencies `pkgdepend resolve` on all Step 4 manifests

```
$ pkgdepend generate -md proto mypkg.p5m.mog > mypkg.p5m.dep
$ pkgdepend resolve -m mypkg.p5m.dep
```

Creating a Simple IPS Package 'Assembly Line'

6. Verify: `pkglint` manifests to catch any errors

```
$ pkglint mypkg.p5m.4.res
Lint engine setup…
Starting lint run…
```

7. (Optional): Merge: `pkgmerge` the package from different repositories to create multi-variant packages.

Create a package that:

- Installs on both Sparc and x86
- Includes debug and non-debug bits
- Works in both the global zone and non-global zone

Publishing a Simple IPS Package Deployment

- For development, publishing to a private file repository is best
- For deployment, the choice of the type of repository depends on business and customer needs

Publishing a Simple IPS Package
To local file-based repository

Create the repo under `/scratch`

```
$ pkgrepo create /scratch/my-repository
$ pkgrepo -s /scratch/my-repository set publisher/prefix=mypublisher
$ find /scratch/my-repository/
/scratch/my-repository/
/scratch/my-repository/pkg5.repository
```

Publish the package to the repo, then examine the repo

```
$ pkgsend -s /scratch/my-repository/ publish -d proto mypkg.p5m.4.res
pkg://mypublisher/mypkg@1.0,5.11-0:20120619T034303Z
PUBLISHED
$ pkgrepo -s /scratch/my-repository info
PUBLISHER   PACKAGES STATUS           UPDATED
mypublisher 1        online           2012-06-13T03:43:04.117536Z
```

If desired, this repo can also be served over the network using `pkg.depotd(1M)`. Use an apache proxy if this repository will have much load.

Publishing a Simple IPS Package
Testing the package - 1

As a user with Software Installation privileges (or root) configure the publisher

```
$ sudo pkg set-publisher -p /scratch/my-repository
pkg set-publisher:
  Added publisher(s): mypublisher
```

Install the package:

```
$ sudo pkg install mypkg
           Packages to install:  1
       Create boot environment: No
Create backup boot environment: No
DOWNLOAD                                  PKGS       FILES    XFER (MB)
Completed                                  1/1         3/3      0.7/0.7
PHASE                                        ACTIONS
Install Phase                                  15/15
PHASE                                          ITEMS
Package State Update Phase                       1/1
Image State Update Phase                         2/2
PHASE                                          ITEMS
Reading Existing Index                           8/8
Indexing Packages                                1/1
```

Publishing a Simple IPS Package
Testing the package - 2

Check that the files expected are present and that the metadata is correct.

```
$ find /opt/mysoftware/
/opt/mysoftware/
/opt/mysoftware/bin
/opt/mysoftware/bin/mycmd
/opt/mysoftware/lib
/opt/mysoftware/lib/mylib.so.1
/opt/mysoftware/man
       :

$ pkg info mypkg
          Name: mypkg
       Summary: This is our example package
   Description: This is a full description of all the interesting attributes of
                this example package.
      Category: Applications/Accessories
         State: Installed
     Publisher: mypublisher
       Version: 1.0
       :
```

Resources for Solaris 11 Developers

Recorded Sessions

Webinar Series Topic	Date	Speaker
Writing Oracle Solaris 11 Device Drivers Replay - Slides ✔	06-05-12 @ 9am PT	Bill Knoche (Principal Software Engineer)
Maximize Application Performance and Reliability with Oracle Solaris Studio Replay - Slides ✔	05-22-12 @ 9am PT	Vijay Tatkar (Senior Manager Software Development)
Optimize Your Applications on Oracle Solaris 11: The DTrace Advantage Replay - Slides ✔	05-08-12 @ 9am PT	Angelo Rajadurai (Principal Software Engineer)
Managing Application Services - Using SMF Manifests in Oracle Solaris 11 Replay - Slides ✔	04-24-12 @ 9am PT	Matthew Hosanee (Principal Software Engineer)
Simplify Your Development Environement with Zones, ZFS & More Replay - Slides ✔	04-10-12 @ 9am PT	Eric Reid (Principal Software Engineer) and Stefan Schneid[illegible] (Chief Technolog[illegible] ISV-Engineerin[illegible])
Modern Software Packaging for Enterprise Developers Replay - Slides ✔	03-27-12 @ 9am PT	Eric Re[illegible] (Principal S[illegible]ftware Engi[illegible]er)

Agenda - Next Sessions

- Click on event to register
- All webinars on Tuesday's 9-10am PT (Event will support VOIP)

Webinar Series Topic	Date	Speaker
Publishing IPS Packages	06-19-12 @ 9am PT	Eric Reid (Principal Software Engineer) and Brock Pytlik (Senior Software Engineer
The World of IPS 2: Tools and Commands	07-17-12 @ 9am PT	Eric Reid (Principal Software Engineer) and Brock Pytlik (Senior Software Engineer
Oracle Solaris Remote Lab	07-31-12 @ 9am PT	Ron Larson (Project Manager, ISV Engineering) and Angelo Rajadurai (Principal Software Engineer)

Today's Webinar

Registration:
http://www.oracle.com/technetwork/server-storage/solaris11/overview/webinar-series-1563626.html

Questions

Hardware and Software
Engineered to Work Together

Publishing a Simple IPS Package Alternative: To Package Archive (.p5p)

```
$ pkgrecv -s /scratch/my-repository -a -d myarchive.p5p mypkg
Retrieving packages for publisher mypublisher …
Retrieving and evaluating 1 package(s)…
DOWNLOAD                                  PKGS       FILES    XFER (MB)
Completed                                  1/1         3/3      0.7/0.7
ARCHIVE                                                FILES   STORE (MB)
myarchive.p5p                                          14/14      0.7/0.7
```

Tips and tricks: pkgsend

- Make your build produce a proto area which mirrors how the software should be installed.
- Use -T with files where timestamps matter
    - .py files generated .pyc files if the .py file is older than .pyc files
- Use --target if your proto area has hardlinks for reproducible packaging operations.

Tips and tricks: pkgdepend resolve

- Use -R to decouple build machine from packaging results
  - Resolve usually uses resolves against installed packages
  - -S is an option, but usually leads to unresolved dependencies
  - Create standard reference images and resolve against them
    - `pkgdepend -R <path to image> resolve ...`