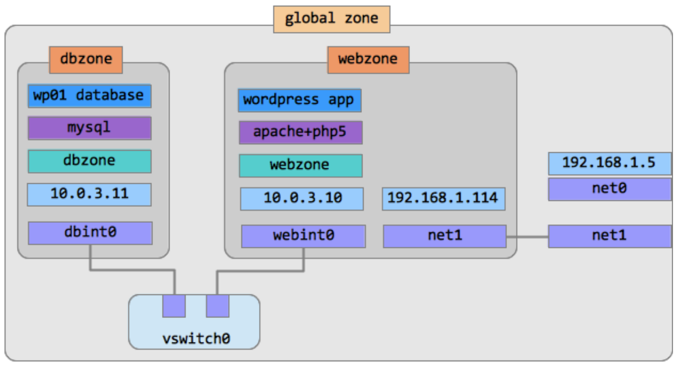
Oracle Solaris 11 Cloud in a Box

Task: You have to configure a secure multi-layered application environment in Oracle Solaris 11.

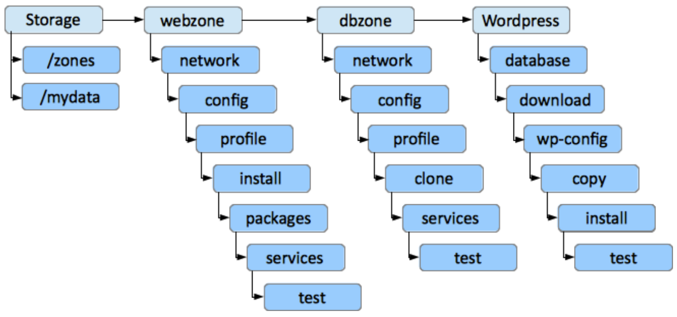
Lab: In this lab we will install a Wordpress blog application in Oracle Solaris 11 zones. We will create two Solaris zones: one for the database server and another for the web server. We will connect the zones via an internal virtual switch to make sure the database zone is connected to the web zone, but not visible from the outside world. The web zone will have two network interfaces: one for internal connection to the database zone and another for external connection.

Here is what we are going to build.



The final configuration will have a database layer, a web layer, an internal virtual network inside the Solaris box to connect them, and an outside connection for clients. It's pretty typical in today's applications and we are going to use this simple model to learn some modern Oracle Solaris 11 features. You can always extend this simple example to more complex architectures.

And here is our action plan:



We are going to perform the following steps to configure the application layer by layer.

1. Storage Layer
   - Create a ZFS file system where we will keep zones' filesystems. Mount it at `/zones`
   - Create a ZFS file system for our database files (later it will be used inside the database zone)
2. Web Layer
   - Create network infrastructure for the zone: virtual switch and VNIC
   - Configure the zone with `zonecfg`
   - Create a system profile for the zone
   - Install the zone from the default package repository
   - Install the necessary packages into the zone
   - Enable the webserver (Apache) service in the zone
   - Test the webserver layer
3. Database Layer
   - Create a VNIC for the zone
   - Configure the zone with zonecfg
   - Create a system profile for the zone
   - Clone the zone from `webzone`
   - Configure the database service to use the separate ZFS filesystem for database files
   - Enable the database (MySQL) service in the zone
   - Test the database layer
4. Application Layer
   - Create a database for the application
   - Download and unpack the Wordpress distribution

- Configure the application using wp-config.php file
- Copy the application files into the webserver directory
- Perform the installation
- Test the installation

Looks scary? Don't worry. You never know what you can do till you try. Let's begin!

Storage Layer

We'll start with creating a separate ZFS filesystem to store zone root directories. It will be created in our root pool and mounted at `/zones`.

```
root@solaris:~# zfs create -o mountpoint=/zones rpool/zones
```

Also we are going to create a separate filesystem to store MySQL data files. We will later assign it to the database zone. This way the database zone administrator can manage this dataset separately: change its compression and deduplication parameters, create snapshots etc.

```
root@solaris:~# zfs create rpool/mydata
```

That was all for the Storage Layer.

Web Layer

Network

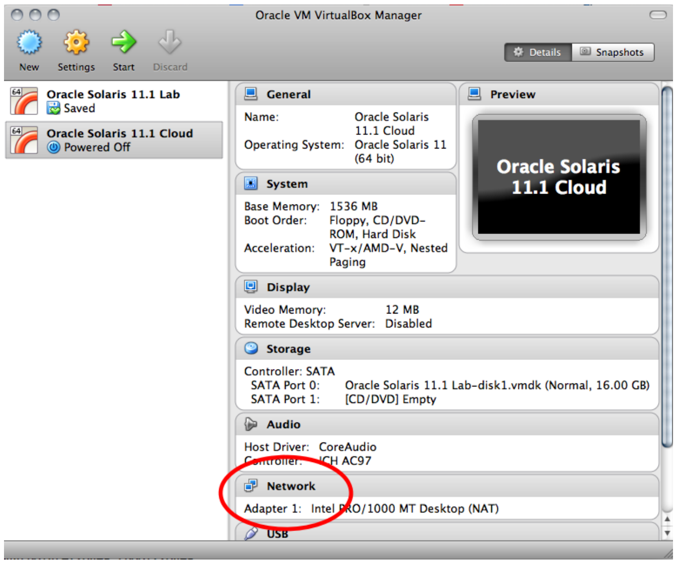
We begin with creating a network infrastructure for the zone. It will include a virtual internal switch and two network interfaces. First network interface will be for internal communication with the database zone. Second network interface will be used for outside communications.

Let's start with the outside connection. In our example we will use the second VirtualBox network interface which is called `net1` in Solaris. Check if you have two network interfaces configured in your virtual machine:

```
root@solaris:~# dladm show-phys
LINK              MEDIA                STATE      SPEED  DUPLEX    DEVICE
net0              Ethernet             up         1000   full      e1000g0
net1              Ethernet             up         1000   full      e1000g1
```

If there is only one network interface you have to *power off* your virtual machine and add the second network interface using VirtualBox Manager. Configure it as "Bridged Adapter".

Use the following screenshots as a guidance.



General
Name: Oracle Solaris 11.1 Cloud
Operating System: Oracle Solaris 11 (64 bit)

System
Base Memory: 1536 MB
Boot Order: Floppy, CD/DVD-ROM, Hard Disk
Acceleration: VT-x/AMD-V, Nested Paging

Display
Video Memory: 12 MB
Remote Desktop Server: Disabled

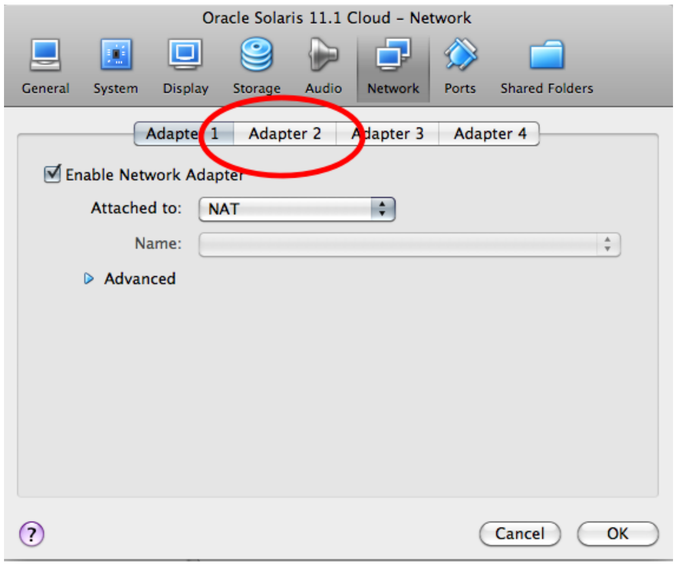
Storage
Controller: SATA
SATA Port 0: Oracle Solaris 11.1 Lab-disk1.vmdk (Normal, 16.00 GB)
SATA Port 1: [CD/DVD] Empty

Audio
Host Driver: CoreAudio
Controller: ICH AC97

Network
Adapter 1: Intel PRO/1000 MT Desktop (NAT)

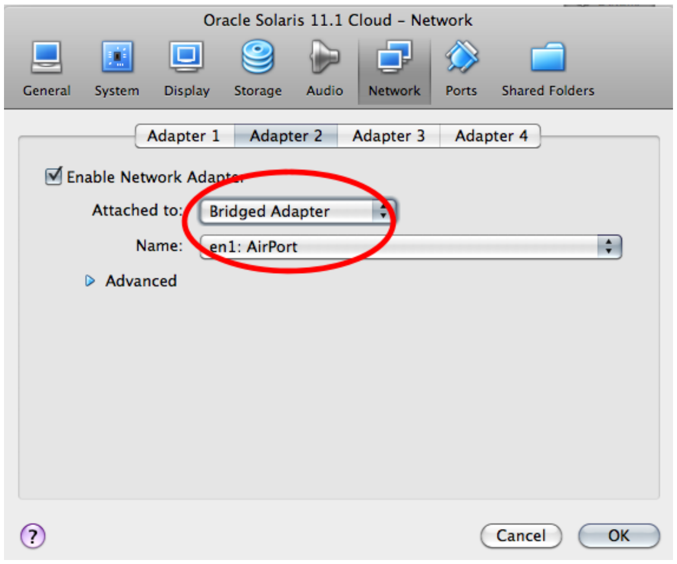
USB

Here is only one network configured. Press "Network".



☑ Enable Network Adapter
Attached to: NAT
Name:

Only one NIC is enabled. Press "Adapter 2".



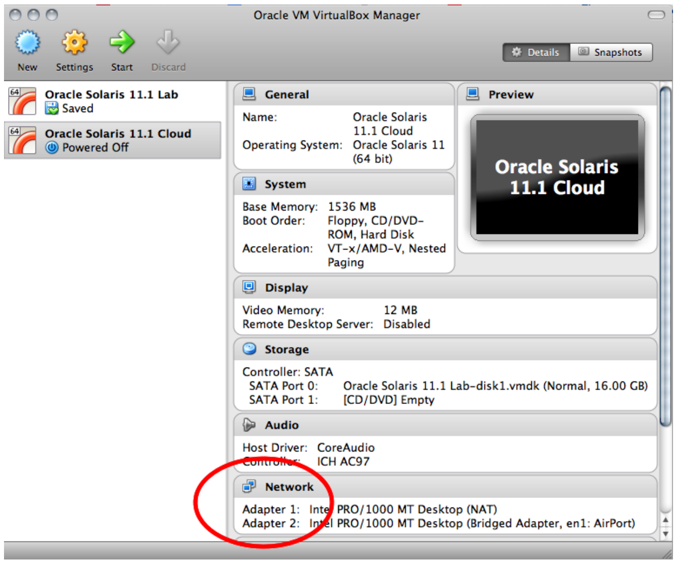
☑ Enable Network Adapter

Attached to: Bridged Adapter

Name: en1: AirPort

▷ Advanced

Make sure you've chosen "Bridged Ethernet" for the second adapter.



Oracle Solaris 11.1 Lab
Saved

Oracle Solaris 11.1 Cloud
Powered Off

General

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Audio

Host Driver: CoreAudio
Controller: ICH AC97

Network

Adapter 1: Intel PRO/1000 MT Desktop (NAT)
Adapter 2: Intel PRO/1000 MT Desktop (Bridged Adapter, en1: AirPort)

Here is how it should look like with two networks.

After this is done, boot your Oracle Solaris 11 virtual machine again and check with '`dladm show-phys`' that you have two network interfaces now.

Most likely, now `net1` is already used by the global zone because it had received its IP address from your local DHCP server. Check it:

```
root@solaris:~# ipadm show-addr net1
ADDROBJ            TYPE     STATE        ADDR
net1/v4            dhcp     ok           192.168.1.114/24
net1/v6            addrconf ok           fe80::a00:27ff:fe42:ee04/10
```

To be able to use the datalink `net1` in our `webzone` we have to disable the IP stack associated with it:

```
root@solaris:~# ipadm delete-ip net1
root@solaris:~# ipadm show-addr net1
ipadm: cannot get address information: No such interface
```

At the same time `net1` still exists as datalink:

```
root@solaris:~# dladm show-link net1
LINK                CLASS     MTU    STATE    OVER
```

```
net1                phys      1500   up       --
```

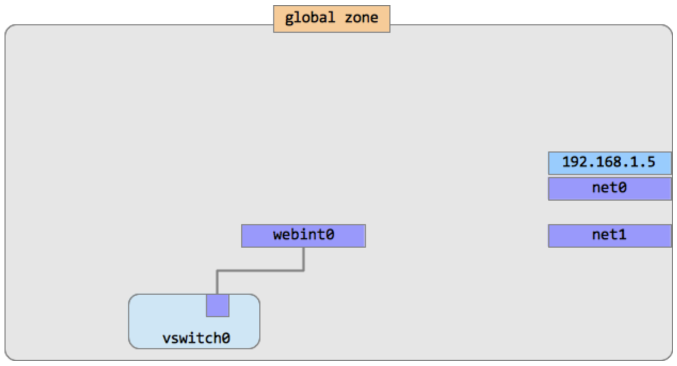
OK, `net1` is ready for use by our zone. Now we will create a virtual Ethernet switch, or *etherstub*.

```
root@solaris:~# dladm create-etherstub vswitch0
```

Then we create a Virtual NIC (VNIC) for internal connections which is connected to that virtual switch.

```
root@solaris:~# dladm create-vnic -l vswitch0 webint0
```

Now we have two network interfaces for use in this zone.



Zone configuration

At this step we'll configure our web layer zone which is called `webzone`.

```
root@solaris:~# zonecfg -z webzone
zonecfg:webzone> create
zonecfg:webzone> set zonepath=/zones/webzone
zonecfg:webzone> add net
zonecfg:webzone:net> set physical=webint0
zonecfg:webzone:net> end
zonecfg:webzone> add net
zonecfg:webzone:net> set physical=net1
zonecfg:webzone:net> end
zonecfg:webzone> exit
```

Zone is configured, but not installed yet. We can install it right now, but in that case after the first boot we will have to login into it and create a system profile which includes hostname, time zone, root password etc. Not very convenient. We want to have our zone ready to use right after the first boot, so we will create its profile before the installation and then use it. This way it is also pretty easy to automate the process of future zone creation.

Zone's system profile

Use the `sysconfig` command to create a system profile for `webzone`:

```
root@solaris:~# sysconfig create-profile -o /root/webzone-profile.xml
```

In the dialog screens set the following system's parameters:

```
Computer Name: webzone
Network connection: None (we will configure networking later from within the zone)
Time Zone: select your time zone (hint: when selecting the country, press its first letter, e.g. U for Unites States)
Root password: solaris1
User real name: Zone User
User id: zuser
User password: oracle1
everything else: accept the defaults, just press F2 or ESC-2 to continue.
```

Zone installation

And now install the zone:

```
root@solaris:~# zoneadm -z webzone install -c /root/webzone-profile.xml
```

It will take about 10 minutes depending on your computer and network connection.

When the installation is completed we have to 1) configure the zone's networking and 2) install the necessary packages. Let's start with the networking part.

```
root@solaris:~# zoneadm -z webzone boot
...wait a couple of minutes...
root@solaris:~# zlogin -C webzone
[Connected to zone 'webzone' console]
Hostname: webzone

webzone console login: zuser
Password: oracle1 (not displayed)
Last login: Thu Apr 25 11:54:37 on console
Oracle Corporation      SunOS 5.11      11.1    September 2012
zuser@webzone:~$ su -
root@webzone:~#
```

Let's take a look at our network configuration.

```
root@webzone:~# ipadm
NAME              CLASS/TYPE STATE        UNDER      ADDR
lo0               loopback   ok           --         --
   lo0/v4         static     ok           --         127.0.0.1/8
   lo0/v6         static     ok           --         ::1/128
root@webzone:~# dladm
LINK                CLASS     MTU    STATE    OVER
net1                phys      1500   up       --
webint0             vnic      9000   unknown  ?
net0                vnic      1500   up       ?
```

OK, we don't have any IP addresses configured, but we have three datalinks available. Why three? We have configured only two interfaces using `zonecfg`. The third network interface, `net0`, is configured for us automatically. Even if we didn't configure any network in `zonecfg`, we would still have an automatic datalink `net0`.

Now let's configure our IP interfaces for this zone. We need one interface to communicate with the outside world and we are going to use `net1` for that. I am going to use my home router's DHCP server to get the address, so I configure net1 in the following way:

```
root@webzone:~# ipadm create-ip net1
root@webzone:~# ipadm create-addr -T dhcp net1
Jun 25 14:51:07 webzone in.routed[19810]: route 0.0.0.0/8 --> 0.0.0.0 nexthop is not directly connected
net1/v4
root@webzone:~# ipadm
NAME              CLASS/TYPE STATE        UNDER      ADDR
lo0               loopback   ok           --         --
   lo0/v4         static     ok           --         127.0.0.1/8
   lo0/v6         static     ok           --         ::1/128
net1              ip         ok           --         --
   net1/v4        dhcp       ok           --         192.168.1.114/24
```

Looks good so far. Check if you can ping your router:

```
root@webzone:~# ping 192.168.1.1
ping: sendto Network is unreachable
```

What?? Is something wrong with my routing table? Check it:

```
root@webzone:~# netstat -nr

Routing Table: IPv4
  Destination           Gateway           Flags  Ref     Use     Interface
-------------------- -------------------- ----- ----- ---------- ---------
default              192.168.1.1          UG        1          0 net1
127.0.0.1            127.0.0.1            UH        2         74 lo0
192.168.1.0          192.168.1.114        U         3          1 net1

Routing Table: IPv6
  Destination/Mask            Gateway                   Flags Ref   Use    If
--------------------------- --------------------------- ----- --- ------- -----
::1                         ::1                         UH      2       0 lo0
```

No, it looks good! What's the problem then? The answer is: "Secure by Default" mode in Solaris which enables strict firewall rules automatically when you manually create a network interface. Check the firewall configuration:

```
root@webzone:~# ipfstat -io
block out log all
pass out quick on lo0 all
pass out quick proto udp from any to any port = bootps
block in log all
pass in quick on lo0 all
pass in quick proto udp from any to any port = bootpc
```

The firewall is enabled and it blocks all our connections! Interesting to note that in Solaris 11 we use "exclusive IP" configuration by default with zones and that allows you to configure firewall rules on a per-zone basis. For our lab we will just disable the firewall service, but in real life you should implement some real filtering rules according to your security policy.

```
root@webzone:~# svcadm disable svc:/network/ipfilter
root@webzone:~# ping 192.168.1.1
192.168.1.1 is alive
root@webzone:~# ping 8.8.8.8
8.8.8.8 is alive
```

OK, not only our local router is accessible, but also the outside network (Google's DNS server) can be reached as well. What about Oracle Solaris repository? Can we ping `oracle.com`?

```
root@webzone:~# ping oracle.com
ping: unknown host oracle.com
```

That means that our DNS server is not configured. In Solaris 11 some changes were introduced in configuring network naming services. Now it's not enough just to edit /etc/resolv.conf file to get it done. In Solaris 11 services' configurations are stored within those services, not separately from them. This makes services framework more robust and less error-prone. So, we have to change the `dns/client` service's configuration.

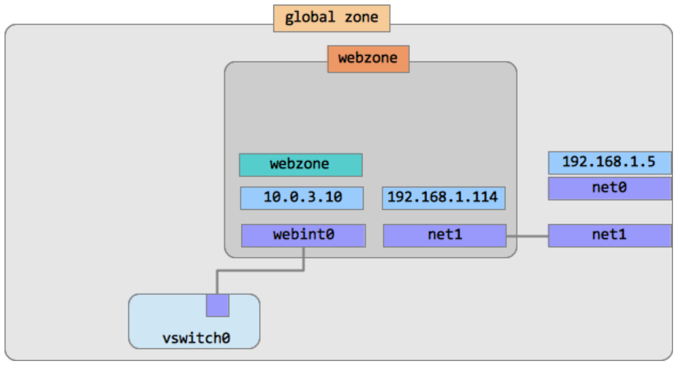
```
root@solaris:~# svccfg -s dns/client 'setprop config/nameserver = net_address: 192.168.1.1'
root@solaris:~# svccfg -s name-service/switch 'setprop config/host = astring: "files dns" '
root@solaris:~# svcadm refresh name-service/switch
root@solaris:~# svcadm refresh dns/client
root@webzone:~# svcadm disable dns/client
root@webzone:~# svcadm enable dns/client
root@webzone:~# ping oracle.com
oracle.com is alive
```

Now we have to configure another interface for our internal communications. We have `webint0` datalink available for that. Let's create an IP interface on top of webint0 and then assign the IP address to it.

```
root@webzone:~# ipadm create-ip webint0
root@webzone:~# ipadm create-addr -a local=10.0.3.10/24 webint0/v4
root@webzone:~# ipadm
NAME              CLASS/TYPE STATE        UNDER      ADDR
lo0               loopback   ok           --         --
   lo0/v4         static     ok           --         127.0.0.1/8
   lo0/v6         static     ok           --         ::1/128
net1              ip         ok           --         --
   net1/v4        dhcp       ok           --         192.168.1.114/24
webint0           ip         ok           --         --
   webint0/v4     static     ok           --         10.0.3.10/24
```

To finish with the networking part, let's add hostnames of our zones to `/etc/hosts`. We will need this for the Wordpress installation.

```
root@webzone:~# echo '10.0.3.10 webzone' >> /etc/hosts
root@webzone:~# echo '10.0.3.11 dbzone' >> /etc/hosts
```



Packages

Now we can install packages. We could install separate sets of packages into webzone and dbzone, but for simplicity sake we will install the full set of AMP (Apache, MySQL, PHP) packages into webzone and then clone it into dbzone. We will use the 'pkg' command which is new in Solaris 11.

```
root@webzone:~# pkg install amp
```

Check:

```
root@webzone:~# pkg list *apache*
root@webzone:~# pkg list *php*
root@webzone:~# pkg list *mysql*
```

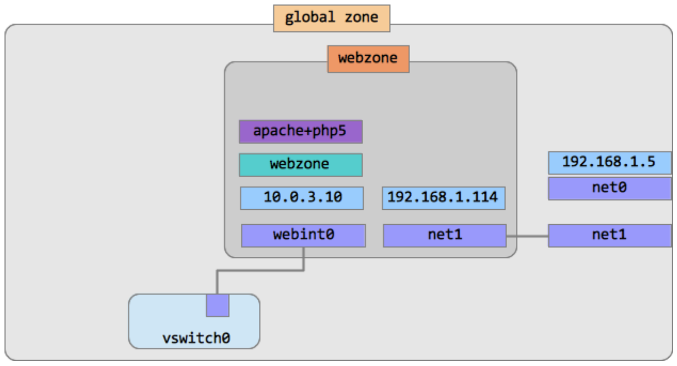
Make sure all the packages have the letter 'i' in the right column, which means "installed".

Start the web server service and check if it's running OK.

```
root@webzone:~# svcadm enable apache22
root@webzone:~# svcs apache22
STATE          STIME    FMRI
online         12:59:06 svc:/network/http:apache22
```

In your Solaris desktop open the Firefox browser and enter the webzone's external IP address (the one assigned to net1, in my case it's 192.168.1.114) into the address line. The page should read **"It works!"**.

Now our webzone is fully configured. In the next step of this lab we are going to clone it to create dbzone. To clone a zone we have to halt it first.



```
root@webzone:~# exit
root@solaris:~# zoneadm -z webzone halt
```

Database Layer

At the next step we will create a database server zone. Instead of installing it (and waiting another 10 minutes) we will just clone our existing zone to save time and disk space. So, we repeat the first two steps (configuration and profile creation) and then replace the third one with the cloning operation. But before that we have to create a virtual NIC which we will use inside the zone.

Network

We want the database zone to be connected only internally to `webzone`, so we'll create a virtual NIC which is connected to the virtual switch we have created before.

```
root@solaris:~# dladm create-vnic -l vswitch0 dbint0
```

Zone configuration

As this zone will be running the database part of our application, we called it `dbzone`. In this configuration we set the path where the zone will be located (`/zones/dbzone`), its network interface (`dbint0`) and also we assign the dataset we have created in the very beginning of the lab (`rpool/mydata`) to use inside the zone.

```
root@solaris:~# zonecfg -z dbzone
zonecfg:dbzone> create
zonecfg:dbzone> set zonepath=/zones/dbzone
zonecfg:dbzone> add net
zonecfg:dbzone:net> set physical=dbint0
zonecfg:dbzone:net> end
zonecfg:dbzone> add dataset
zonecfg:dbzone:dataset> set name=rpool/mydata
zonecfg:dbzone:dataset> end
zonecfg:dbzone> exit
```

Zone's system profile

Next, we have to create the zone's profile where we configure networking, passwords, time zone etc. It's very similar to the one we have created for `webzone`.

```
root@solaris:~# sysconfig create-profile -o /root/dbzone-profile.xml
```

In the dialog screens set the following system's parameters (use F2 or ESC-2 to go from screen to screen):

```
Computer Name: dbzone
Network connection: None
Time Zone: select your time zone (hint: when selecting a country, press its first letter, e.g. U for Unites States)
Root password: solaris1
User real name: Zone User
User id: zuser
User password: oracle1
everything else: accept the defaults, just press F2 or ESC-2 to continue.
```

Zone cloning

Now we can clone `webzone` into `dbzone`:

```
root@solaris:~# zoneadm -z dbzone clone -c /root/dbzone-profile.xml webzone
```

How long did it take? It was much faster than initial installation, wasn't it?

You may want to check the disk sizes of both zones:

```
root@solaris:~# zfs list rpool/zones rpool/zones/webzone rpool/zones/dbzone
NAME                 USED  AVAIL  REFER  MOUNTPOINT
rpool/zones          624M  8.45G    33K  /zones
rpool/zones/dbzone   363K  8.45G    35K  /zones/dbzone
rpool/zones/webzone  624M  8.45G    33K  /zones/webzone
```

Isn't it cool to have two zones installed using disk space of only one?

Boot both zones and then login into `dbzone` to check if everything is all right.

Testing

```
root@solaris:~# zoneadm -z webzone boot
```

```
root@solaris:~# zoneadm -z dbzone boot
...You may need to wait for a couple of minutes or more...
root@solaris:~# zlogin -C dbzone
[Connected to zone 'dbzone' console]
Hostname: dbzone
Apr 25 16:19:39 dbzone sendmail[3606]: My unqualified host name (dbzone) unknown; sleeping for retry

dbzone console login: zuser
Password: oracle1 (not displayed)
Last login: Thu Apr 25 11:54:37 on console
Oracle Corporation      SunOS 5.11      11.1    September 2012
zuser@dbzone:~$ su -
root@dbzone:~#
```

Check what was cloned from `webzone`. Remember, we have installed `apache`, `php` and `mysql` paskages in `webzone`? Check if they are installed here:

```
root@dbzone:~# pkg list *apache*
root@dbzone:~# pkg list *php*
root@dbzone:~# pkg list *mysql*
```

Yes, they are! But wait, there is more! Even the webserver is up and running in our cloned zone:

```
root@dbzone:~# svcs apache22
STATE          STIME    FMRI
online         13:07:06 svc:/network/http:apache22
```

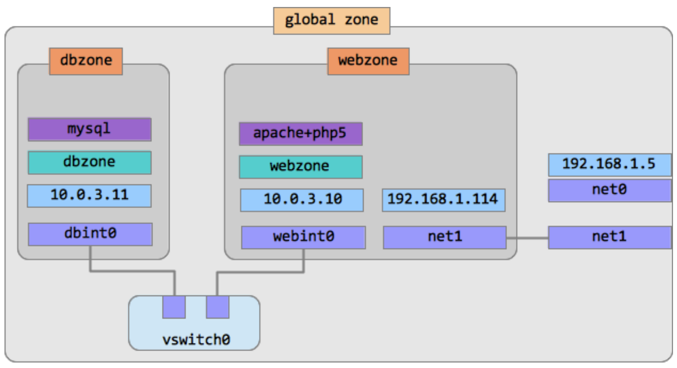
We don't need it here, in the database zone. Stop it:

```
root@dbzone:~# svcadm disable apache22
```

We haven't configured the networking part in the system profile. It's time to do it now.

```
root@dbzone:~# ipadm create-ip dbint0
root@dbzone:~# ipadm create-addr -a local=10.0.3.11/24 dbint0/v4
root@dbzone:~# ipadm
NAME              CLASS/TYPE STATE        UNDER      ADDR
dbint0            ip         ok           --         --
   dbint0/v4      static     ok           --         10.0.3.11/24
lo0               loopback   ok           --         --
   lo0/v4         static     ok           --         127.0.0.1/8
   lo0/v6         static     ok           --         ::1/128
root@dbzone:~# ping 10.0.3.10
root@dbzone:~# ping webzone
webzone is alive
```

That's all we need--to be able to talk to `webzone`. Note that we can access `webzone` by name: that means we have cloned the `/etc/hosts` file as well. Very convenient!



Services

We have to start the database service in this zone, similarly to the web server we have started in `webzone`. But before that we have to configure MySQL to use our ZFS dataset instead of the default `/var/mysql/data`. First, check if it's there:

```
root@dbzone:~# zfs list
NAME                        USED  AVAIL  REFER  MOUNTPOINT
mydata                       31K  7.64G    31K  /mydata
```

```
rpool                      41.7M  7.64G    31K  /rpool
rpool/ROOT                 41.6M  7.64G    31K  legacy
rpool/ROOT/solaris-0       41.6M  7.64G   658M  /
rpool/ROOT/solaris-0/var    408K  7.64G  53.7M  /var
rpool/VARSHARE               20K  7.64G    45K  /var/share
rpool/export               74.5K  7.64G    32K  /export
rpool/export/home          53.5K  7.64G    32K  /export/home
rpool/export/home/zuser    32.5K  7.64G  32.5K  /export/home/zuser
```

Now we have to change ownership and permissions for this directory:

```
root@dbzone:~# chown -R mysql:mysql /mydata
root@dbzone:~# chmod -R 700 /mydata
```

Tell MySQL service that we are going to use different directory for data:

```
root@dbzone:~# svccfg -s mysql:version_51 setprop mysql/data=/mydata
root@dbzone:~# svcadm refresh mysql:version_51
```

Now we can enable the MySQL service and check if it works:

```
root@dbzone:~# svcadm enable mysql
root@dbzone:~# mysql -u root
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 1
Server version: 5.1.37 Source distribution

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql>
```

Great, the database server works too!

Wordpress

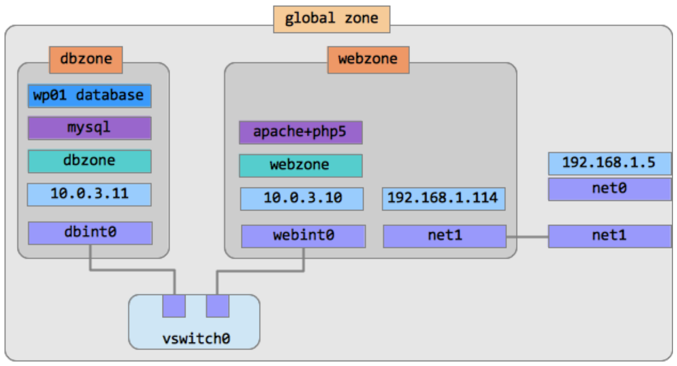
Time to install the application. While we are still in the database zone and logged into the MySQL monitor, let's create the database we need for Wordpress (we call it `wp01` here).

```
mysql> create database wp01;
```

Add access privileges for user '`wordpress`' from host '`webzone`' with password '`oracle1`':

```
mysql> grant all privileges on wp01.* to 'wordpress'@'webzone' identified by 'oracle1';
mysql> flush privileges;
mysql> quit;
root@dbzone:~#
```

That's all for the database part.



```
root@dbzone:~# exit
root@solaris:~#
```

Now log in to `webzone`, download and unpack the Wordpress distribution.

```
root@solaris:~# zlogin webzone
root@webzone:~# wget http://wordpress.org/latest.zip
root@webzone:~# unzip latest.zip
```

Now we have to enter our database parameters into Wordpress configuration. Rename the `wp-config-sample.php` file to `wp-config.php`.

```
root@webzone:~# cd wordpress
root@webzone:~/wordpress# mv wp-config-sample.php wp-config.php
```

Enter database details in `wp-config.php`

```
root@solaris:~/wordpress# vi wp-config.php
```

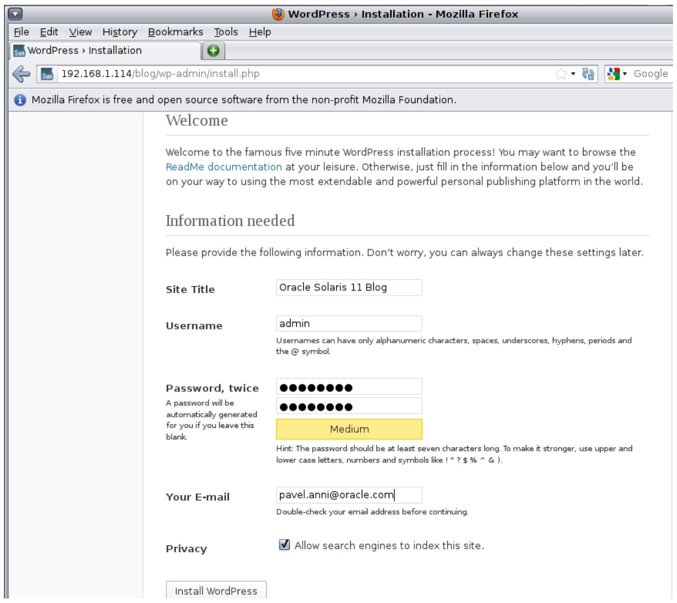
Edit the following lines:

```
// ** MySQL settings - You can get this info from your web host ** //
/** The name of the database for WordPress */
define('DB_NAME', 'wp01');

/** MySQL database username */
define('DB_USER', 'wordpress');

/** MySQL database password */
define('DB_PASSWORD', 'oracle1');

/** MySQL hostname */
define('DB_HOST', 'dbzone');
```

Now we have to copy the Wordpress distribution to the webserver document root. We can do it from the global zone:

```
root@webzone:~/wordpress# mkdir /var/apache2/2.2/htdocs/blog/
root@webzone:~/wordpress# cp -r * /var/apache2/2.2/htdocs/blog/
```

Now your can install Wordpress from your browser, either from your global zone or from other computer in the same network. Open the browser and enter the URL `http://192.168.1.114/blog/wp-admin/install.php` (replace `192.168.1.114` with your `net1` address). The rest is easy. Enter the name of the blog, your administrator's login name ('admin' by default) and the password ('solaris1', for example).



WordPress › Installation - Mozilla Firefox

192.168.1.114/blog/wp-admin/install.php

Mozilla Firefox is free and open source software from the non-profit Mozilla Foundation.

Welcome

Welcome to the famous five minute WordPress installation process! You may want to browse the ReadMe documentation at your leisure. Otherwise, just fill in the information below and you'll be on your way to using the most extendable and powerful personal publishing platform in the world.

Information needed

Please provide the following information. Don't worry, you can always change these settings later.

Site Title: Oracle Solaris 11 Blog

Username: admin

Usernames can have only alphanumeric characters, spaces, underscores, hyphens, periods and the @ symbol.

Password, twice: ●●●●●●●● / ●●●●●●●● — Medium

A password will be automatically generated for you if you leave this blank.

Hint: The password should be at least seven characters long. To make it stronger, use upper and lower case letters, numbers and symbols like ! " ? $ % ^ &).

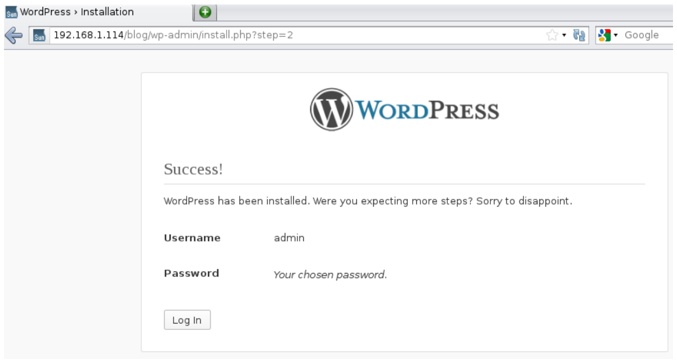
Your E-mail: pavel.anni@oracle.com

Double-check your email address before continuing.

Privacy: ✓ Allow search engines to index this site.

Install WordPress

Now you have to wait for a while (couple of minutes or so) until you see this:



192.168.1.114/blog/wp-admin/install.php?step=2

Success!

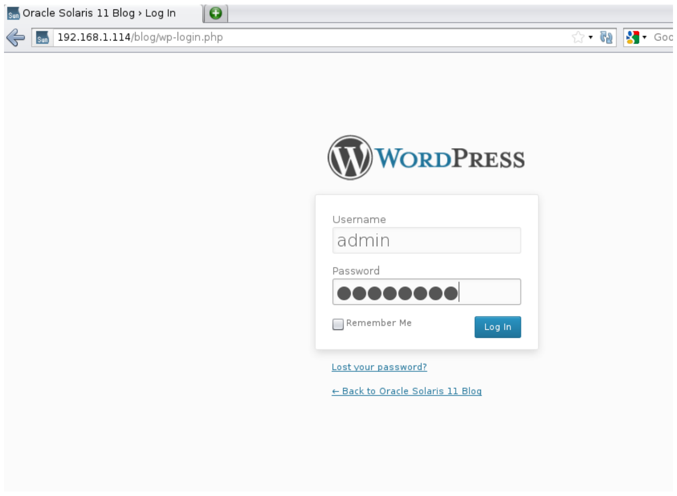
WordPress has been installed. Were you expecting more steps? Sorry to disappoint.

Username: admin

Password: *Your chosen password.*

Log In

Now check if it works. Log in with your admin login name and password:



Oracle Solaris 11 Blog › Log In

192.168.1.114/blog/wp-login.php

Username: admin

Password: ●●●●●●●●

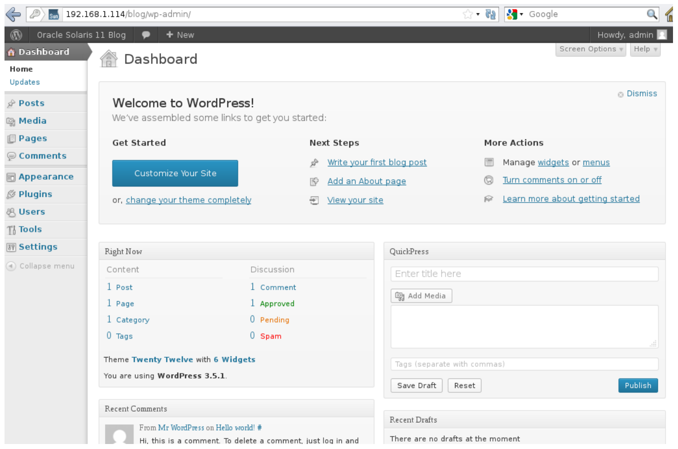
Remember Me

Log In

Lost your password?

← Back to Oracle Solaris 11 Blog

After the login you should see your blog's dashboard:



192.168.1.114/blog/wp-admin/

Oracle Solaris 11 Blog   + New   Howdy, admin

Dashboard

Welcome to WordPress!
We've assembled some links to get you started:

Get Started
Customize Your Site
or, change your theme completely

Next Steps
Write your first blog post
Add an About page
View your site

More Actions
Manage widgets or menus
Turn comments on or off
Learn more about getting started

Right Now

Content		Discussion	
1	Post	1	Comment
1	Page	1	Approved
1	Category	0	Pending
0	Tags	0	Spam

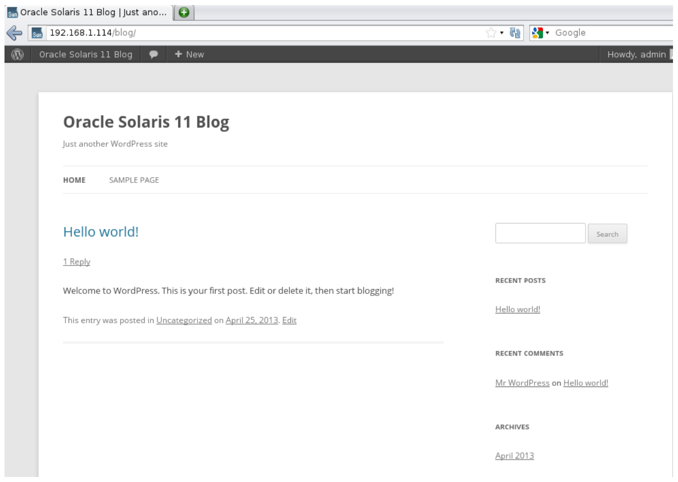
Theme Twenty Twelve with 6 Widgets
You are using WordPress 3.5.1.

QuickPress
Enter title here
Tags (separate with commas)

Recent Comments
From Mr WordPress on Hello world! #
Hi, this is a comment. To delete a comment, just log in and

Recent Drafts
There are no drafts at the moment

Click on "Oracle Solaris 11 Blog" in the top left corner and you will see your blog:



Oracle Solaris 11 Blog | Just ano...
192.168.1.114/blog/

Oracle Solaris 11 Blog   + New   Howdy, admin

Oracle Solaris 11 Blog
Just another WordPress site

HOME   SAMPLE PAGE

Hello world!
1 Reply
Welcome to WordPress. This is your first post. Edit or delete it, then start blogging!
This entry was posted in Uncategorized on April 25, 2013. Edit

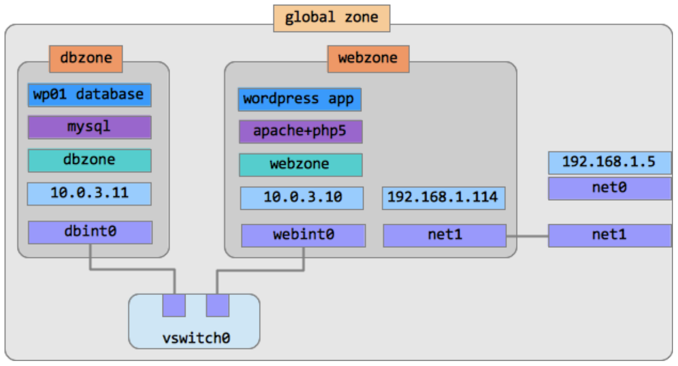
RECENT POSTS
Hello world!

RECENT COMMENTS
Mr WordPress on Hello world!

ARCHIVES
April 2013

Success!

Here is our final architecture:



Resource monitoring

Now afer we have installed our web application and put it into production, we want to know how much resources it uses. Eventually, running our "cloud in a box" we will be able to report to our customers how much resources they use and even charge them for that. So better to be prepared.

In Oracle Solaris 11 we have several tools to track processes running in zones. Some familiar commands now include a `-Z` parameter to help you to monitor zones behavior. Try `ps -efZ` and `prstat -Z` to take a look. Another great Solaris 11 tool was created specifically to monitor zones resource usage: `zonestat`. Give it a try:

```
root@solaris:~# zonestat -z dbzone,webzone 5

Collecting data for first interval...
Interval: 1, Duration: 0:00:05
SUMMARY                   Cpus/Online: 1/1   PhysMem: 2047M  VirtMem: 3071M
                    ---CPU----  --PhysMem-- --VirtMem-- --PhysNet--
               ZONE  USED %PART  USED %USED  USED %USED PBYTE %PUSE
            [total]  0.05 5.45%  968M 47.3% 1251M 40.7%     0 0.00%
           [system]  0.01 1.51%  287M 14.0%  735M 23.9%     -     -
             dbzone  0.00 0.16% 73.8M 3.60% 66.3M 2.16%     0 0.00%
            webzone  0.00 0.13% 73.9M 3.61% 67.2M 2.18%     0 0.00%
```

Note the parameters you can observe with `zonestat`: CPU utilization, physical and virtual memory usage, network bandwidth utilization. In addition to that, it can produce periodic reports with max and average numbers for each parameter. It also can produce machine-parsable output which can be stored in spreadsheets and databases. It can be even piped into another program, such as `gnuplot` to produce nice looking charts. We will use this feature in the next part of our lab when we will be creating our own application package.

Application Packaging with IPS

The Image Packaging System (IPS) is the network based package management system included in Oracle Solaris 11. It provides a framework for complete software lifecycle management such as installation, upgrade and removal of software packages. IPS takes advantage of ZFS using ZFS boot environments, such that administrators can update a system while running production services and then boot into the new boot environment when a planned maintenance window comes along. IPS uses package repositories to install software over the network, and provides for automatic package dependencies. We have covered this topic in our previous Virtual SysAdmin Day (you can find its archived materials on Youtube).

In this session we will be taking the zoneplot, a command line utility for measuring and plotting zone statistics, and creating an IPS package for it that we can install onto the system. This is a very simple example to give you an overview of the packaging process, but it's recommended you take at look at the IPS Developer Guide.

For this package we will need two scripts. First script accepts a standard Unix pipe stream and shows its data using gnuplot. Second script converts the zonestat outpout into a stream readable by the first script. Both scripts are publicly available. Download them from the Internet:

```
root@solaris:~# wget http://www.lysium.de/sw/driveGnuPlotStreams.pl
root@solaris:~# wget http://zoneplot.googlecode.com/files/zoneplot
```

IPS uses package manifests to describe how a package is assembled - what files or directories are included, what dependencies the package has, and basic information about a package such as name, version and description. Fortunately we can generate much of this manifest using IPS and pointing it to a location, or proto area, which contains all the files and directories that we want to include in this package. We'll start by creating this proto area and laying things out how we'd expect the package to look like:

```
root@solaris:~# mkdir -p PROTO/usr/bin
```

In this case we're creating a PROTO directory in $HOME. Within that directory, we have a /usr/bin layout. We'll copy our scripts into this proto area and make them executable:

```
root@solaris:~# cp zoneplot driveGnuPlotStreams.pl PROTO/usr/bin
root@solaris:~# chmod a+x PROTO/usr/bin/*
```

We can see in the following graphic how our directory is now laid out

```
 zoneplot     driveGnuPlotStreams.pl
      \                  /
             bin
              |
             usr
              |
              PROTO
```

Let's generate an initial manifest:

```
root@solaris:~# pkgsend generate PROTO > zoneplot.p5m.gen
```

Let's look at the contents:

```
root@solaris:~# cat zoneplot.p5m.gen
dir group=bin mode=0755 owner=root path=usr
dir group=bin mode=0755 owner=root path=usr/bin
file usr/bin/driveGnuPlotStreams.pl group=bin mode=0755 owner=root path=usr/bin/driveGnuPlotStreams.pl
file usr/bin/zoneplot group=bin mode=0755 owner=root path=usr/bin/zoneplot
```

As you'll see here there are two sets of 'actions' - two directory actions that describe usr and usr/bin directories, and two file actions that describe `zoneplot` and `driveGnuPlotStreams.pl`. These are the contents of our package. Usual IPS practice encourages us to not include directory actions that are already defined on the system. We will remove them.

```
root@solaris:~# vi zoneplot.p5m.gen
root@solaris:~# cat zoneplot.p5m.gen
file usr/bin/driveGnuPlotStreams.pl group=bin mode=0755 owner=root path=usr/bin/driveGnuPlotStreams.pl
file usr/bin/zoneplot group=bin mode=0755 owner=root path=usr/bin/zoneplot
```

The next thing that we need to do is to add some basic meta-information about the package - including package name, package version and package description. Add the following lines to our manifest:

```
root@solaris:~# vi zoneplot.p5m.gen
root@solaris:~# cat zoneplot.p5m.gen
set name=pkg.fmri value=zoneplot@1.0,5.11-0
set name=pkg.summary value="zoneplot utility"
set name=pkg.description value="Utility to plot the output of zone statistics"
set name=info.classification value="org.opensolaris.category.2008:Applications/System Utilities"
file usr/bin/driveGnuPlotStreams.pl group=bin mode=0755 owner=root path=usr/bin/driveGnuPlotStreams.pl
file usr/bin/zoneplot group=bin mode=0755 owner=root path=usr/bin/zoneplot
```

IPS has automatic package dependency checking for all package management operations on the system. For example, if a package requires other packages to work it will automatically install these. We will do the same for zoneplot. We will first try and detect what package dependencies this package might have using the pkgdepend generate command:

```
root@solaris:~# pkgdepend generate -md PROTO zoneplot.p5m.gen > zoneplot.p5m.dep
root@solaris:~# cat zoneplot.p5m.dep
set name=pkg.fmri value=zoneplot@1.0,5.11-0
set name=pkg.summary value="zoneplot utility"
set name=pkg.description value="Utility to plot the output of zone statistics"
set name=info.classification value="org.opensolaris.category.2008:Applications/System Utilities"
file usr/bin/zoneplot path=usr/bin/zoneplot owner=root group=bin mode=0755
file usr/bin/driveGnuPlotStreams.pl path=usr/bin/driveGnuPlotStreams.pl owner=root group=bin mode=0755
depend fmri=__TBD pkg.debug.depend.file=perl pkg.debug.depend.path=usr/bin pkg.debug.depend.reason=usr/bin/driveGnuPlotSt
depend fmri=__TBD pkg.debug.depend.file=bash pkg.debug.depend.path=usr/bin pkg.debug.depend.reason=usr/bin/zoneplot pkg.de
```

You'll see that we have detected that there are two files in this package (zoneplot and driveGnuPlotStreams.pl) that have external dependencies. zoneplot is a bash script and thus depends on bash. driveGnuPlotStreams.pl is a perl script and thus depends on perl. While both of these are already installed by default on Oracle Solaris 11, it's good practice to make sure we define these dependencies.

The next step is resolving these dependencies into the packages they are delivered in. We need to determine what packages bash and perl are a part of. We use the pkgdepend resolve command to achieve this.

```
root@solaris:~# pkgdepend resolve -m zoneplot.p5m.dep
root@solaris:~# cat zoneplot.p5m.dep.res (NOTE the .res extension!)
set name=pkg.fmri value=zoneplot@1.1,5.11-0
set name=pkg.summary value="zoneplot utility"
set name=pkg.description value="Utility to plot the output of zone statistics"
set name=info.classification value="org.opensolaris.category.2008:Applications/System Utilities"
file usr/bin/zoneplot path=usr/bin/zoneplot owner=root group=bin mode=0755
file usr/bin/driveGnuPlotStreams.pl path=usr/bin/driveGnuPlotStreams.pl owner=root group=bin mode=0755
depend fmri=pkg:/runtime/perl-512@5.12.4-0.175.1.0.0.24.0 type=require
depend fmri=pkg:/shell/bash@4.1.9-0.175.1.0.0.24.0 type=require
```

We can see that these dependencies have been resolved to pkg:/runtime/perl-512 and pkg:/shell/bash. While IPS does a good job at trying to detect dependencies by looking at files (ELF headers, #! script definitions, etc.), sometimes we will have to manually provide additional dependencies. In this case, we know that this utility depends on gnuplot to plot the statistics graphically, so we will add this to our manifest.

First we have to figure out the gnuplot's FMRI:

```
root@solaris:~# pkg search -o pkg.shortfmri gnuplot
PKG.SHORTFMRI
pkg:/image/gnuplot@4.6.0-0.175.1.0.0.24.0
```

Now copy this FMRI into the `zoneplot.p5m.dep.res` file as following:

```
root@solaris:~# vi zoneplot.p5m.dep.res
root@solaris:~# cat zoneplot.p5m.dep.res
set name=pkg.fmri value=zoneplot@1.1,5.11-0
set name=pkg.summary value="zoneplot utility"
set name=pkg.description value="Utility to plot the output of zone statistics"
set name=info.classification value="org.opensolaris.category.2008:Applications/System Utilities"
file usr/bin/zoneplot path=usr/bin/zoneplot owner=root group=bin mode=0755
file usr/bin/driveGnuPlotStreams.pl path=usr/bin/driveGnuPlotStreams.pl owner=root group=bin mode=0755
depend fmri=pkg:/runtime/perl-512@5.12.4-0.175.1.0.0.24.0 type=require
depend fmri=pkg:/shell/bash@4.1.9-0.175.1.0.0.24.0 type=require
depend fmri=pkg:/image/gnuplot@4.6.0,5.11-0.175.1.0.0.24.0 type=require
```

Now that we have our PROTO area and manifest completed, it is now time to publish this package to an IPS repository. First we will need to create a repository to host this package - it's best practice not to publish to the existing solaris default publishers even if you have a copy of them locally.

Let's first create a ZFS data set to host our repository:

```
root@solaris:~# zfs create -o mountpoint=/repository rpool/repository
```

And now create an IPS package repository there:

```
root@solaris:~# pkgrepo create /repository
```

We will need to set the publisher prefix of this repository so that we can add it to our publisher configuration on our system. We will call it 'zoneplot':

```
root@solaris:~# pkgrepo -s /repository set publisher/prefix=zoneplot
```

Now we are ready to publish our package:

```
root@solaris:~# pkgsend -s /repository publish -d PROTO zoneplot.p5m.dep.res
pkg://zoneplot/zoneplot@1.0,5.11-0:20130524T160043Z
PUBLISHED
```

We can confirm this by taking a look at the status of the repository:

```
root@solaris:~# pkgrepo -s /repository info
PUBLISHER  PACKAGES  STATUS           UPDATED
zoneplot        1                      online                2013-05-24T16:00:43.695049Z
```

We can query the package now within the repository:

```
root@solaris:~# pkg info -g /repository zoneplot
          Name: zoneplot
       Summary: zoneplot utility
   Description: Utility to plot the output of zone statistics
      Category: Applications/System Utilities
         State: Not installed
     Publisher: zoneplot
       Version: 1.0
 Build Release: 5.11
        Branch: 0
Packaging Date: May 24, 2013 04:00:43 PM
          Size: 6.04 kB
          FMRI: pkg://zoneplot/zoneplot@1.2,5.11-0:20130524T160043Z
```

Let's go ahead and add this publisher to our configuration:

```
root@solaris:~# pkg set-publisher -p /repository
root@solaris:~# pkg publisher
PUBLISHER            TYPE      STATUS P LOCATION
solaris                        origin     online      F http://pkg.oracle.com/solaris/release
zoneplot                       origin     online      F file:///repository
```

And now finally install zoneplot (you will see that it will pull in a number of package dependencies):

```
root@solaris:~# pkg install zoneplot
```

Now you can finally run this small application to watch the resource usage. Open another terminal window and start the application (make sure you are doing this as user "`lab`").

```
lab@solaris:~$ zoneplot
```

Conclusion

In this introductory lab we have build a basic two-layer application architecture using Oracle Solaris 11 virtualization features. So far we have learned:

- How to create a ZFS file system and mount it (in one command)
- How to create a virtual switch and virtual network interface card (VNIC) using Solaris Network Virtualization.
- How to configure a zone and create its system profile and why we need that
- How to install a zone from the default Oracle Solaris IPS repository
- How to install packages using Image Packaging System (IPS)
- How to enable services in Solaris using Service Management Facility (SMF)
- How to clone a zone and inherit all the installed packages and running services
- How to connect zones using internal virtual switch and make sure they are not visible from outside
- How to create databases and assign user rights in MySQL
- How to install Wordpress application
- How to monitor zones resource usage with `zonestat`
- How to package an existing application using Solaris IPS and publish it in a repository

Now you are ready to explore more advanced Oracle Solaris features. Some ideas you might want to try using your "cloud-in-a-box" installation:

- How to manage zone's resources
- How to secure a zone and protect it from unauthorized changes
- How to scale out web server zones and use Solaris load balancer
- How to configure network address translation (NAT) in `webzone` to be able to access the outside world from `dbzone`
- How to migrate a zone between hosts
- ...and many more

All these topics are described in various articles, blogs and how-to's at Oracle Technology Network.
We wish you an interesting journey!