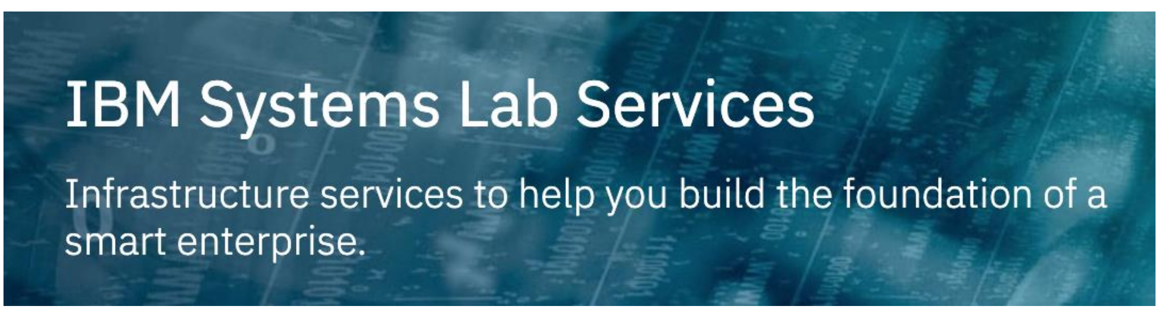
AIX Disaster Recovery with IBM Power Virtual Server

An IBM Systems Lab Services Tutorial



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Chapter 1: Solution Overview

1.1 Introduction

Uptime is a key client expectation for AIX workloads. Across geographic locations, this is accomplished with a disaster recovery (DR) solution. IBM Power Virtual Server (PowerVS) meets that requirement by enabling clients to leverage DR solutions between two AIX Virtual Server Instances (VSIs) in separate IBM Cloud datacenters.

An important characteristic of DR solutions for PowerVS is that they are based on **logical or operating system-level replication**. Many Power Systems clients today use storage-based replication for disaster recovery (DR), which is not an option with PowerVS.

Replication solutions between two datacenters always involve prerequisite network configuration between them to allow the necessary data flow to occur securely. This also applies to DR with PowerVS, which requires specific networking steps in IBM Cloud before implementing the replication software itself.

This tutorial will provide step-by-step instructions to accomplish both phases of configuring DR for AIX workloads in PowerVS:

1. Performing the required network configuration.
2. Implementing the DR solution itself.

1.2 Use Cases

1.2.1 Geographic Logical Volume Manager (GLVM) Replication

In this situation, we use IBM AIX GLVM functionality to replicate data from one IBM Cloud location to another IBM Cloud location for DR purposes. This gives one the capability of recovering their application at a secondary IBM Cloud location should the primary IBM Cloud location be inaccessible for whatever reason.

1.2.2 Geographic Logical Volume Manager (GLVM) Replication with PowerHA

In this situation, we combine the IBM AIX GLVM functionality to replicate data from one IBM Cloud location to another IBM Cloud location with IBM PowerHA to provide a fully automated resiliency solution. This gives one the capability of automatically recovering their application at a secondary IBM Cloud location should the primary IBM Cloud location be inaccessible for whatever reason.

1.3 Solution Components and Requirements

1.3.1 Components

The following components will be required for these solutions:

1. *IBM Power Virtual Servers*
2. *Multiple IBM Cloud locations*
3. *IBM network setup between IBM Cloud locations*
4. *Storage assigned to appropriate VMs*

1.3.2 Requirements

The following will be required for these solutions:

1. *IBM Power Virtual Servers with AIX operating system at multiple IBM Cloud locations*
2. *IBM network setup between IBM Cloud locations*
    a. *The network setup is described in the* ***Chapter 2: Implementation*** *section of this document*
3. *AIX GLVM installed on each AIX VM*
    a. *AIX GLVM comes with AIX, so it is not an additional cost or license*

4. *For integration with IBM PowerHA, the IBM PowerHA Enterprise Edition software installed on each of the AIX VMs that will be part of this environment (high-availability cluster)*
    a. *IBM PowerHA is a separately orderable product and requires an additional licensing*

1.4 Solution Diagram

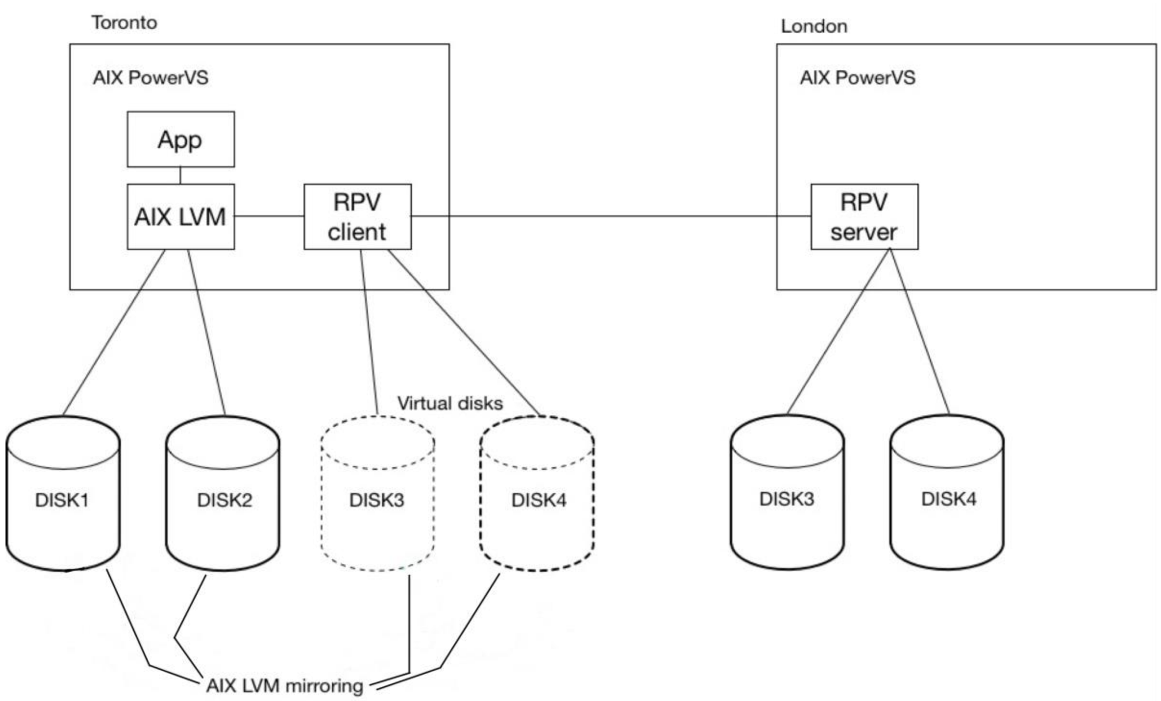


Figure 1.4.1 RPV server/client diagram with virtual drives

Chapter 2: Implementation

2.1 Base IBM Cloud PowerVSI and Networking setup

The following steps are required to implement IBM PowerVS VMs and setup the network between IBM Cloud locations:

1. *Open an IBM Cloud account*
2. *Create two Power PowerVS location Services and a private subnet in each PowerVS location.*
3. *Provision AIX VSIs in each PowerVS location*
4. *Order Direct Link Connect Classic to connect each PowerVS location to IBM Cloud*
5. *Order two Vyatta Gateways one in each datacenter: Lon06 and Tor01 datacenters or your chosen datacenters to allow for PowerVS location-to-PowerVS location communication*
6. *Request a Generic Routing Encapsulation (GRE) tunnel to be provisioned at each PowerVS location.*
7. *Configure three GRE tunnels in the Vyatta Gateways. Two to connect Vyatta Gateway to the PowerVS location GRE tunnels created in Step 6 above and one across Vyatta Gateways to connect Vyatta-to-Vyatta. This will allow end-to-end PowerVS location to PowerVS location communication for the VSIs in the PowerVS locations and to the IBM Cloud VSIs and other services such as Cloud Object Storage (COS).*

2.1.1 Open an IBM Cloud account

Login to https://cloud.ibm.com and follow the procedure to open an Internal to external account.

For internal accounts, you can use your IBM intranet ID and password. For external accounts you will need to provide a billing source such as a credit card.

2.1.2 Create PowerVS location Service and Subnet(s)

All Power VSIs are provisioned in what is called a PowerVS location. This is a separate datacenter adjacent to IBM Cloud datacenters. In order to setup your PowerVS location, you will setup a PowerVS location service in the IBM Cloud UI. The PowerVS location service is a service within IBM Cloud which allows you to provision Power AIX and IBM I VSIs. There is a limit of one PowerVS location service per datacenter in IBM Cloud. In our scenario we have created two PowerVS locations, one is Toronto and one in London datacenters.

Prior to provisioning Power VSI in the PowerVS location, you will need to create at least one subnet. You can have as many subnets as you require in each PowerVS location service on which you can provision your Power VSIs.

2.1.3 Provision AIX and IBM i VSIs in each PowerVS location

In each PowerVS location service you can create AIX or IBM i VSIs. The details are provided in the next section.

2.1.4 Order Direct Link Connect Classic to connect PowerVS location to IBM Cloud

You will need to order Direct Link (DL) Connect Classic to allow your Power VSIs to communication with Linux/Window VSIs in IBM Cloud and also with all other IBM Cloud services such as VMWare VMs, and Cloud Object Storage (COS). Ordering a DL may take 1-2 weeks to complete. There is no charge for this service as of June 2020.

2.1.5 Order two Vyatta Gateways, one in each datacenter

In order to setup communication between the two PowerVS location datacenters, you will need to use a Generic Routing Encapsulation (GRE) tunnels. GRE tunnels are provisioned on Vyatta Gateways so you will need to order one Vyatta Gateway in each PowerVS location.

We ordered one Vyatta in LON06 and the other in TOR01 datacenters where our PowerVS locations exists.

2.1.6 Request a Generic Routing Encapsulation (GRE) tunnel to be provisioned at each PowerVS location

You will need to open a support ticket with Power Systems and request that a GRE tunnel be provisioned in each PowerVS location. They will provision their end of the GRE tunnel and send you the information so you can continue and provision your end on the Vyatta Gateways. You will need to provide the subnets information in each PowerVS location in the ticket.

2.1.7 Configure three GRE tunnels in the Vyatta Gateways

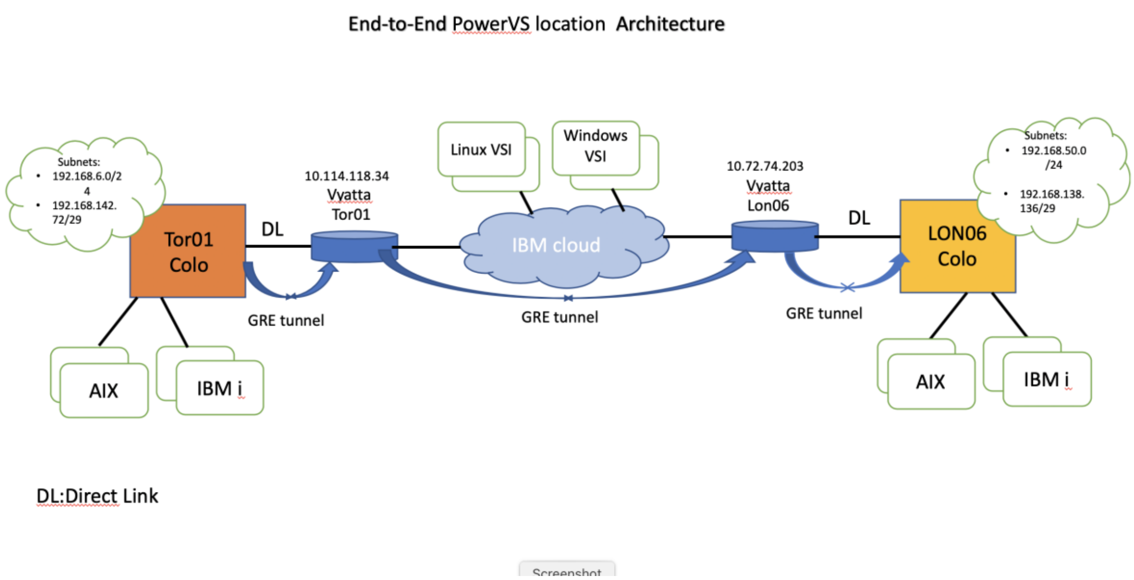
After the support team finished configuring the GRE tunnel, you will need to configure your end of the GRE tunnel on the two Vyatta Gateways.

You will need three GRE tunnels

1. *GRE tunnel on Vyatta to terminate the PowerVS location GRE in LON06*
2. *GRE tunnel on Vyatta to terminate the PowerVS location GRE in TOR01*
3. *GRE tunnel across the two Vyatta gateways. One on each side.*

2.1.8 Diagrams

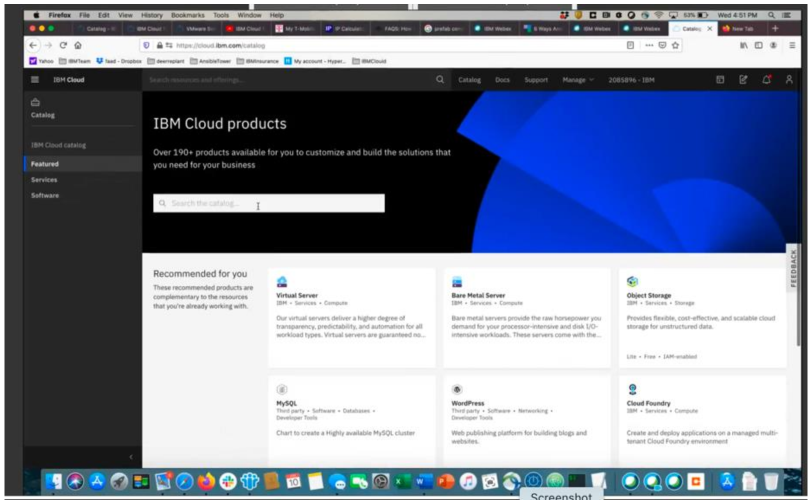
The overall architecture of our deployment is shown in Figure 1.



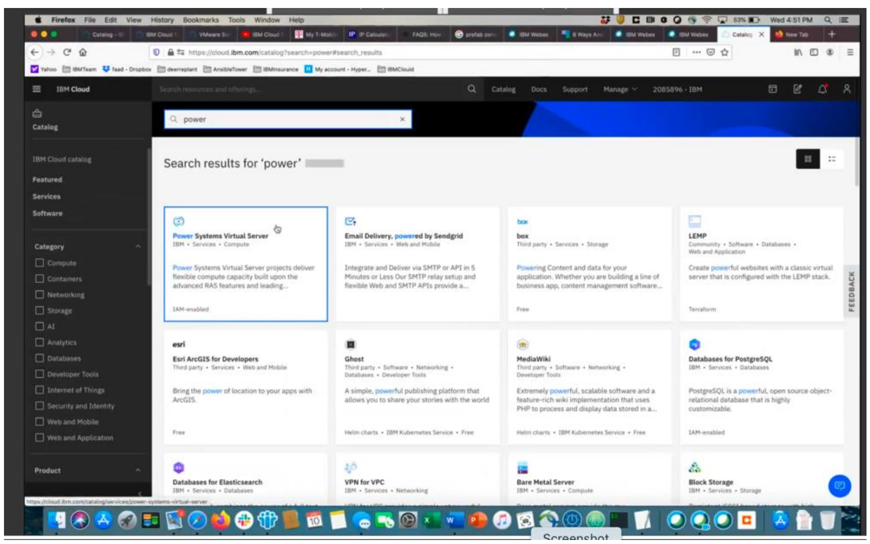
2.1.9 Create PowerVS location Services and Subnet(s)

You will need an IBM Cloud account to start this process.

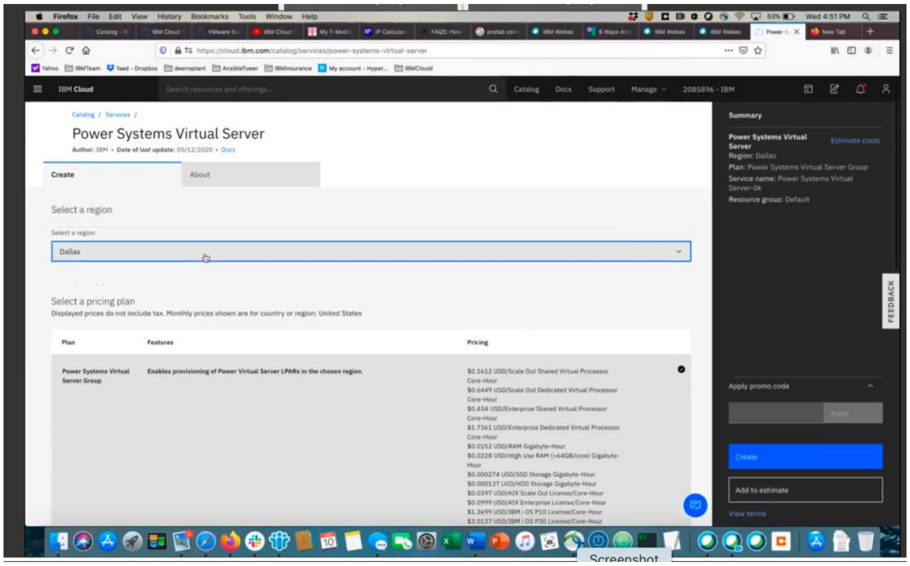
Go to the main IBM Cloud UI page and click on "Catalog" on upper right side of the UI.



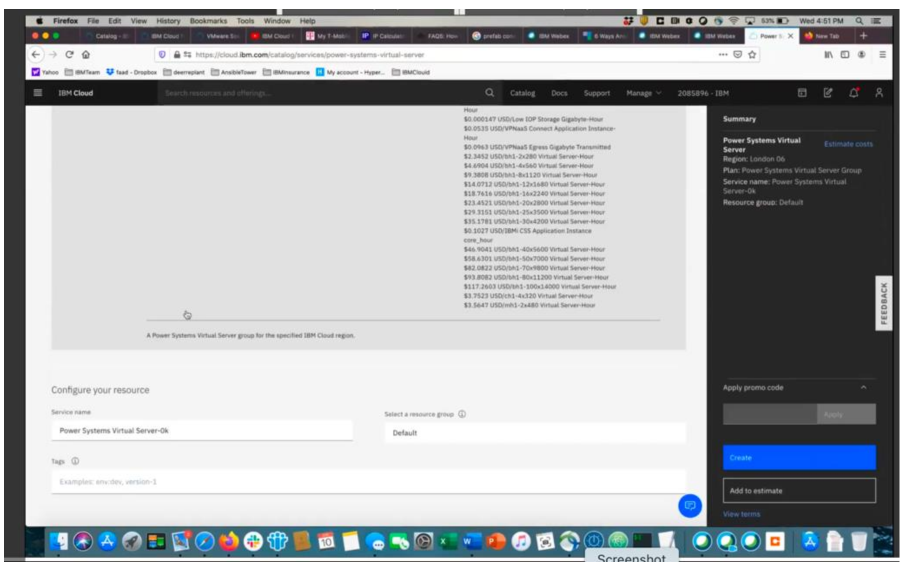
Search for “Power”



Select “Power System Virtual Servers”.

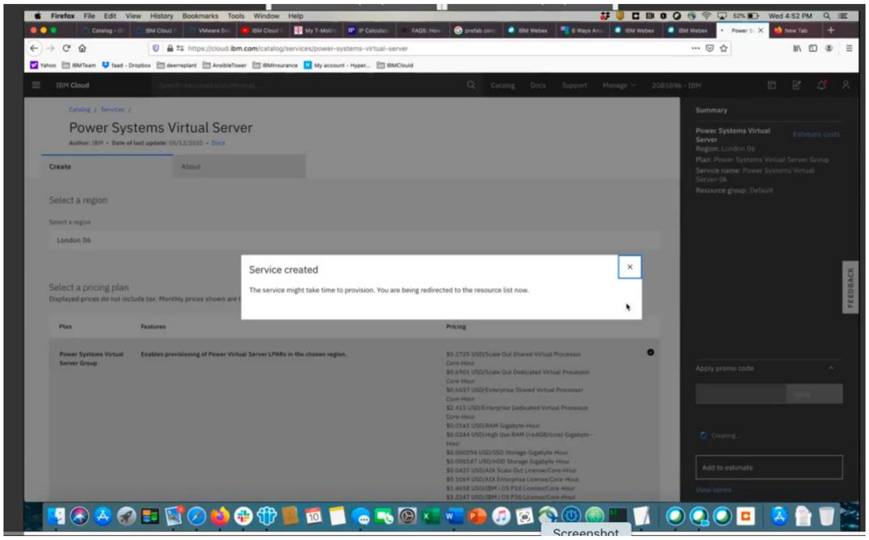


Under Select Region, choose your region. You are limited to only one service per region.



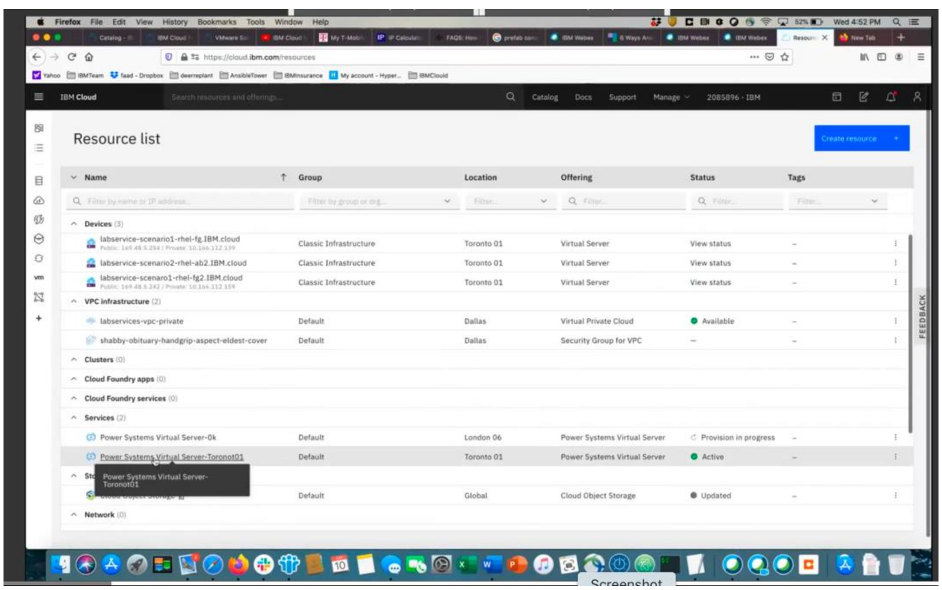
Select a "Service Name" or chose default name provided.

Then press "Create"

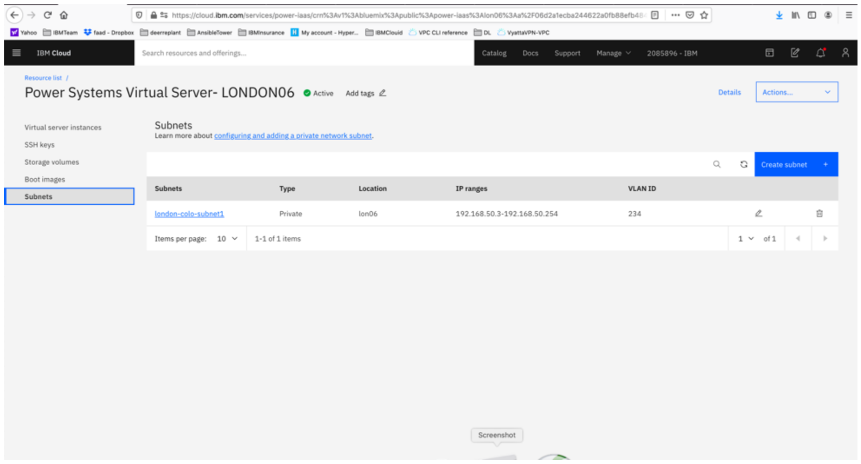


Your PowerVS location service will now appear under the Services tab.

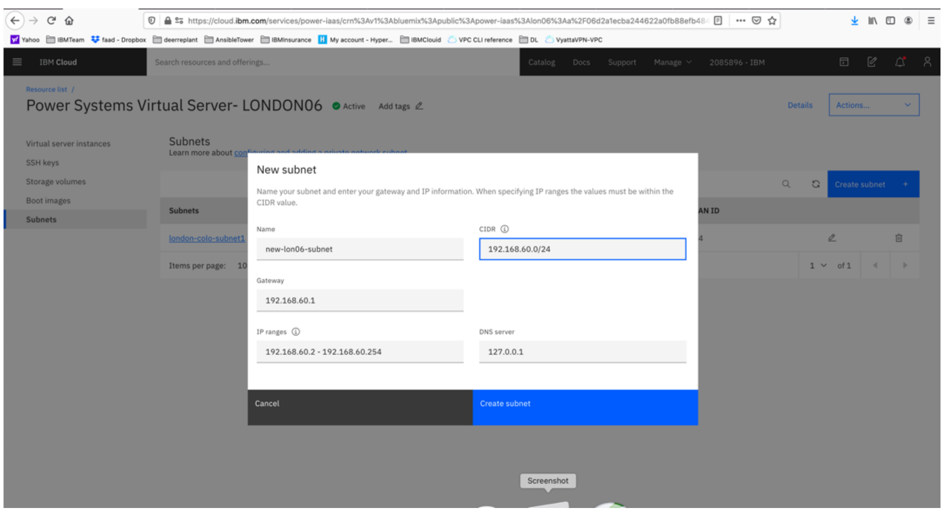
You will repeat this process to create a second PowerVS location service. In our case we have two PowerVS location services, one in London and one in Toronto.



Next you will need to click on the PowerVS location Service you created and provision a subnet to be used by your Power VSI servers.



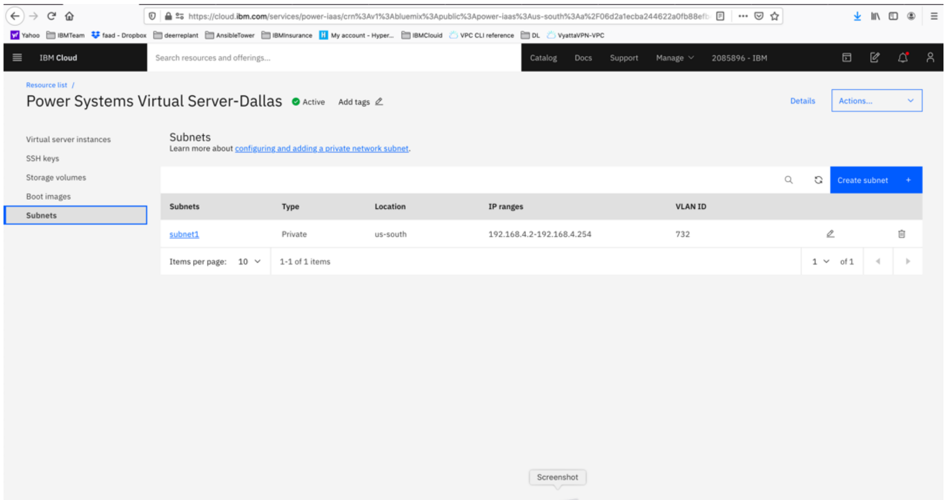
Choose “Subnets” from the menu on the left.



Provide the following information:

1. *name for your subnet*
2. *CIDR range. This can be any private IP subnet ranges. For example, 192.168.5.0/24. You may choose /21 to /30 based on how many IPs you will require. You may use your own private CIDR if you wish.*
3. *The rest of the fields will be automatically populated based on the CIDR you provided.*

Press “Create Subnet”



There should be a VLAN ID associated with the subnet.

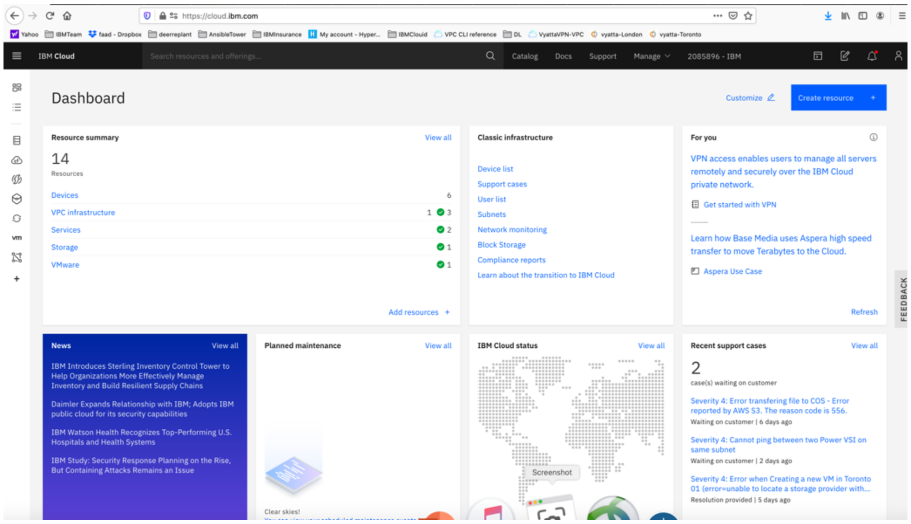
At this point, you will need to open a Support Ticket with Power System to request that the subnet be configured to allow local communication between any Power VSI you create in this PowerVS location service. Provide your PowerVS location service location, and your subnet in the ticket.

Without this step, the Power VSI you create will not be able to ping between each other even if they are on same subnet in the same PowerVS location.

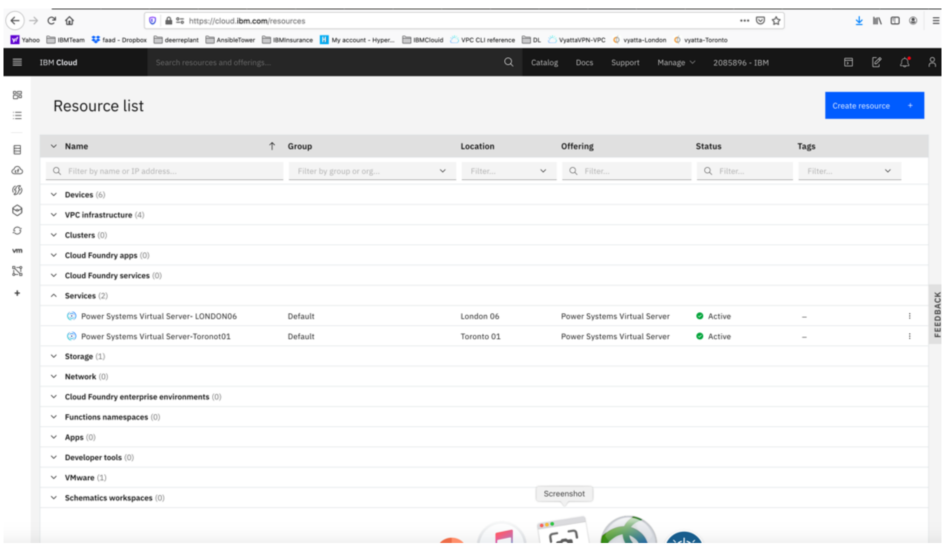
2.1.10 Provision AIX and IBM i VSIs in each PowerVS location

The procedure is similar for both AIX and IBM i VSI provisioning. Here is a procedure to create an AIX 7.2 VSI. The cost shown are monthly costs, but you are being charged hourly.

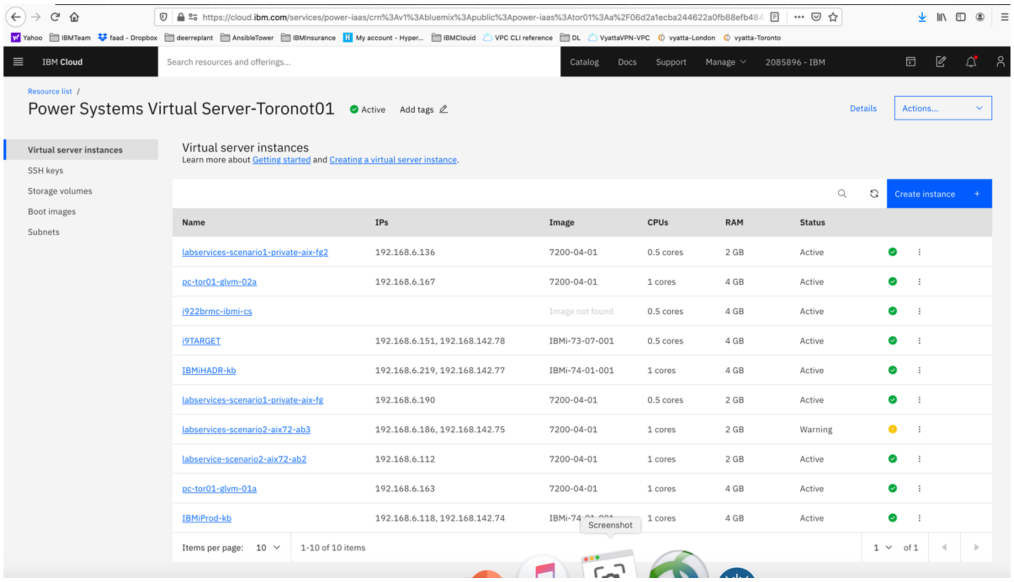
Go to the IBM Cloud Catalog and press the “IBM Cloud” on top left side of the UI.



Choose “Services” from the list shown.

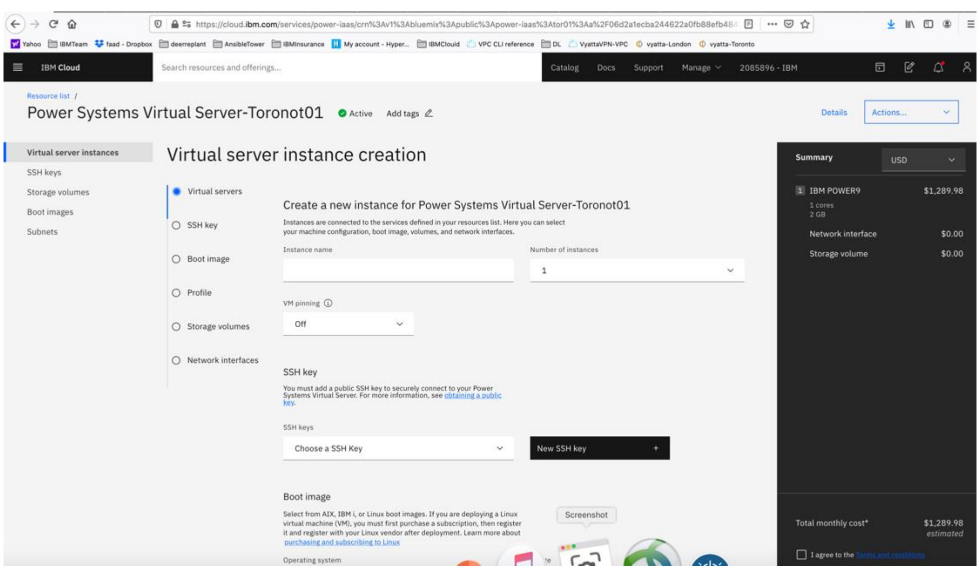


Click on the service for datacenter in which you have created a PowerVS location power service. In this case we will choose Toronot01 PowerVS location service.



Since we have already provisioned several VSIs, we see the list show above. If you are creating VSIs for the first time, your list will be empty.

Press "Create Instance" on upper right-hand side.

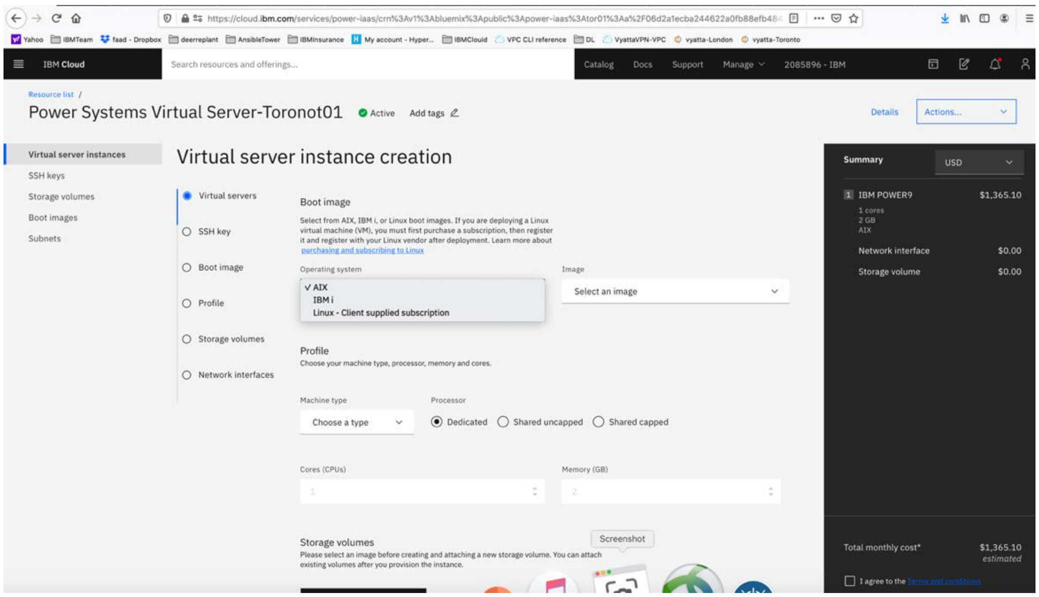


This is where you provision AIX or IBM i VSIs.

Choose a name for your VSI, i.e., AIX-72-Tor01 and select how many VSIs you need to configure. The names of the VSI will be appended with a "-1", "-2" etc. if you select more than one VSI.

You may leave VM pruning and SSH key as is since the VSIs will have no passwords when you create them for the first time. You will need to create a password via the OS command.

Scroll down to choose other options.

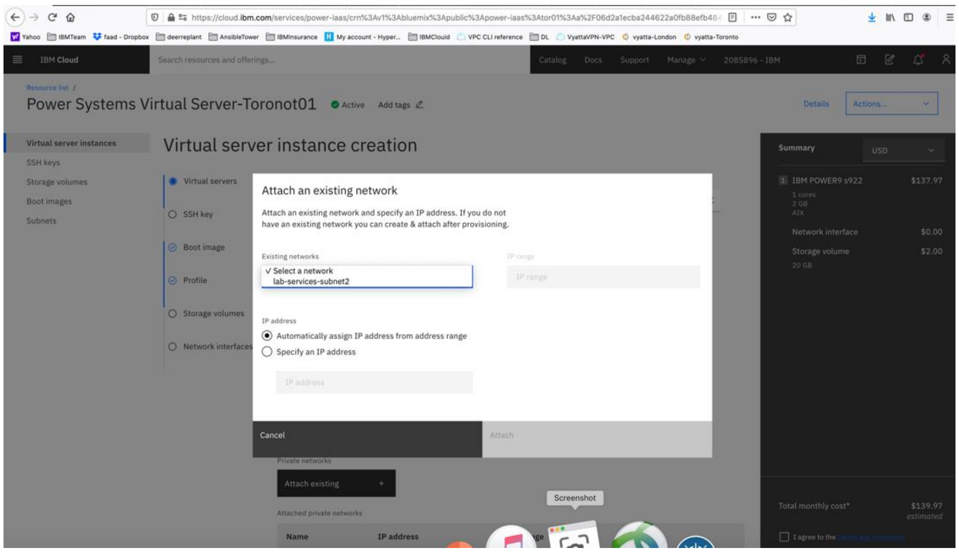


Here you will choose the following options:

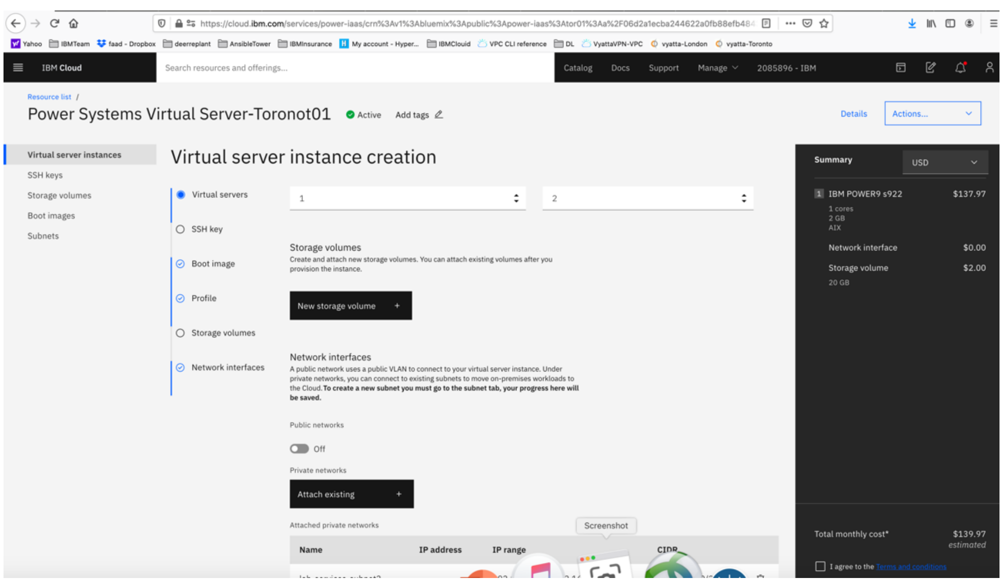
- *Operating System – AIX*
- *Image type: AIX 7.1 or 7.2, etc.*
- *Disk types: Type 1 or 3. Type 3 is a less expensive option which we selected.*
- *Machine type: S922 or E980. S922 is the cheater of the two which we selected.*
- *Processor: Dedicated or Shared or Shared Capped. We choose "shared" as its less expensive.*
- *Choose the number of cores and RAM you will need. The minimum core is "0.25".*
- *You can also attach additional volume to the VSI is you wish. We did not do that here and only used the root volume which is included.*

Next you will scroll down to choose your subnet on which these VSIs will be provisioned. It is assumed you have already created one or more subnets prior to this step.

Click on the "Attached Existing" under networks.



Choose the subnet you wish to attach, and the press "Attach"



Now check the box "I agree to the ...." And press "create Instance" in lower right-hand side.

Your VSI is now being provisioned.

2.1.11 Order Direct Link Connect Classic to connect PowerVS location to IBM Cloud

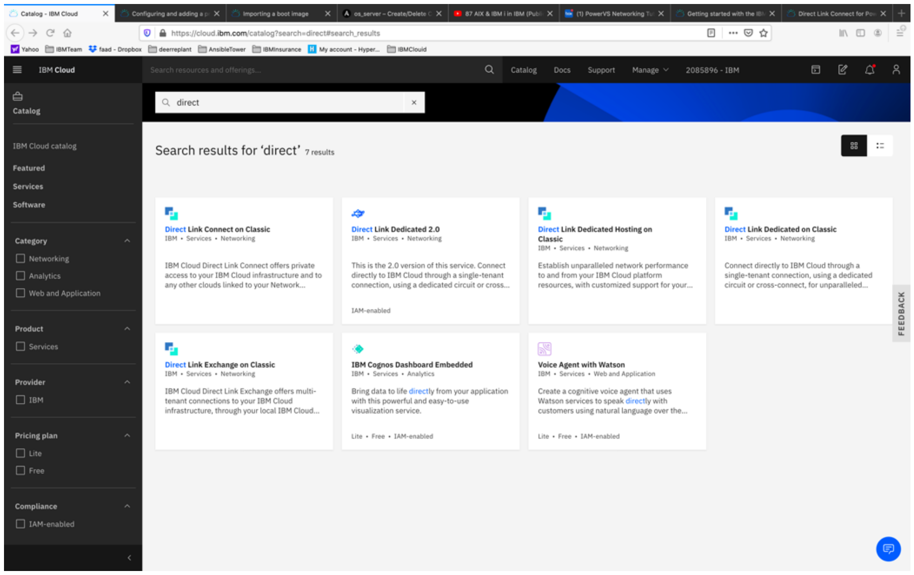
You will need to order Direct Link (DL) Connect Classic to allow your Power VSIs in the PowerVS location to communication with Linux/Window VSIs in IBM Cloud and also with all other IBM Cloud services such as Cloud Object Storage and VMware services. This process may take 1-2 weeks to complete.

There are several steps involved in completing DL ordering:

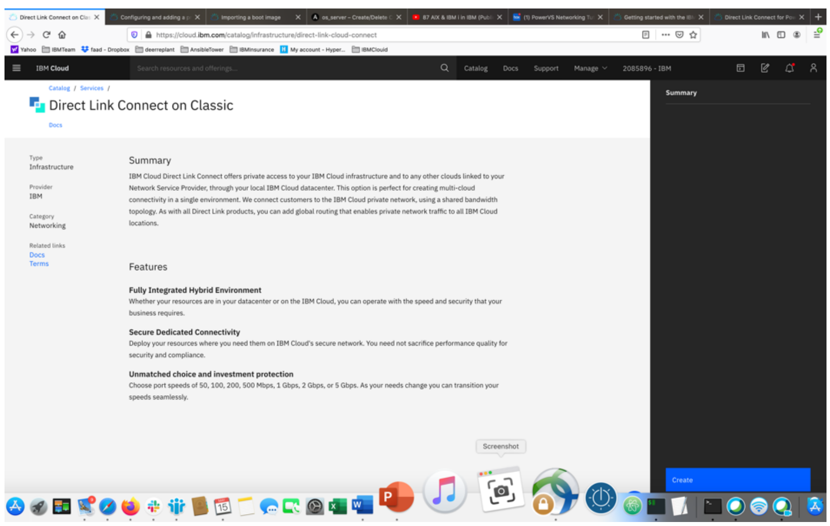
- *Order Direct link connect classic service on IBM Cloud UI – see steps below*
- *Next a support ticket will be created, and Support will send you a word document with questionnaires to be completed concerning various DL settings.*
- *Complete the questionnaires and upload it to support in the ticket.*
- *Support will then request that you create a new support ticket with the Power System so they can complete their side of the DL provisioning. Attach information about the DL in the original ticket to this ticket.*
- *The DL will be provisioned, and you will be notified when complete.*
- *You can now test connection to any Linux/Windows VSI you may have in IBM Cloud and other IBM Cloud services.*

To start the DL order process, go to IBM Cloud UI and log in.

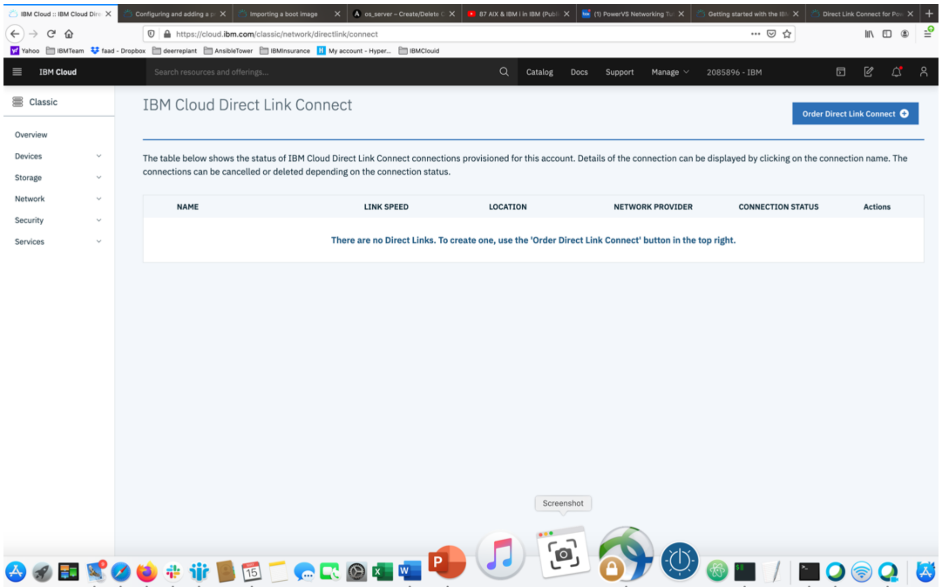
Choose “Catalog” from upper right-hand side, and search for “direct”.



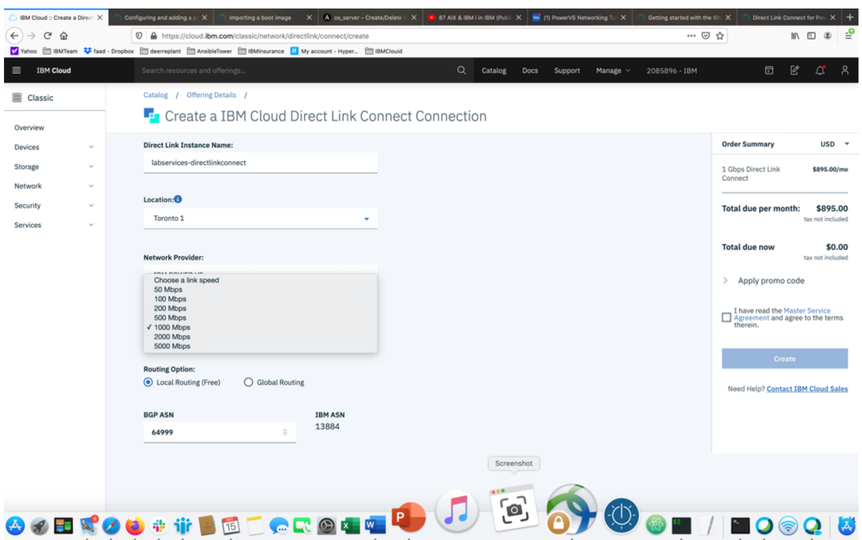
Select "Direct Link Connect on Classic".



Press "Create". There are no options to select.



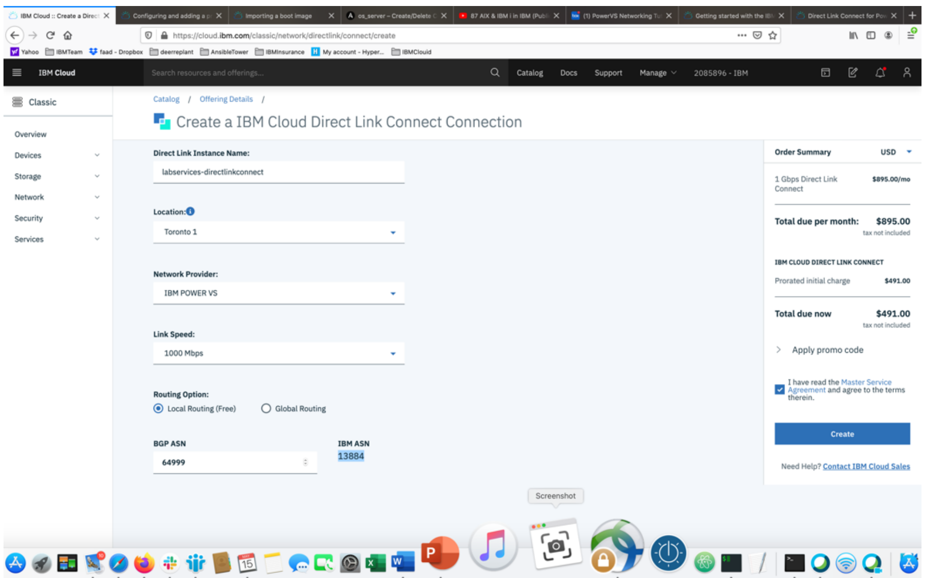
Now choose “Order Direct Link Connect” from top right-hand side.



- *Choose a “name” for the DL.*
- *Choose a location for the DL. This should be the same location as where you created your PowerVS location Service.*
- *Choose “link speed” under network provider menu.*
- *Choose “Local Routing (free)”*

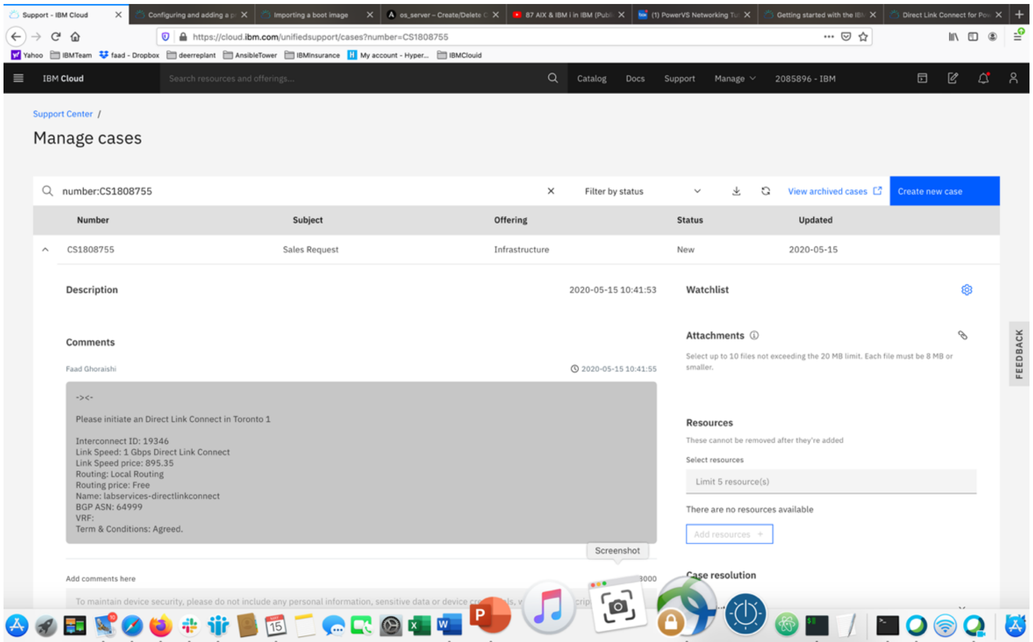
Global routing will require additional charges and will allow for easier PowerVS location-to-PowerVS location communication. You will also need to order a Vyatta Gateway Router to complete your Global routing option via use of a GRE tunnel. Support can help you with this further.

In our case, we decided to use Local Routing and then order a Vyatta Gateway in each PowerVS location and provision a GRE tunnel end-to-end.



- *Check the box to accept the offer and press "Create"*

A support case will be opened with the information required.



After this is complete, you will then be contacted by support and requested to complete and answer some questions in an attached document and send it back as attachment to the same ticket.

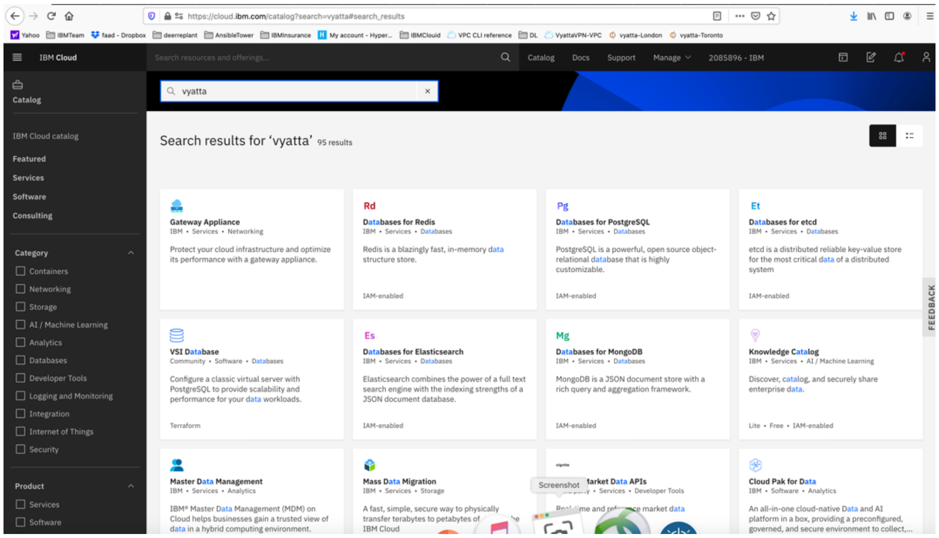
After this step is complete, support will request that you open a new IBM support ticket and address it to the Power System. Include the information in the original DL ticket. This new ticket will be sent to the PowerVS location support to configure their side of the DL connection.

This should be the last step before DL communication works. You can test your connection by pinging IBM Cloud Linux/Windows VSI from your Power VSIs and in reverse.

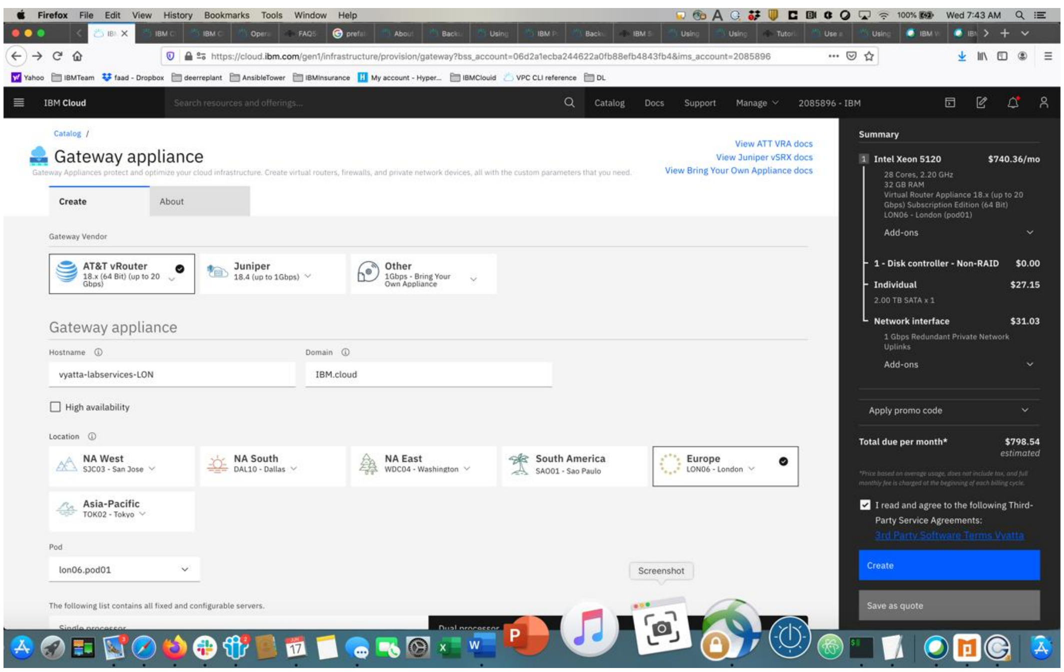
2.1.12 Order two Vyatta Gateways, one in each datacenter

In our scenarios we used two Vyatta Gateways, one in each PowerVS location to provide end-to-end PowerVS location-to-PowerVS location communication using GRE tunnels.

Login to IBM Cloud and click on the "Catalog", then search for Vyatta.



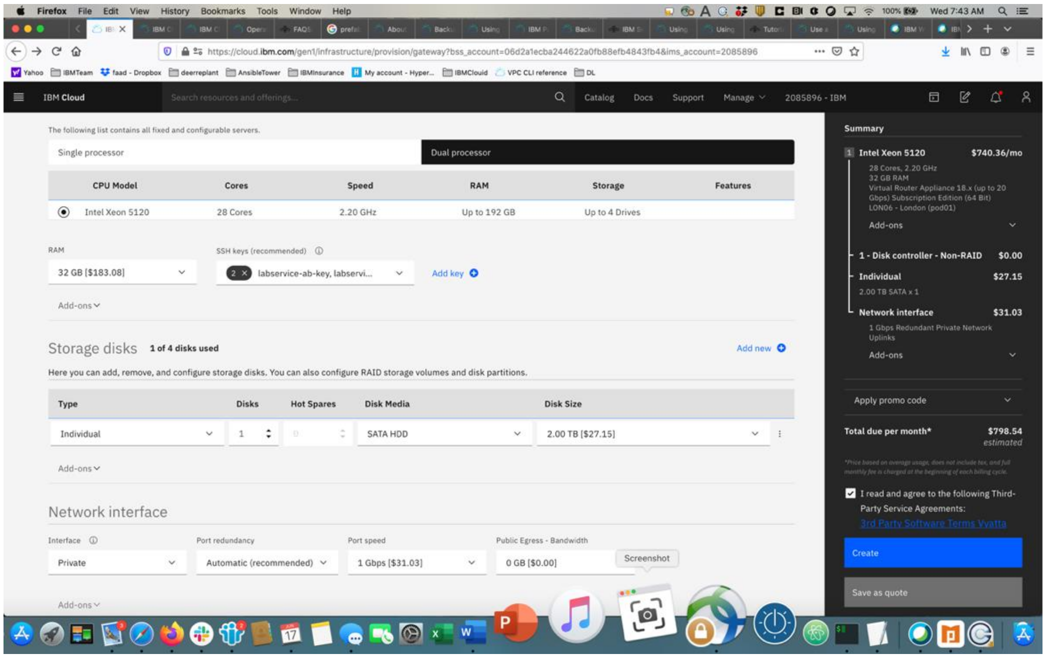
Select "Gateway Appliance" and click on it.



Select "AT&T vRouter". This is the Vyatta Gateway. You have other choices of Gateways, but we will use Vyatta.

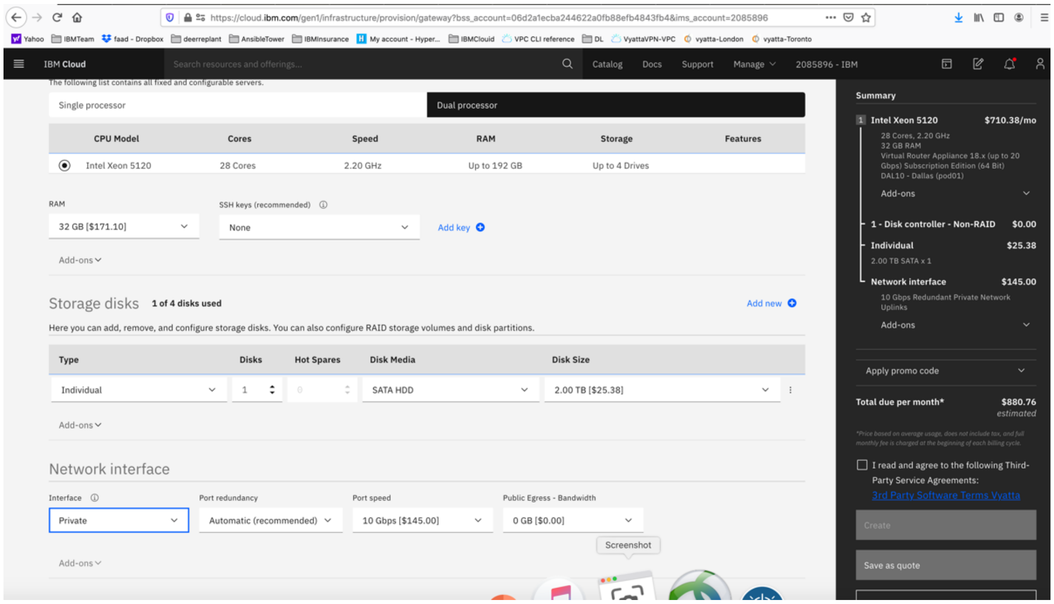
Provide a name for the Gateway and include the PowerVS location name in it so you can distinguish them later.

Select Location to match your PowerVS location.



Choose the following options:

- *Uncheck the High Availability option unless you wish to order one which means you will order two Vyatta Gateways in each PowerVS location. We uncheck this option.*
- *Select the location by pressing on the arrow key in each location to find the exact datacenter where you PowerVS location are located.*
- *You may need to choose the POD if there are several PODs in the selected datacenter location.*
- *Select the CPU single or dual processor. We chose Single Processor.*
- *Select the amount of RAM you wish and add ssh keys if you like to login without password. This can be done later too.*
- *Choose Private network interface unless you wish to use the default which is public/private interface. We chose private network interface only.*

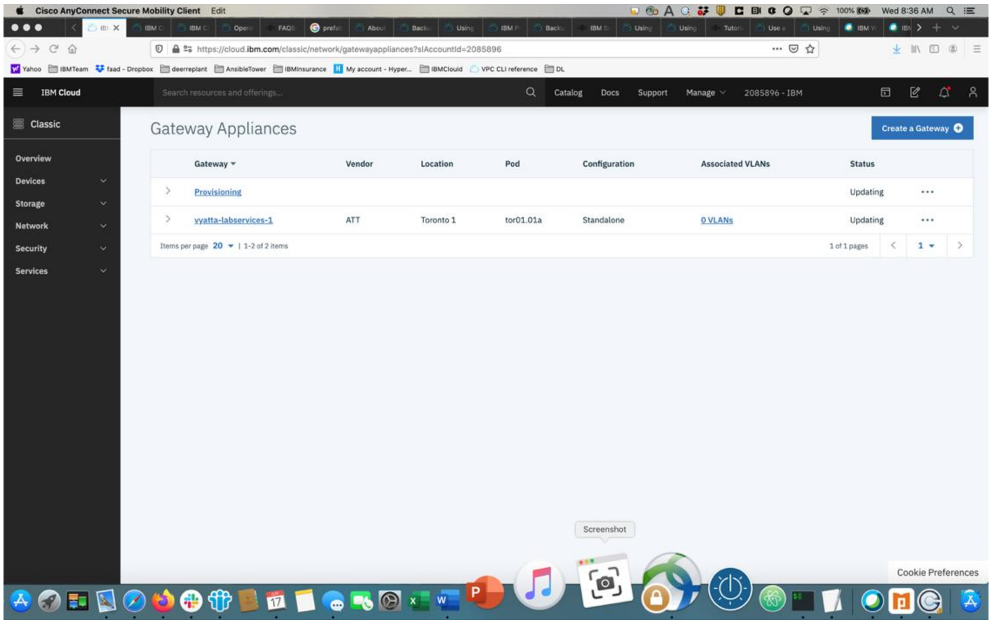


Now check the box to agree with service agreement on the bottom-right side and press “Create”

The Vyatta gateway is now being provisioned. This may take several hours.

You will need to do this process in each of the two PowerVS locations.

After the Vyatta Gateway is provisioned, you can see it listed under “Devices” where you can find your “Vyatta” and “root” user passwords.

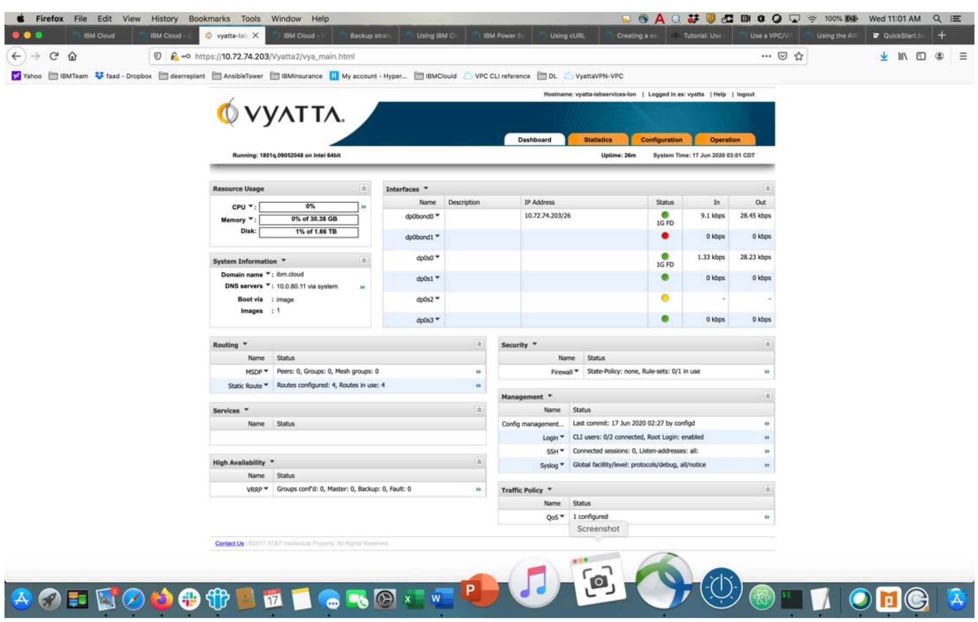


To log into the Vyatta gateway, use a browser and access it via the link:

https://<ip address of the Vyatta gateway>

user: Vyatta

password: as show under "devices" in IBM Cloud UI and password tab on the left.



Typically, you will use a command line to ssh to the Vyatta for further configuration. You will use the “Vyatta” user id to do the configurations.

2.1.13 Request a Generic Routing Encapsulation (GRE) tunnel to be provisioned at each PowerVS location

You will need to open a support ticket to Power Systems and request that a GRE tunnel be provisioned in each PowerVS location. You will need to provide information on the subnets you created in the PowerVS location. They will provision their end of the GRE tunnel and send you the information you will need so you can continue and provision your end of the GRE tunnel on the Vyatta Gateways.

Power Support team will send you the following information for your GRE tunnels after they complete their end of the GRE tunnel:

TOR01:

```
In Tor01 to POWERVS LOCATION GRE:
Your destination should be 10.254.0.30
Your tunnel ip 172.20.8.1
Power-PowerVS location-Side:
Tor01: interface Tunnel5
description IBM5-GRE
vrf forwarding IBM5
ip address 172.20.8.2 255.255.255.252
keepalive 5 3
tunnel source 10.254.0.30
tunnel destination 10.114.118.34
tunnel vrf IBM5
```

LON06:

In Lon06 to POWERVS LOCATION GRE: Your destination should be 10.254.0.26 Your tunnel ip 172.20.2.1 Power-PowerVS location-Side: Lon06: interface Tunnel4 description IBM3-GRE vrf forwarding IBM3 ip address 172.20.2.2 255.255.255.252 keepalive 5 3 tunnel source 10.254.0.26 tunnel destination 10.72.74.203 tunnel vrf IBM3

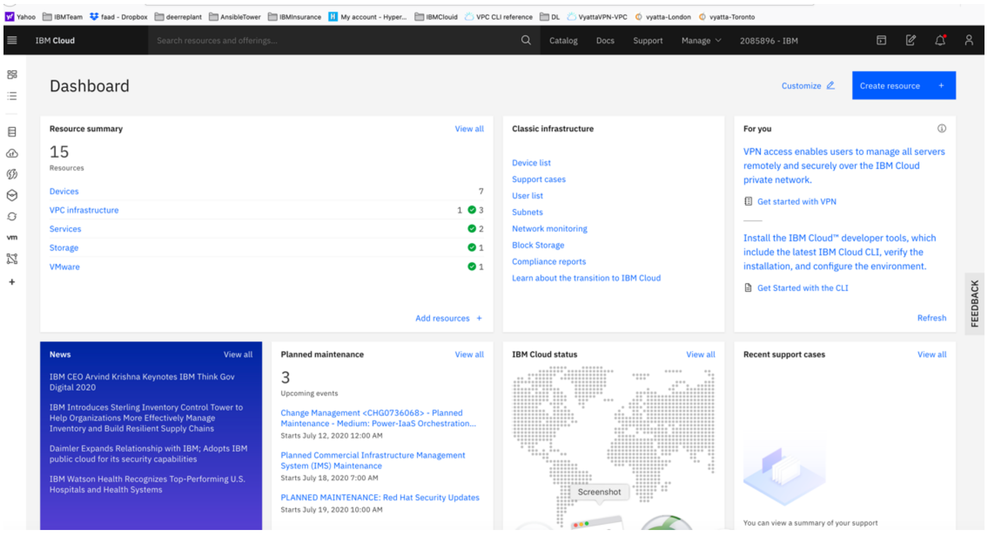
The items shown in Red is what you will need to configure your end of the GRE tunnel in each Vyatta Gateways.

- *Note that your tunnel IP address is 172.20.2.1/30 where 255.255.255.252 translate to /30*
- *Your tunnel destination IP is their tunnel source IP.*
- *Your tunnel source IP is the IP address of the Vyatta gateway*

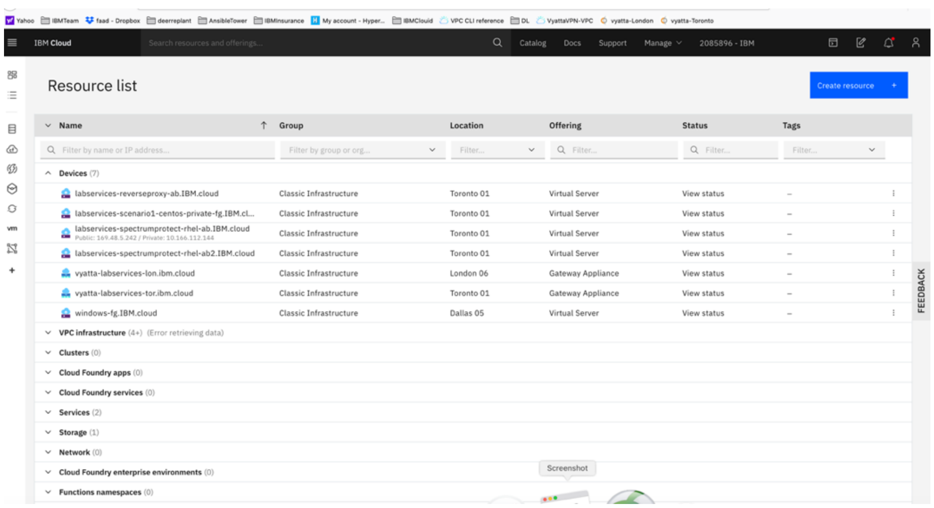
Verify your Vyatta Gateway access.

The Vyatta Gateway address can be find in the IBM Cloud UI under Devices.

Login to IBM Cloud UI and press “IBM Cloud” on top left-hand side.



Click on “Devices”

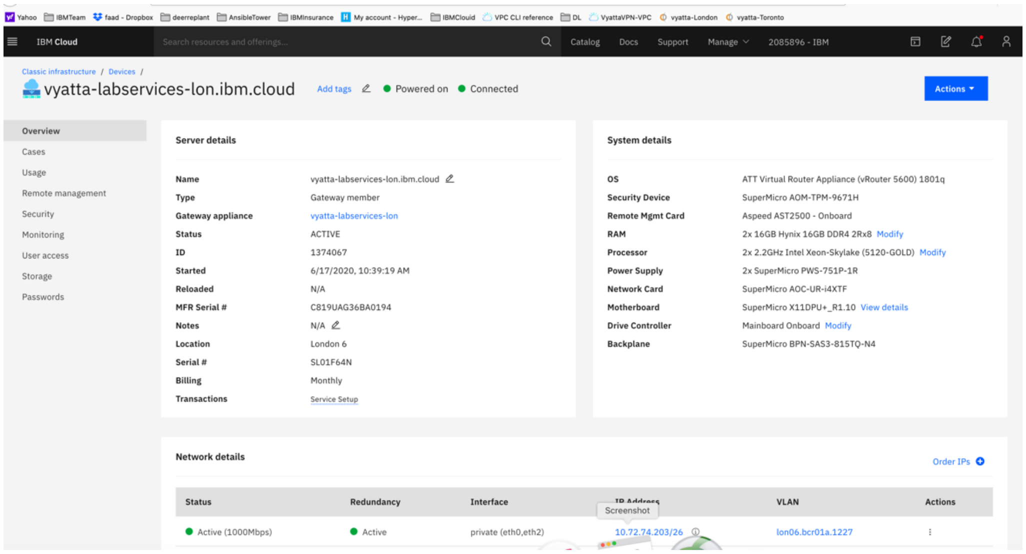


Choose the Vyatta system you like to configure:

- vyatta-labservices-lon.ibm.cloud
- vyatta-labservices-tor.ibm.cloud

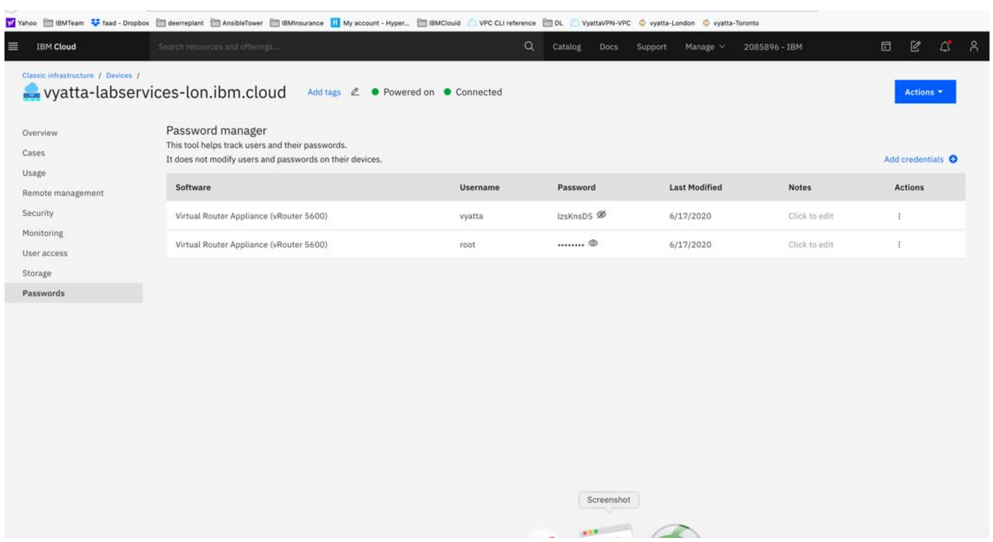
LON06:

Click on the London Vyatta: vyatta-labservices-lon.ibm.cloud



Under the “Network Details” you will see your Vyatta Gateway IP address:

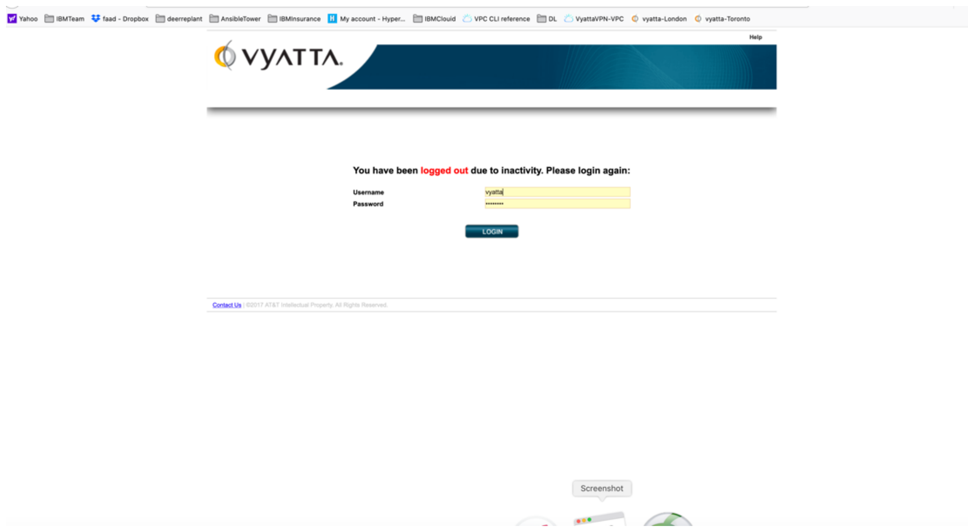
Your credentials are under the “password” menu on the left-hand side. Click on the icon next to the password to see it unencrypted.



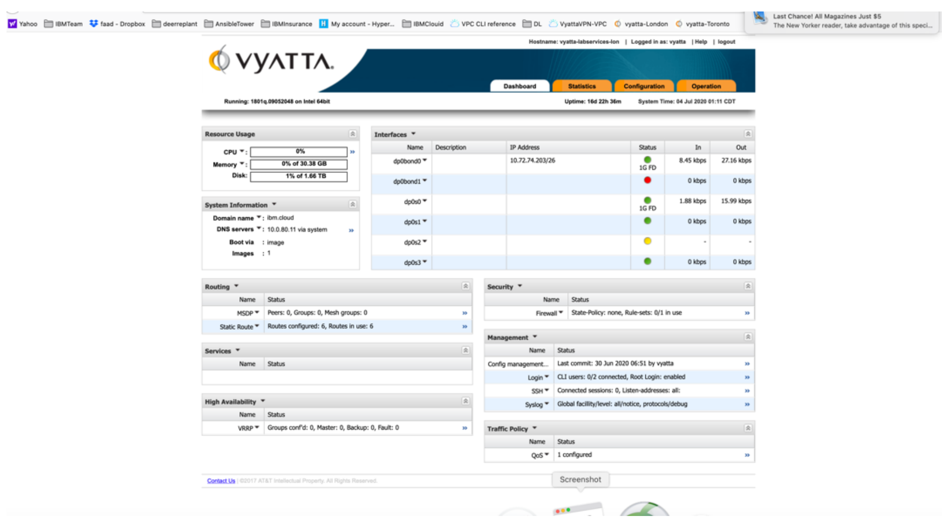
Open a browser and login to the Vyatta Gateway using:

userID: Vyatta
Password: as show in the GUI
https://10.72.74.203
ssh vyatta@10.72.74.203

Note: Prior to login to a 10.x.x.x private IPs in IBM Cloud you will need to start your MotionPro Plus VPN access. This will give you access to IBM Cloud private IPs.



Login with the userID and password.



Now that you have verified you access to the Vyatta Gateways, you will need to now access it via ssh to continue your GRE tunnel provisioning.

2.1.14 Setup PowerVS location GRE tunnels in the Vyatta Gateways

The following references may help in configuring GRE tunnels:

https://cloud.ibm.com/docs/virtual-router-appliance?topic=solution-tutorials-configuring-IPSEC-VPN

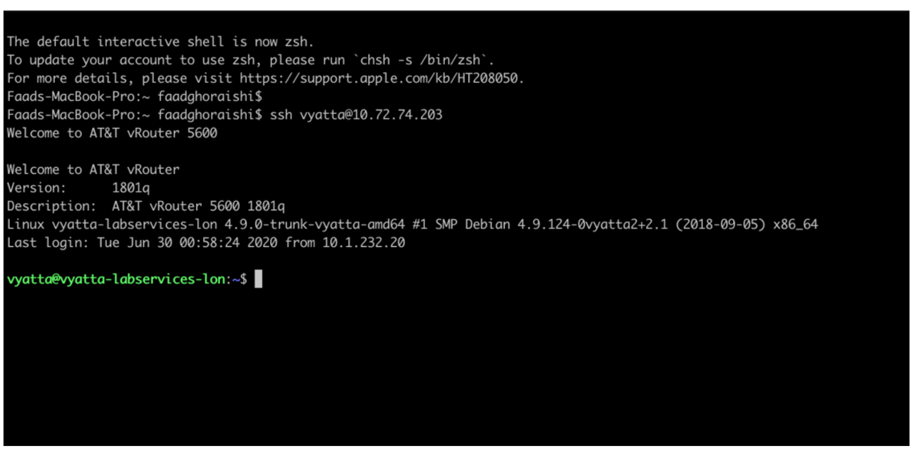
https://docs.huihoo.com/vyatta/6.5/Vyatta-Tunnels_6.5R1_v01.pdf

Open a command window on your Mac/Window.

Note: Prior to login to a 10.x.x.x private IPs in IBM Cloud you will need to start your MotionPro Plus VPN access.

Setup GRE PowerVS location Tunnel in LON06:

userID: Vyatta
Password: as show in the GUI
ssh vyatta@10.72.74.203
ssh to LON06 Vyatta Gateway.



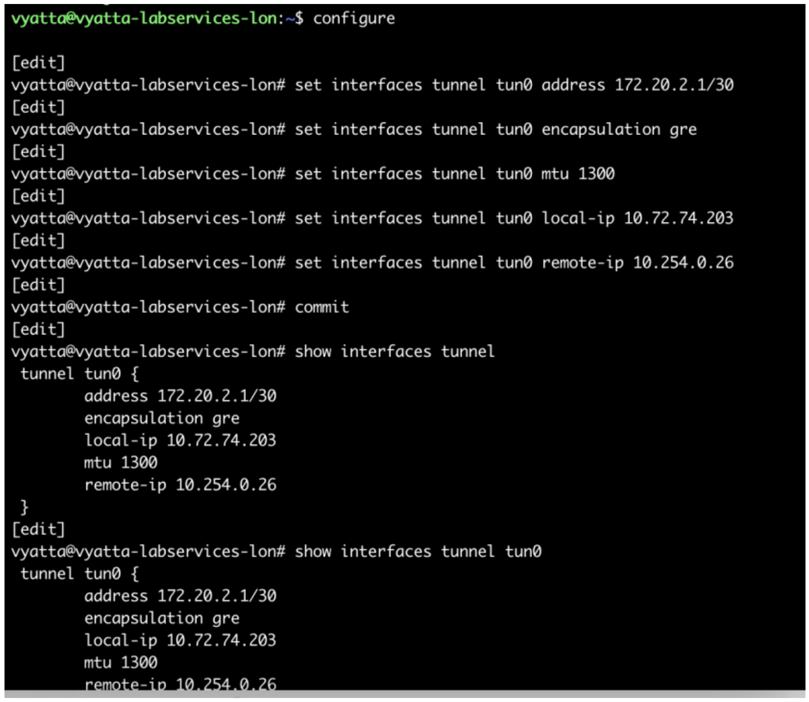
We are using the information provided by support for LON06 GRE.

In Lon06 to POWERVS LOCATION GRE:
Your destination should be 10.254.0.26
Your tunnel ip 172.20.2.1
Power-PowerVS location-Side:
Lon06: interface Tunnel4
description IBM3-GRE
vrf forwarding IBM3
ip address 172.20.2.2 255.255.255.252 (172.20.2.2/30)
keepalive 5 3
tunnel source 10.254.0.26
tunnel destination 10.72.74.203
tunnel vrf IBM3

Run the following commands:

We have chosen to call our tunnel "tun0" on the Vyatta Gateway.

- *configure*
- *set interfaces tunnel tun0 address 172.20.2.1/30*
- *set interfaces tunnel tun0 local-ip 10.72.74.203*
- *set interfaces tunnel tun0 remote-ip 10.254.0.26*
- *set interfaces tunnel tun0 encapsulation gre*
- *set interfaces tunnel tun0 mtu 1300*
- *commit*
- *exit*

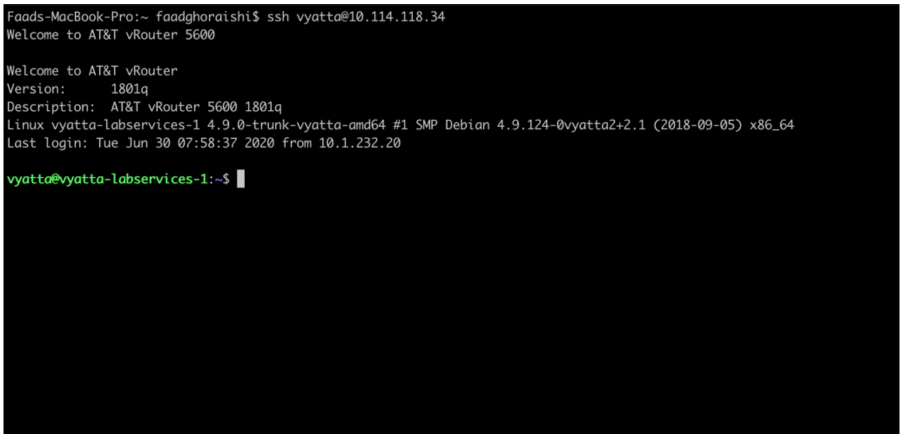


You can verify that your GRE tunnel is setup by running the following commands:

- *configure*
- *show interfaces tunnel*
- *Or to get more info:*
- *Show interface tunnel tun0*
- *exit*

2.1.15 Setup GRE PowerVS location Tunnel in TOR01:

userID: Vyatta
Password: as show in the GUI
ssh vyatta@10.114.118.34
ssh to Tor01 Vyatta Gateway.



In Tor01 to POWERVS LOCATION GRE:

Your destination should be 10.254.0.30

Your tunnel ip 172.20.8.1

Power-PowerVS location-Side:

Tor01: interface Tunnel5

description IBM5-GRE

vrf forwarding IBM5

ip address 172.20.8.2 255.255.255.252

keepalive 5 3

tunnel source 10.254.0.30

tunnel destination 10.114.118.34

tunnel vrf IBM5

Run the following commands:

We have chosen to call our tunnel “tun0” in the Vyatta Gateway same as the other Vyatta Gateway.

- *configure*
- *set interfaces tunnel tun0 address 172.20.8.1/30*
- *set interfaces tunnel tun0 local-ip 10.114.118.34*
- *set interfaces tunnel tun0 remote-ip 10.254.0.30*
- *set interfaces tunnel tun0 encapsulation gre*
- *set interfaces tunnel tun0 mtu 1300*
- *commit*
- *exit*

```
vyatta@vyatta-labservices-1# configure
vbash: configure: command not found
[edit]
vyatta@vyatta-labservices-1# set interfaces tunnel tun0 address 172.20.8.1/30
[edit]
vyatta@vyatta-labservices-1# set interfaces tunnel tun0 encapsulation gre
[edit]
vyatta@vyatta-labservices-1# set interfaces tunnel tun0 mtu 1300
[edit]
vyatta@vyatta-labservices-1# set interfaces tunnel tun0 local-ip 10.114.118.34
[edit]
vyatta@vyatta-labservices-1# set interfaces tunnel tun0 remote-ip 10.254.0.30
[edit]
vyatta@vyatta-labservices-1# commit
[edit]
```

To show the status:

- *configure*
- *show interfaces tunnel*
- *Or to get more info:*
- *Show interface tunnel tun0*
- *exit*

```
vyatta@vyatta-labservices-1:~$ configure

[edit]
vyatta@vyatta-labservices-1# show interfaces tunnel
 tunnel tun0 {
        address 172.20.8.1/30
        encapsulation gre
        local-ip 10.114.118.34
        mtu 1300
        remote-ip 10.254.0.30
 }
```

2.1.16 Setup GRE tunnel between Two Vyatta Gateways

In this section you will setup a new tunnel in each of the two Vyatta gateways to allow for cross Vyatta connection via a GRE tunnel.

In this case we choose the tunnel address and tunnel source and destination IPs. The tunnel address can be any IP subnet you choose. We named our tunnel “tun1” in both Vyatta Gateways. We have selected a similar IP as the ones used in the PowerVS location GRE tunnels. We choose a CIDR of /30 since we only need two IP address, one in Tor01 and one in Lon06.

- *In Lon06 Vyatta the GRE Vyatta-to-Vyatta tunnel address is 172.20.4.1/30*
- *In Tor01 Vyatta the GRE Vyatta-to-Vyatta tunnel address is 172.20.4.2/30*
- *Your tunnel destination IP is the IP address of the Vyatta gateway in each location*
- *Your tunnel source IP is the IP address of the Vyatta gateway in each location*
- *We call the tunnels tun1 in both locations*

TOR01 GRE Configuration:

```
configure
set interfaces tunnel tun1 address 172.20.4.1/30
set interfaces tunnel tun1 local-ip 10.114.118.34
set interfaces tunnel tun1 remote-ip 10.72.74.203
set interfaces tunnel tun1 encapsulation gre
set interfaces tunnel tun1 mtu 1300
commit
exit
```

```
vyatta@vyatta-labservices-1# show interfaces tunnel tun1
 tunnel tun1 {
        address 172.20.4.1/30
        encapsulation gre
        local-ip 10.114.118.34
        mtu 1300
        remote-ip 10.72.74.203
 }
[edit]
vyatta@vyatta-labservices-1#
```

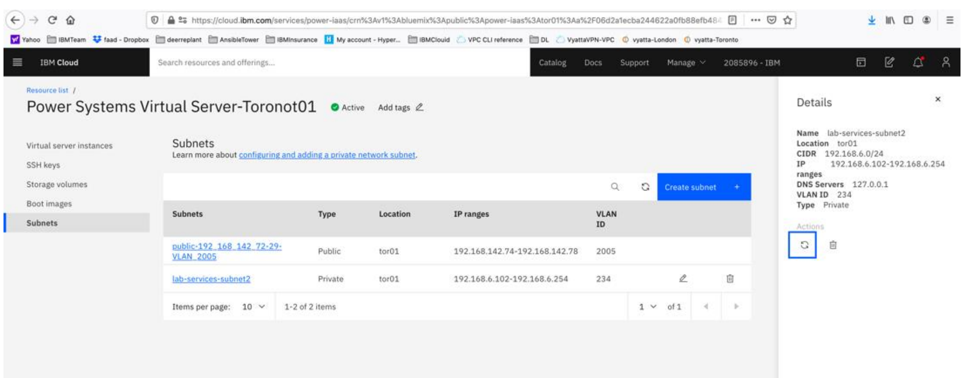
LON06 GRE Configuration:

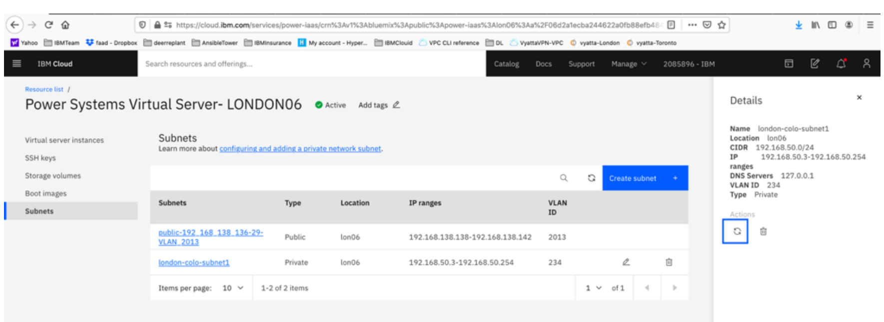
```
configure
set interfaces tunnel tun1 address 172.20.4.2/30
set interfaces tunnel tun1 remote-ip 10.114.118.34
set interfaces tunnel tun1 local-ip 10.72.74.203
set interfaces tunnel tun1 encapsulation gre
set interfaces tunnel tun1 mtu 1300
commit
exit
```

The final steps needed is to setup static routes in each Vyatta to point the subnets for our PowerVS location to the right tunnels.

2.1.17 Setup GRE tunnel between Two Vyatta Gateways

Find the subnets you created in each PowerVS location in TOR01 and LON06 by accessing the services in the IBM Cloud UI for each PowerVS location.





The static routes in LON06 will need to point to the subnets in TOR01 and vis versa.

We will configure both GREs to the PowerVS location and between Vyattas.

Run the following commands in each Vyatta Gateway after login in via ssh using the Vyatta userID:

in TOR01 Vyatta:

- *configure*
- *set protocols static route 192.168.6.0/24 next-hop 172.20.8.2*
- *set protocols static route 192.168.50.0/24 next-hop 172.20.4.2*
- *commit*
- *exit*

in LON06 Vyatta:

- *configure*
- *set protocols static route 192.168.50.0/24 next-hop 172.20.2.2*
- *set protocols static route 192.168.6.0/24 next-hop 172.20.4.1*
- *commit*
- *exit*

At this point you should have end-to-end connectivity and be able to ping between your Power VSIs in each PowerVS location and also from the Power VSI to IBM Cloud services such as Linux/Windows VSI.

If you cannot ping the IBM Cloud VSIs from the PowerVS location VSIs, you will need to open a ticket to address this issue. Support needs to address this from their Cisco Router side.

2.2 Geographic Logical Volume Manager (GLVM) Replication

AIX Geographic Logical Volume Manager (GLVM) is a software-based technology for real time geographic data mirroring over standard TCP/IP networks. AIX GLVM can help protect your business from a disaster by mirroring your mission-critical data to a remote disaster recovery site.

Using AIX GLVM, we will mirror the data of an IBM Power Virtual Server image from one data center to another. We will then simulate a DR event and recover that data at the remote data center.

2.2.1 Basic Concepts

We will use a simple configuration to describe the basic concepts of GLVM. We will use an example configuration for this tutorial. Consider an IBM AIX image that is running a business application. All of the data resides on two disks, DISK1 and DISK2. Each disk contains exactly half of the data. In other words, there is only one copy of the data which spans both disks. This configuration is shown in the following diagram:

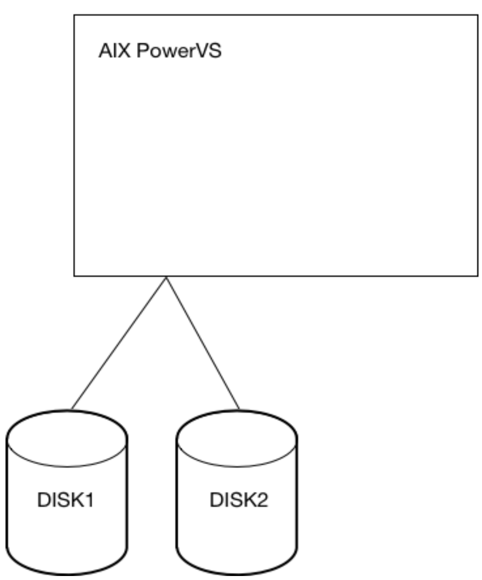


Figure 2.2.1.1 Typical AIX configuration

With only one copy of the data, a single storage failure would cause this environment to fail. To make this environment more redundant, we need to make a copy of the data.

AIX GLVM helps you to solve this problem by allowing a complete mirror to exist in a geographically distant location, the DR site. For this we will need two servers, one at the production site and another at the disaster recovery site and each site needs a complete mirror copy of the data. Both servers are connected by a TCP/IP network. This can be any type of TCP/IP network. The production and disaster recovery sites do not have to be on the same physical network. Routers and gateways between the two sites are allowed. For our example, the primary site will be in Toronto, CA and the DR site will be in London, UK. This is shown in the following diagram:

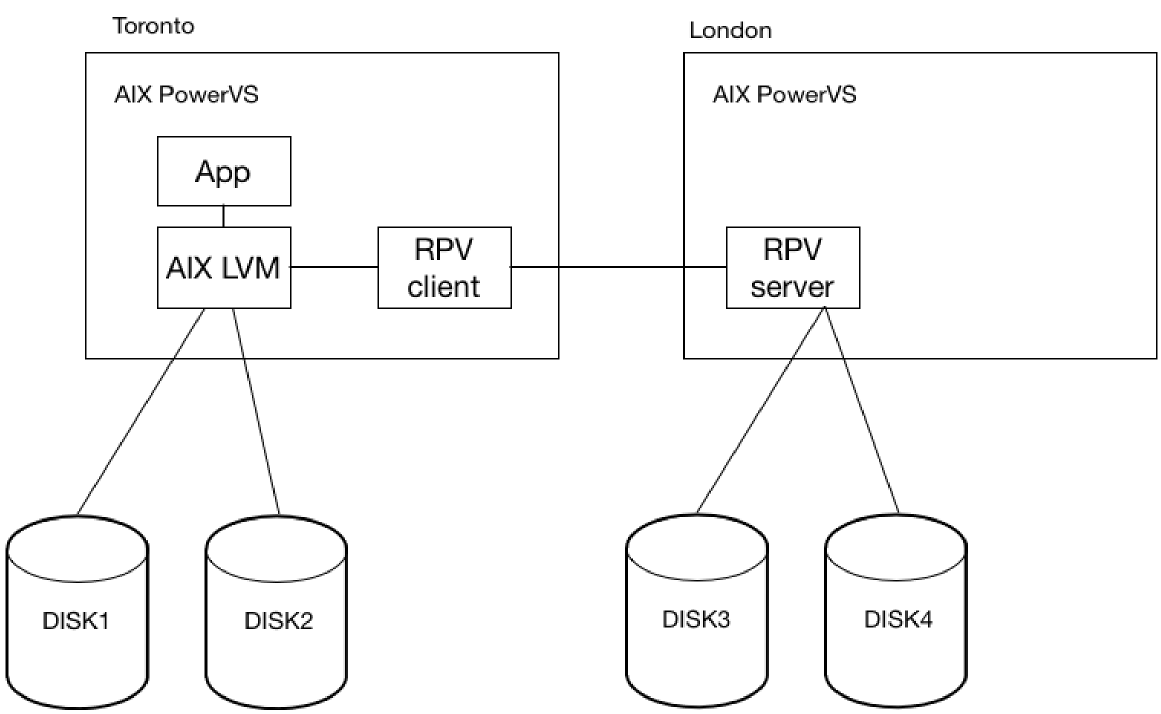


Figure 2.2.1.2 RPV server with disks

In this configuration, we can take the same volume group, containing the business application described earlier and stretch it across both sites. This is now a geographically mirrored volume group.

In the above diagram, the volume group will be varied on at the primary site and no replication is occurring. The Remote Physical Volume (RPV) device driver will allow AIX LVM at the production site to access the disks at the disaster recovery site as if they were locally attached. This will be accomplished by defining disks DISK3 and DISK4 to the production site as remote physical volumes.

There are two components to the RPV device driver, the RPV client and the RPV server. The RPV client will reside on the production site. The RPV server will reside on the DR site. The RPV server will process read/write requests from a the remote RPV client. Both RPV cdevice driver components work together to enable AIX LVM at the production site to access the DR disk(s).

Here is how it will work:

• The RPV server will present a disk from the DR site to the RPV client on the production site

• The production site will see a virtual disk that acts like a real disk and any writes to that disk go from the production site to the DR site.

• The production site will see a virtual disk that acts like a real disk and any writes to that disk go from the production site to the DR site

• Because the production site now sees extra disks, we can use regular IBM LVM processes to copy data from the local production disks to the remote DR disks

At this point, if a disaster were to destroy the primary site, the DR site would contain a copy of that data.

See the following diagram.

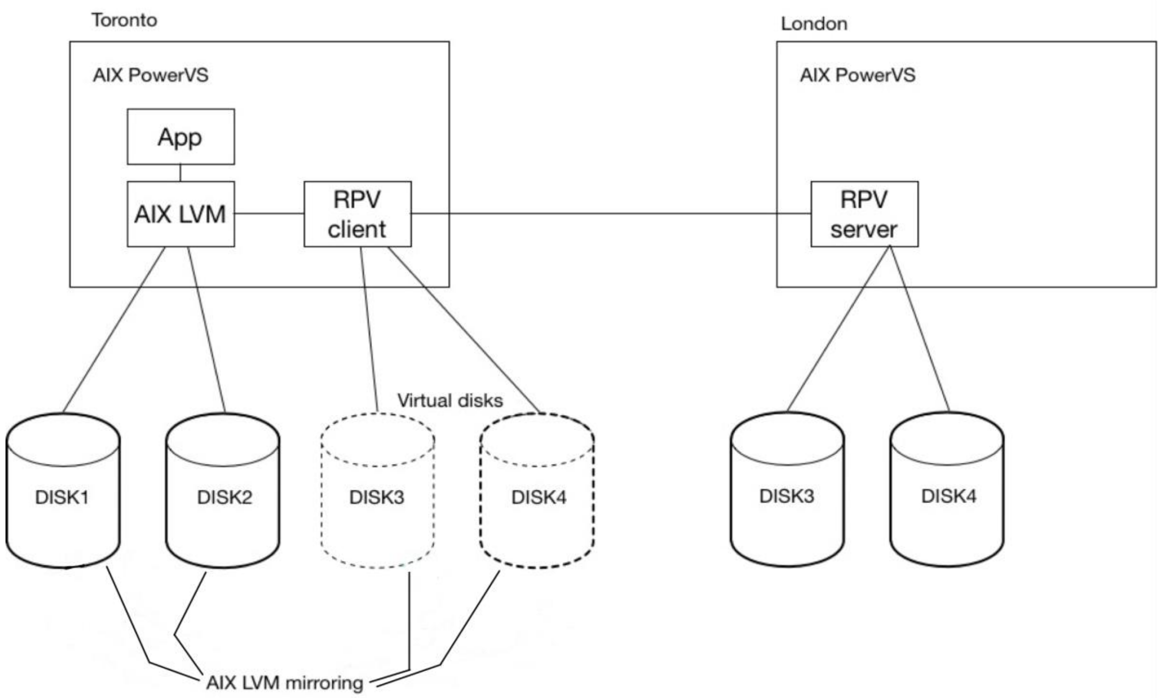


Figure 2.2.1.3 RPV server/client with virtual disks

In our example environment, we will create virtual disks in both directions. It was only drawn in one direction above for clarity.

2.2.2 Example environment

For our discussion, we will use the following configuration:

- *Single AIX PowerVS in Toronto location*
- *Single AIX PowerVS in London location*
- *Storage (tier 3, 6-20GB LUNs) allocated to each AIX PowerVS*
- *Communication between IBM Cloud locations*
- *Setting LV strictness*

2.2.3 Preparing for IBM AIX GLVM setup

For our discussion, we will use the following configuration:

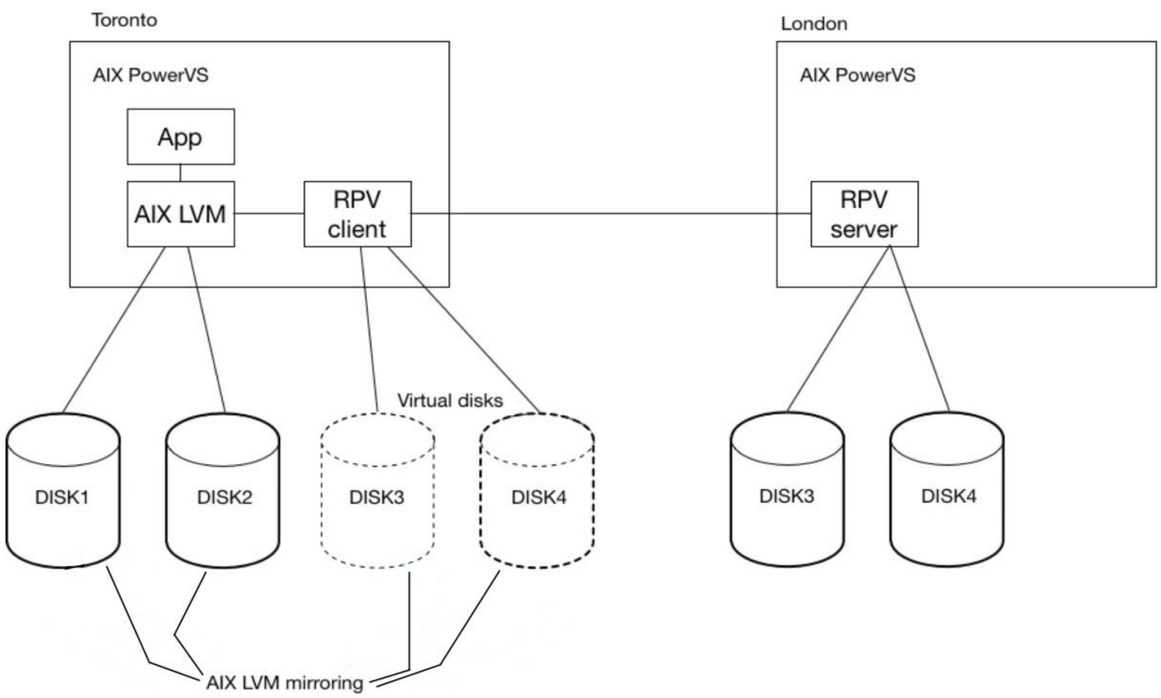


Figure 2.2.3.1 RPV server/client with virtual disks

In our example scenario, we have implemented an application with a couple of volume groups, dbvg and appvg. Those volume groups have 2 disk drives each.

We will prepare this environment for IBM GLVM replication by performing the following steps:

- *Change or verify the volume groups are a scalable volume group*
- *Updating the volume groups so as to not vary on automatically at reboot time*
- *Updating the volume groups by turning off bad block relocation*
- *Updating volume groups by setting super strict mirror pools*
- *Defining mirror pools*

2.2.4 Change or verify the volume groups are a scalable volume group

For our example, we did create the volume groups as scalable volume groups. This can be verified using the *lspv* and *readvgda* commands:

```
# lspv | grep dbvg
hdisk1          00c8d4403180f273                    dbvg            active
hdisk2          00c8d4403180f319                    dbvg            active
# readvgda hdisk2 | grep type
.....    readvgda_type: svg
type:           jfs2log
type:           jfs2
type:           jfs2
type:           jfs2
type:           jfs2
#
```

Figure 2.2.4.1 Using “readvgda” to find VG type

For our example, we did create the volume groups as scalable volume. If the volume groups were not scalable, they could be changed to scalable volume groups via the following command: *chvg -G <VGNAME>* where <VGNAME> is the name of the volume group. Note that the volume group needs to be varied off when this *chvg* command is executed.

2.2.5 Updating the volume groups so as to not vary on automatically at reboot time

We can update the volume group, so it does not automatically varyon at boot time using the following command: *chvg -a n <VGNAME>* where <VGNAME> is the name of the volume group. See the output of our command execution:

```
# chvg -an dbvg
# chvg -a n appvg
# lsvg dbvg
VOLUME GROUP:       dbvg                     VG IDENTIFIER:  00c8d44000004b00000
001733180f36e
VG STATE:           active                   PP SIZE:        16 megabyte(s)
VG PERMISSION:      read/write               TOTAL PPs:      2550 (40800 megabyt
es)
MAX LVs:            256                      FREE PPs:       2037 (32592 megabyt
es)
LVs:                5                        USED PPs:       513 (8208 megabytes
)
OPEN LVs:           5                        QUORUM:         2 (Enabled)
TOTAL PVs:          2                        VG DESCRIPTORS: 3
STALE PVs:          0                        STALE PPs:      0
ACTIVE PVs:         2                        AUTO ON:        no
MAX PPs per VG:     32768                    MAX PVs:        1024
LTG size (Dynamic): 512 kilobyte(s)          AUTO SYNC:      no
HOT SPARE:          no                       BB POLICY:      relocatable
MIRROR POOL STRICT: off
PV RESTRICTION:     none                     INFINITE RETRY: no
DISK BLOCK SIZE:    512                      CRITICAL VG:    no
FS SYNC OPTION:     no                       CRITICAL PVs:   no
#
```

Figure 2.2.5.1 Status of VG auto vary on field

Note the “AUTO ON: no” field on the lower right indicating this volume group will not automatically vary on at boot time.

2.2.6 Updating the volume groups by turning off bad block relocation

We can update the volume group so that black block relocation is disabled. By default, if a bad block is detected, that block is relocated to a different location on the disk. This would create dissimilar block maps between replicated LUNs, so it needs to be disabled.

Bad block relocation can be disabled via the following command: *chvg -b n <VGNAME>* where <VGNAME> is the name of the volume group. See the output of our command execution:

```
# chvg -b n dbvg
# lsvg dbvg
VOLUME GROUP:       dbvg                     VG IDENTIFIER:  00c8d44000004b00000
001733180f36e
VG STATE:           active                   PP SIZE:        16 megabyte(s)
VG PERMISSION:      read/write               TOTAL PPs:      2550 (40800 megabyt
es)
MAX LVs:            256                      FREE PPs:       2037 (32592 megabyt
es)
LVs:                5                        USED PPs:       513 (8208 megabytes
)
OPEN LVs:           5                        QUORUM:         2 (Enabled)
TOTAL PVs:          2                        VG DESCRIPTORS: 3
STALE PVs:          0                        STALE PPs:      0
ACTIVE PVs:         2                        AUTO ON:        no
MAX PPs per VG:     32768                    MAX PVs:        1024
LTG size (Dynamic): 512 kilobyte(s)          AUTO SYNC:      no
HOT SPARE:          no                       BB POLICY:      non-relocatable
MIRROR POOL STRICT: off
PV RESTRICTION:     none                     INFINITE RETRY: no
DISK BLOCK SIZE:    512                      CRITICAL VG:    no
FS SYNC OPTION:     no                       CRITICAL PVs:   no
#
```

Figure 2.2.6.1 Status of VG relocatable field

Note the “BB POLICY: non-relocatable” field on the lower right indicating bad block relocation is disabled.

2.2.7 Updating volume groups by setting super strict mirror pools

As mentioned previously, it is critical that we can guarantee one copy of the data is local and a secondary copy of the data is remote. We can do this by setting super strict mirror pools.

Super strict mirror pools can be set via the following command: *chvg -M s <VGNAME>* where <VGNAME> is the name of the volume group. See the output of our command execution:

```
# chvg -M s dbvg
# lsvg dbvg
VOLUME GROUP:       dbvg                     VG IDENTIFIER:  00c8d44000004b00000
001733180f36e
VG STATE:           active                   PP SIZE:        16 megabyte(s)
VG PERMISSION:      read/write               TOTAL PPs:      2550 (40800 megabyt
es)
MAX LVs:            256                      FREE PPs:       2037 (32592 megabyt
es)
LVs:                5                        USED PPs:       513 (8208 megabytes
)
OPEN LVs:           5                        QUORUM:         2 (Enabled)
TOTAL PVs:          2                        VG DESCRIPTORS: 3
STALE PVs:          0                        STALE PPs:      0
ACTIVE PVs:         2                        AUTO ON:        no
MAX PPs per VG:     32768                    MAX PVs:        1024
LTG size (Dynamic): 512 kilobyte(s)          AUTO SYNC:      no
HOT SPARE:          no                       BB POLICY:      non-relocatable
MIRROR POOL STRICT: super
PV RESTRICTION:     none                     INFINITE RETRY: no
DISK BLOCK SIZE:    512                      CRITICAL VG:    no
FS SYNC OPTION:     no                       CRITICAL PVs:   no
#
```

Figure 2.2.7.1 Status of VG mirror pool strictness

Note the “MIRROR POOL STRICT: super” field on the lower left indicating super strict mirror pools is enabled.

2.2.8 Defining mirror pools

Once we define the volume group with super strict mirror pools, we need to define the mirror pools. Mirror pool names can follow any type of convention, so it is up to the customer to determine that naming convention. For our purposes, we will the location as part of the naming convention.

Mirror pools can be set by adding physical volumes to the mirror pool. In our case, we will use the following:

- *Using “lspv” to determine the disks for a VG: lspv | grep dbvg*

```
# lspv | grep dbvg
hdisk1          00c8d4403180f273                    dbvg            active
hdisk2          00c8d4403180f319                    dbvg            active
#
```

Figure 2.2.8.1 Determining disks in a VG

- *Using "chpv" to create the mirror pool and add the volumes to it: chpv -p dbvg_tor01 hdisk1 hdisk2*

```
# chpv -p dbvg_tor01 hdisk1 hdisk2
0516-1010 chpv: Warning, the physical volume hdisk1 has open logical
        volumes.  Continuing with change.
0516-1010 chpv: Warning, the physical volume hdisk2 has open logical
        volumes.  Continuing with change.
#
```

Figure 2.2.8.2 Adding disks to a mirror pool

- *Using "lsmp" and "lspv" to display the mirror pool information: "lsmp -A" dbvg and "lspv -P"*

```
# lsmp -A dbvg
VOLUME GROUP:       dbvg                Mirror Pool Super Strict: yes

MIRROR POOL:        dbvg_tor01          Mirroring Mode:           SYNC
# lspv -P
Physical Volume   Volume Group      Mirror Pool
hdisk0            None
hdisk1            dbvg              dbvg_tor01
hdisk2            dbvg              dbvg_tor01
hdisk3            rootvg
hdisk4            None
hdisk5            appvg
hdisk6            appvg
#
```

Figure 2.2.8.3 Displaying mirror pool information

In our example, we continue defining mirror pools for the second vg 'appvg' and end up with the following:

```
# lspv -P
Physical Volume   Volume Group      Mirror Pool
hdisk0            None
hdisk1            dbvg              dbvg_tor01
hdisk2            dbvg              dbvg_tor01
hdisk3            rootvg
hdisk4            None
hdisk5            appvg             appvg_tor01
hdisk6            appvg             appvg_tor01
#
```

Figure 2.2.8.4 Displaying mirror pool information

2.2.9 Setting LV strictness

The AIX LVs also have to be set to superstrict. We do this to every LV in the volume group. We use “lsvg -l <VGNAME>” to display the LVs and then “chlv -s s <LVNAME>” to set the strictness.

```
pc-tor01-glvm-01a: / >
# chlv -s s loglv00
pc-tor01-glvm-01a: / >
#
```

Figure 2.2.9.1 Changing LV strictness to superstrict

And

```
# lslv loglv00 | more
LOGICAL VOLUME:     loglv00                VOLUME GROUP:   dbvg
LV IDENTIFIER:      00c8d44000004b00000001733180f36e.1 PERMISSION:     read/writ
e
VG STATE:           active/complete        LV STATE:       closed/syncd
TYPE:               jfs2log                WRITE VERIFY:   off
MAX LPs:            512                    PP SIZE:        16 megabyte(s)
COPIES:             2                      SCHED POLICY:   parallel
LPs:                1                      PPs:            2
STALE PPs:          0                      BB POLICY:      relocatable
INTER-POLICY:       minimum                RELOCATABLE:    yes
INTRA-POLICY:       middle                 UPPER BOUND:    2
MOUNT POINT:        N/A                    LABEL:          None
DEVICE UID:         0                      DEVICE GID:     0
DEVICE PERMISSIONS: 432
MIRROR WRITE CONSISTENCY: on/ACTIVE
EACH LP COPY ON A SEPARATE PV ?: yes (superstrict)
Serialize IO ?:     NO
INFINITE RETRY:     no                     PREFERRED READ: 0
DEVICESUBTYPE:      DS_LVZ
COPY 1 MIRROR POOL: dbvg_tor01
COPY 2 MIRROR POOL: dbvg_lon06
COPY 3 MIRROR POOL: None
```

Figure 2.2.9.2 Displaying LV strictness

Note the field “EACH LP COPY ON A SEPARATE PV ?” is “yes (superstrict).

We repeat this process for all LVs in all of the appropriate VGs.

2.2.10 Implementing AIX GLVM RPV servers and RPV clients

Now that the AIX volume groups have been readied for AIX GLVM, we can implement the AIX GLVM RPV servers and clients. As noted before, the RPV server presents a physical disk to the RPV client. The RPV client uses that to present a virtual disk to the AIX operating system. The operating system can use that virtual disk and store data in it. That data is actually being replicated to the remote RPV server instance and written to the physical volume at that remote location.

To mirror data from our Toronto PowerVS to London, we will setup an RPV server at our London PowerVS. That RPV server will present its physical volume to the RPV client instance at our Toronto PowerVS. The Toronto PowerVS, in turn, will present that volume as a virtual volume to the AIX operating system and we can start to use AIX LVM to replicate data between the different drives.

2.2.11 Implementing AIX GLVM RPV servers

Now that the AIX volume groups have been readied for AIX GLVM, we can implement the AIX GLVM RPV servers. The AIX GLVM RPV servers will exist on the DR site, the IBM Cloud London location for our example. We note the IP address of our PowerVS images at the Toronto and London locations:

- *Toronto: 192.168.6.163*
- *London: 192.168.50.184*

We log into our London PowerVS instance and make sure the LUNs we will be using have PVIDs on them:

- *Checking hdisks we will make available, hdisk1, hdisk2, hdisk5, hdisk6*

```
pc-lon06-glvm-01a:/ >
# lspv
hdisk0          none                                    None
hdisk1          none                                    None
hdisk2          none                                    None
hdisk3          00f6db0af58e9775                        rootvg          active
hdisk4          none                                    None
hdisk5          none                                    None
hdisk6          none                                    None
pc-lon06-glvm-01a:/ >
#
```

Figure 2.2.11.1 Determining available disks

- *Adding PV ID's to hdisk1, hdisk2, hdisk5, hdisk6*

```
pc-lon06-glvm-01a:/ >
# chdev -a pv=yes -l hdisk1
hdisk1 changed
pc-lon06-glvm-01a:/ >
# chdev -a pv=yes -l hdisk2
hdisk2 changed
pc-lon06-glvm-01a:/ >
# chdev -a pv=yes -l hdisk5
hdisk5 changed
pc-lon06-glvm-01a:/ >
# chdev -a pv=yes -l hdisk6
hdisk6 changed
pc-lon06-glvm-01a:/ >
# lspv
hdisk0          none                                    None
hdisk1          00c8cf803fb0193a                        None
hdisk2          00c8cf803fb02116                        None
hdisk3          00f6db0af58e9775                        rootvg          active
hdisk4          none                                    None
hdisk5          00c8cf803fb029cd                        None
hdisk6          00c8cf803fb03444                        None
pc-lon06-glvm-01a:/ >
#
```

Figure 2.2.11.2 Adding PVIDs to disks

- *We verify that both RPV server and RPV client IP addresses are on the /etc/hosts file*

```
pc-lon06-glvm-01a:/ >
# hostent -S
127.0.0.1               loopback localhost      # loopback (lo0) name/address
192.168.6.163 pc-tor01-glvm-01a
192.168.50.184 pc-lon06-glvm-01a
pc-lon06-glvm-01a:/ >
#
```

Figure 2.2.11.3 Verifying /etc/hosts entries

- *We define the RPV site name by going into the SMIT menu 'rpvserver'*

```
                         Remote Physical Volume Servers

Move cursor to desired item and press Enter.

  Remote Physical Volume Server Site Name Configuration
  List All Remote Physical Volume Servers
  Add Remote Physical Volume Servers
  Change / Show a Remote Physical Volume Server
  Change Multiple Remote Physical Volume Servers
  Remove Remote Physical Volume Servers
  Configure Defined Remote Physical Volume Servers











F1=Help             F2=Refresh          F3=Cancel           F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.2.11.4 Displaying primary RPV server SMIT panel

- *Then select "Remote Physical Volume Server Site Name Configuration" -> "Define / Change / Show Remote Physical Volume Server Site Name" and enter the site name, london06, for our example.*

```
         Define / Change / Show Remote Physical Volume Server Site Name

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
* Remote Physical Volume Server Site Name            [london06












F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.2.11.5 Adding an RPV server site name

- *Depress the Enter key and wait for SMIT to complete the process (no output will be given).*
- *IMPORTANT NOTE: The site name must be entered for each site even if only one site will have RPV servers*
- *Then we add the RPV servers by going to SMIT panel, smit rpvserver, then selecting "Add Remote Physical Volume Servers" where the available LUNs are presented. We will select hdisk1 for this example.*

```
                         Remote Physical Volume Servers

Move cursor to desired item and press Enter.

  Remote Physical Volume Server Site Name Configuration
  List All Remote Physical Volume Servers

                         Physical Volume Identifiers

    Move cursor to desired item and press F7.
        ONE OR MORE items can be selected.
    Press Enter AFTER making all selections.

      # Physical Volume        Physical Volume Identifier
      # ----------------------------------------------------
      hdisk1           00c8cf803fb0193a
      hdisk2           00c8cf803fb02116
      hdisk5           00c8cf803fb029cd
      hdisk6           00c8cf803fb03444

    F1=Help                  F2=Refresh               F3=Cancel
    F7=Select                F8=Image                 F10=Exit
F1  Enter=Do                 /=Find                   n=Find Next
F9
```

Figure 2.2.11.6 Adding PVs to an RPV server

- *At this point, we add the client IP address to the "Remote Physical Volume Client Internet Address" field and depress the Enter key.*

```
                         Add Remote Physical Volume Servers

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                         [Entry Fields]
  Physical Volume Identifiers                          00c8cf803fb0193a
* Remote Physical Volume Client Internet Address     [192.168.6.163          +
  Configure Automatically at System Restart?         [no]                    +
  Start New Devices Immediately?                     [yes]                   +









F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.2.11.7 Configuring RPV server

- *The confirmation is displayed*

```
                                   COMMAND STATUS

Command: OK            stdout: yes           stderr: no

Before command completion, additional instructions may appear below.

 pvserver0 Available










F1=Help             F2=Refresh          F3=Cancel           F6=Command
F8=Image            F9=Shell            F10=Exit            /=Find
n=Find Next
```

Figure 2.2.11.8 Output of RPV server configuration

- *Then we repeat this process for the rest of the LUNs we will be presenting to our Toronto PowerVS.*

2.2.12 Implementing AIX GLVM RPV clients

With the RPV servers setup, we can proceed to the RPV client and configure them to see the remote LUNs. Again, the IP addresses of the dare:

- *Toronto: 192.168.6.163*
- *London: 192.168.50.184*

We log into our Toronto PowerVS instance proceed to the RPV client menu, smit rpvclient:

```
                         Remote Physical Volume Clients

Move cursor to desired item and press Enter.

  List All Remote Physical Volume Clients
  Add Remote Physical Volume Clients
  Change / Show a Remote Physical Volume Client
  Change Multiple Remote Physical Volume Clients
  Remove Remote Physical Volume Clients
  Configure Defined Remote Physical Volume Clients











F1=Help             F2=Refresh          F3=Cancel           F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.2.12.1 SMIT panel for RPV clients

- *We select "Add Remote Physical Volume Clients", determine whether we are using IPv6 or not. The example does not use IPv6.*

```
                     Add Remote Physical Volume Clients

Type or select a value for the entry field.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
* Does data mirroring network use Internet Protocol   no                     +
  Version 6 (IPv6)?










F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.2.12.2 RPV client configuration, IPv6 confirmation

- *Then add the IP address of the RPV server*

```
                     Add Remote Physical Volume Clients

Type or select a value for the entry field.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
* Remote Physical Volume Server Internet Address     [192.168.50.184         +










F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.2.12.3 RPV client configuration of RPV server IP

- *And*

```
                     Add Remote Physical Volume Clients

Type or select a value for the entry field.
Press Enter AFTER making all desired changes.

                                                         [Entry Fields]
* Remote Physical Volume Server Internet Address      [192.168.50.184]        +

  ┌──────────────────────────────────────────────────────────────────────────┐
  │            Remote Physical Volume Local Internet Address                │
  │                                                                          │
  │ Move cursor to desired item and press Enter.                             │
  │                                                                          │
  │   192.168.6.163    pc-tor01-glvm-01a                                     │
  │                                                                          │
  │ F1=Help                 F2=Refresh              F3=Cancel                │
F1│ F8=Image                F10=Exit                Enter=Do                 │
Es│ /=Find                  n=Find Next                                      │
F9└──────────────────────────────────────────────────────────────────────────┘
```

Figure 2.2.12.4 Selecting RPV server location from RPV client

- *You will be presented with the available RPV servers which correspond to the LUNs that are being presented by the RPV server PowerVS instance.*

```
                     Add Remote Physical Volume Clients

Ty┌──────────────────────────────────────────────────────────────────────────┐
Pr│                  Remote Physical Volume Server Disks                     │
  │                                                                          │
  │ Move cursor to desired item and press F7.                                │
* │     ONE OR MORE items can be selected.                                   │
  │ Press Enter AFTER making all selections.                                 │
  │                                                                          │
  │ [MORE...5]                                                               │
  │   # pc-lon06-glvm-01a)                                                   │
  │   #                                                                      │
  │   # Physical Volume        Physical Volume Identifier                    │
  │   # -------------------------------------------------------              │
  │     hdisk1                 00c8cf803fb0193a0000000000000000              │
  │     hdisk2                 00c8cf803fb02116000000000000000 0             │
  │     hdisk5                 00c8cf803fb029cd0000000000000000              │
  │     hdisk6                 00c8cf803fb034440000000000000000              │
  │ [BOTTOM]                                                                 │
  │                                                                          │
  │ F1=Help                 F2=Refresh              F3=Cancel                │
F1│ F7=Select               F8=Image                F10=Exit                 │
Es│ Enter=Do                /=Find                  n=Find Next              │
F9└──────────────────────────────────────────────────────────────────────────┘
```

Figure 2.2.12.5 Selecting RPV server LUN from RPV client

- *We select “hdisk1” and depress the Enter key bring up the device parameter menu.*

```
                       Add Remote Physical Volume Clients

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
  Remote Physical Volume Server Internet Address      192.168.50.184
  Remote Physical Volume Local Internet Address       192.168.6.163
  Physical Volume Identifiers                          0c8cf803fb0193a00000>
  I/O Timeout Interval (Seconds)                     [180]                  #
  Start New Devices Immediately?                     [yes]                  +









F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.2.12.6 Configuring RPV client parameters

- *For our case, we select the default parameters and depress the Enter key bring up the results screen.*

```
                                 COMMAND STATUS

Command: OK            stdout: yes           stderr: no

Before command completion, additional instructions may appear below.

 disk7 Available













F1=Help             F2=Refresh          F3=Cancel           F6=Command
F8=Image            F9=Shell            F10=Exit            /=Find
n=Find Next
```

Figure 2.2.12.7 RPV client configuration output

- *We then repeat the same process for the remaining LUNs.*
- *Once completed, we note the new LUNs available on our Toronto PowerVS instance (hdisk7->hdisk10).*

```
pc-tor01-glvm-01a: / >
# lspv
hdisk0          none                                None
hdisk1          00c8d4403180f273                    dbvg            active
hdisk2          00c8d4403180f319                    dbvg            active
hdisk3          00f6db0af58e9775                    rootvg          active
hdisk4          none                                None
hdisk5          00c8d44031815edd                    appvg           active
hdisk6          00c8d44031815f5a                    appvg           active
hdisk7          00c8cf803fb0193a                    None
hdisk8          00c8cf803fb02116                    None
hdisk9          00c8cf803fb029cd                    None
hdisk10         00c8cf803fb03444                    None
pc-tor01-glvm-01a: / >
#
```

Figure 2.2.12.8 Displaying addition of RPV client

- *And also note that these LUNs are RPV clients by using the "lsdev -Cc disk" command.*

```
pc-tor01-glvm-01a: / >
# lsdev -Ccdisk
hdisk0  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk1  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk2  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk3  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk4  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk5  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk6  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk7  Available          Remote Physical Volume Client
hdisk8  Available          Remote Physical Volume Client
hdisk9  Available          Remote Physical Volume Client
hdisk10 Available          Remote Physical Volume Client
pc-tor01-glvm-01a: / >
#
```

Figure 2.2.12.9 Display local and RPV client hdisks

2.2.13 Replicating data between sites using AIX LVM

With the RPV servers and clients defined, the virtual drives can now be used to replicate the data between sites.

In our example, we have a volume group "dbvg", which include the following LUNs: hdisk1, hdisk2

```
pc-tor01-glvm-01a: / >
# lspv -P
Physical Volume   Volume Group      Mirror Pool
hdisk0            None
hdisk1            dbvg              dbvg_tor01
hdisk2            dbvg              dbvg_tor01
hdisk3            rootvg
hdisk4            None
hdisk5            appvg             appvg_tor01
hdisk6            appvg             appvg_tor01
hdisk7            None
hdisk8            None
hdisk9            None
hdisk10           None
pc-tor01-glvm-01a: / >
```

Figure 2.2.13.1 Displaying disks and associated mirror pools

- *We will add the virtual disks, hdisk7 and hdisk8 to the volume group dbvg with a mirror pool name of dbvg_lon06 using the command: extendvg -p dbvg_lon06 dbvg hdisk7 hdisk8*

```
pc-tor01-glvm-01a: /usr/sbin >
# lspv -P
Physical Volume   Volume Group      Mirror Pool
hdisk0            None
hdisk1            dbvg              dbvg_tor01
hdisk2            dbvg              dbvg_tor01
hdisk3            rootvg
hdisk4            None
hdisk5            appvg             appvg_tor01
hdisk6            appvg             appvg_tor01
hdisk7            dbvg              dbvg_lon06
hdisk8            dbvg              dbvg_lon06
```

Figure 2.2.13.2 Extended a VG with new disk and mirror pool

- *Note that hdisk7, hdisk8 (our virtual drives) are now part of the "dbvg" volume group and belong to a mirror pool named "dbvg_lon06"*
- *We then mirror our "dbvg" by mirror each of the LVs, such as fslv00, using the following command: mklvcopy -p copy1=dbvg_tor01 -p copy2=dbvg_lon06 fslv00 2*
  The above command tells AIX to mirror the""fslv00" logical volume with copy 1 being in the "dbvg_tor01" mirror pool and copy 2 being in the "dbvg_lon06" making a total of 2 copies
- *We verify the replication by using the "lsvg -l dbvg" command*

```
# mklvcopy -p copy1=dbvg_tor01 -p copy2=dbvg_lon06 fslv00 2
pc-tor01-glvm-01a: /usr/sbin >
# lsvg -l dbvg
dbvg:
LV NAME             TYPE       LPs     PPs     PVs  LV STATE      MOUNT POINT
loglv00             jfs2log    1       1       1    closed/syncd  N/A
fslv00              jfs2       128     256     2    closed/stale  /data01
fslv01              jfs2       128     128     1    closed/syncd  /data02
fslv02              jfs2       128     128     1    closed/syncd  /data03
fslv03              jfs2       128     128     1    closed/syncd  /data04
```

Figure 2.2.13.3 Displaying multiple copies of fslv00 LV

- *Note that the "fslv00" logical volume now has 2 copies and the state is "stale". The state will be updated in the near future.*
- *We proceed in mirroring the remaining LVs, loglv00, fslv01, fslv02, fslv03. This is verified with the "lsvg -l dbvg" command.*

```
pc-tor01-glvm-01a: /usr/sbin >
# lsvg -l dbvg
dbvg:
LV NAME             TYPE       LPs     PPs     PVs  LV STATE      MOUNT POINT
loglv00             jfs2log    1       2       2    closed/stale  N/A
fslv00              jfs2       128     256     2    closed/stale  /data01
fslv01              jfs2       128     256     2    closed/stale  /data02
fslv02              jfs2       128     256     2    closed/stale  /data03
fslv03              jfs2       128     256     2    closed/stale  /data04
```

Figure 2.2.13.4 Displaying multiple copies of all LVs in VG, dbvg

- *Note that all LVs are now 2 copies (1 LP and 2 PPs) across 2 PVs and in stale status.*
- *To start the synchronization, simply execute the varyonvg command: varyonvg dbvg*
- *The synchronization will initiate which can be verified by running the "ps -ef | grep sync" command*

```
pc-tor01-glvm-01a: /usr/sbin >
# varyonvg dbvg
pc-tor01-glvm-01a: /usr/sbin >
# ps -ef | grep -i sync
    root  3539314        1   0   Jul 11      -  0:04 /usr/sbin/syncd 60
    root  9306570 19792158   0 03:51:42   vty0  0:00 lresynclv -l 00c8d44000004b
00000001733180f36e
    root 19792158        1   0 03:51:42   vty0  0:00 /bin/ksh /usr/sbin/syncvg -
v dbvg
    root 22151544  7406072   0 03:51:48   vty0  0:00 grep -i sync
```

Figure 2.2.13.5 Displaying VG synchronization processes

- *Note the "lresynclv" command is running which is what is synchronizing that volume group.*

- *The progress can be checked by running the "lsvg -l dbvg" command*

```
pc-tor01-glvm-01a: /usr/sbin >
# lsvg -l dbvg
dbvg:
LV NAME             TYPE       LPs     PPs     PVs  LV STATE      MOUNT POINT
loglv00             jfs2log    1       2       2    closed/syncd  N/A
fslv00              jfs2       128     256     2    open/stale    /data01
fslv01              jfs2       128     256     2    closed/stale  /data02
fslv02              jfs2       128     256     2    closed/stale  /data03
fslv03              jfs2       128     256     2    closed/stale  /data04
```

Figure 2.2.13.6 Displaying LV synchronization status

- *Note that the LV, "loglv00", is now in syncd state which means is fully synchronized between all drives (local and remote) while the other LVs remain to be synchronized as those are still in "stale" state.*
- *The same process is repeated for the additional VG, appvg in our example.*

2.2.14 Accessing the data in a DR event

The replication setup implemented in this scenario is a "true" DR setup. The implementation is purely one way, from the production site to the DR site.

In the event of a disaster, we will only have half of the storage for each of the volume groups.

We will simulate a DR event by shutting down the production PowerVS.

```
1 unsuccessful login attempt since last login.
Last unsuccessful login: Tue Jul 21 17:33:46 CDT 2020 on /dev/vty0
Last login: Tue Jul 21 14:41:46 CDT 2020 on /dev/vty0

pc-tor01-glvm-01a: / >
# shutdown -F

SHUTDOWN PROGRAM
Tue Jul 21 17:34:04 CDT 2020
Jul 21 2020 17:34:04
/usr/es/sbin/cluster/utilities/clstop : called with flags -f -y -s -N -S
0513-044 The clinfoES Subsystem was requested to stop.
0513-044 The clevmgrdES Subsystem was requested to stop.
Running /etc/rc.d/rc2.d/Kcluster stop
Quiescing cthags...
Stopping IBM.ConfigRM...
0513-004 The Subsystem or Group, IBM.ConfigRM, is currently inoperative.
Running /etc/rc.d/rc2.d/Ksshd stop
0513-044 The sshd Subsystem was requested to stop.
Running /etc/rc.d/rc2.d/Kwpars stop

Wait for '....Halt completed....' before stopping.
Error reporting has stopped.
```

Figure 2.2.14.1 Shutting down production PowerVS

This results in the DR PowerVS being the only active image. We long into the DR PowerVS in London and note that we see only the local disks.

```
pc-lon06-glvm-01a:/ >
# lspv
hdisk0          00c8cf80601b4933                    None
hdisk1          00c8cf803fb0193a                    None
hdisk2          00c8cf803fb02116                    None
hdisk3          00f6db0af58e9775                    rootvg          active
hdisk4          00c8cf8049bac9fa                    caavg_private   active
hdisk5          00c8cf803fb029cd                    None
hdisk6          00c8cf803fb03444                    None
pc-lon06-glvm-01a:/ >
#
```

Figure 2.2.14.1 DR PowerVS storage

The process for accessing the data is to import the volume groups with the LUNs that are available. We note that hdisk1 and hdisk2 are associated with the “dbvg” volume group and hdisk5, hdisk6 are associated with the “appvg” volume group.

We import the “dbvg” volume group using “importvg -f -y dbvg -V 100 hdisk1” command. Note that the “-f” means we are forcing the import, the "-V 100" flag means we are assigning the VG the major number of 100. In the following figure, note the error messages as they will be utilized when cleaning up the VG.

```
pc-lon06-glvm-01a:/ >
# importvg -f -y dbvg -V 100 hdisk1
PV Status:      hdisk1  00c8cf803fb0193a        PVACTIVE
                hdisk2  00c8cf803fb02116        PVACTIVE
                        00c8d4403180f273        NONAME
                        00c8d4403180f319        NONAME
varyonvg: Volume group dbvg is varied on.
0516-510 synclvodm: Physical volume not found for physical volume
        identifier 00c8d4403180f2730000000000000000.
0516-510 synclvodm: Physical volume not found for physical volume
        identifier 00c8d4403180f3190000000000000000.
0516-548 synclvodm: Partially successful with updating volume
        group dbvg.
dbvg
0516-783 importvg: This imported volume group is concurrent capable.
        Therefore, the volume group must be varied on manually.
```

Figure 2.2.14.2 Importing a VG on the DR PowerVS

After importing the VG, we will vary it on so that the filesystems can be access. We utilize the "varyonvg -f -O dbvg" command. Note the "-f" and "-O" flags are utilized to vary on the VG due the fact there is no quorum.

```
# varyonvg -O dbvg
0516-052 varyonvg: Volume group cannot be varied on without a
        quorum. More physical volumes in the group must be active.
        Run diagnostics on inactive PVs.
pc-lon06-glvm-01a:/ >
# varyonvg -f -O dbvg
PV Status:      hdisk1  00c8cf803fb0193a        PVACTIVE
                hdisk2  00c8cf803fb02116        PVACTIVE
                        00c8d4403180f273        NONAME
                        00c8d4403180f319        NONAME
varyonvg: Volume group dbvg is varied on.
pc-lon06-glvm-01a:/ >
```

Figure 2.2.14.3 Varying on a VG without a quorum

At this point, we list the VG and note the filesystems are still there.

```
pc-lon06-glvm-01a:/ >
# lsvg -l dbvg
dbvg:
LV NAME             TYPE       LPs     PPs     PVs  LV STATE      MOUNT POINT
loglv00             jfs2log    1       2       2    closed/syncd  N/A
fslv00              jfs2       128     256     2    closed/syncd  /data01
fslv01              jfs2       128     256     2    closed/syncd  /data02
fslv02              jfs2       128     256     2    closed/syncd  /data03
fslv03              jfs2       128     256     2    closed/syncd  /data04
```

Figure 2.2.14.4 Listing filesystems

We mount the filesystems so the data can be accessed.

```
pc-lon06-glvm-01a:/ >
# mount /data01;mount /data02;mount /data03;mount /data04
pc-lon06-glvm-01a:/ >
#
```

Figure 2.2.14.5 Mounting filesystems

And

```
pc-lon06-glvm-01a:/ >
# df
Filesystem    512-blocks      Free %Used    Iused %Iused Mounted on
/dev/hd4          196608    105560   47%     3038    21% /
/dev/hd2         4784128    330112   94%    40766    50% /usr
/dev/hd9var      1966080   1533632   22%     1764     2% /var
/dev/hd3          458752    453424    2%       55     1% /tmp
/dev/hd1           65536     64792    2%        7     1% /home
/dev/hd11admin     262144    261384    1%        5     1% /admin
/proc                  -         -    -         -     - /proc
/dev/hd10opt      786432     85096   90%    11482    53% /opt
/dev/livedump     524288    523552    1%        4     1% /var/adm/ras/livedump
/dev/repo00     15335424     66280  100%     2534    25% /usr/sys/inst.images
/dev/toolslv     2621440    452056   83%       12     1% /tools
/ahafs                 -         -    -        48     1% /aha
/dev/fslv00      4194304   4084024    3%     1016     1% /data01
/dev/fslv01      4194304   3598480   15%     1945     1% /data02
/dev/fslv02      4194304   4000328    5%      826     1% /data03
/dev/fslv03      4194304   4193008    1%        4     1% /data04
```

Figure 2.2.14.6 Displaying mounted filesystems

We proceed with the remaining VG.

At this point, we can start the application and proceed with our recovery.

2.2.15 Cleaning up mirrors after a DR event

While the application and data was successfully brought up in the previous section, there remains some activities to clean up LV mirrors. After mount the filesystems and starting the application, the data will be marked “stale” due to the fact there are no mirror physical volumes. This can be displayed via the “lsvg -l dbvg” command for the “dbvg” volume group.

```
pc-lon06-glvm-01a:/ >
# lsvg -l dbvg
dbvg:
LV NAME             TYPE       LPs     PPs     PVs  LV STATE      MOUNT POINT
loglv00             jfs2log    1       2       2    open/stale    N/A
fslv00              jfs2       128     256     2    open/stale    /data01
fslv01              jfs2       128     256     2    open/stale    /data02
fslv02              jfs2       128     256     2    open/stale    /data03
fslv03              jfs2       128     256     2    open/stale    /data04
```

Figure 2.2.15.1 Displaying stale data

This can be cleaned up by removing the copy from the previously existing drives.

We recall that when we imported the volume group, there were some PVs missing.

```
pc-lon06-glvm-01a:/ >
# varyonvg -f -O dbvg
PV Status:      hdisk1  00c8cf803fb0193a       PVACTIVE
                hdisk2  00c8cf803fb02116       PVACTIVE
                        00c8d4403180f273       NONAME
                        00c8d4403180f319       NONAME
varyonvg: Volume group dbvg is varied on.
pc-lon06-glvm-01a:/ >
```

Figure 2.2.15.2 Importing “dbvg” volume group

We take note of the PVIDs that are missing. We proceed cleaning up the LVs by removing the “stale” copy using the “rmlvcopy <LVNAME> 1 <PVID>” as shown in the following diagram.

```
pc-lon06-glvm-01a:/ >
# rmlvcopy fslv00 1 00c8d4403180f319
pc-lon06-glvm-01a:/ >
#
```

Figure 2.2.15.3 Removing “stale” LV copies

We note that the LV is now no longer stale as there is only one copy.

```
pc-lon06-glvm-01a:/ >
# lsvg -l dbvg
dbvg:
LV NAME             TYPE       LPs     PPs     PVs  LV STATE      MOUNT POINT
loglv00             jfs2log    1       1       1    open/syncd    N/A
fslv00              jfs2       128     128     1    open/syncd    /data01
fslv01              jfs2       128     256     2    open/stale    /data02
fslv02              jfs2       128     256     2    open/stale    /data03
fslv03              jfs2       128     256     2    open/stale    /data04
pc-lon06-glvm-01a:/ >
```

Figure 2.2.15.4 Displaying LV, “fslv00”, has one copy

We proceed with all the LVs until it is all cleaned up as shown in the figure below.

```
pc-lon06-glvm-01a:/ >
# lsvg -l dbvg
dbvg:
LV NAME             TYPE       LPs     PPs     PVs  LV STATE      MOUNT POINT
loglv00             jfs2log    1       1       1    open/syncd    N/A
fslv00              jfs2       128     128     1    open/syncd    /data01
fslv01              jfs2       128     128     1    open/syncd    /data02
fslv02              jfs2       128     128     1    open/syncd    /data03
fslv03              jfs2       128     128     1    open/syncd    /data04
pc-lon06-glvm-01a:/ >
```

Figure 2.2.15.5 Displaying LV are “cleaned up” with only one copy

2.3 Geographic Logical Volume Manager (GLVM) Replication with PowerHA

While AIX GLVM provides a method of replicating an application's data to a DR site, it does not provide a method of automatically detecting a failure and bringing up the DR site. Integrating AIX GLVM with IBM PowerHA Enterprise Edition (EE) will provide that automation.

IBM PowerHA technology provides high availability, business continuity and disaster recovery. It enables the deployment of an HA solution that addresses both storage and high availability requirements with one integrated configuration.

In our configuration, we will build a simple 2 node cluster where one node is our PowerVS instance in the Toronto location and the second node is our PowerVS instance in London.

We will build the IBM PowerHA cluster configuration with a single resource group which will contain the volume groups, dbvg and appvg. For simplicity, there will be no other resources on that resource group such as IP addresses or application controllers.

For examples of more complex PowerHA cluster, there are many resources listed in "Chapter 4: Additional resources".

2.3.1 Preparing AIX GLVM for IBM PowerHA EE

With the AIX GLVM only setup, we had the RPV servers only on the DR site. In essence, it was a one-way replication from the primary site to the DR site. Data did not flow from the DR site to the primary site.

With IBM PowerHA, we will need to have the ability of the data to be replicated in either directions. For that to occur, we will need to create RPV servers on the primary site so that the DR site can see those drives as virtual drives using the RPV clients on the DR site PowerVS.

In that scenario, PowerHA will be managing which site is operational and control the RPV server/client activation and deactivation.

The starting state of the AIX GLVM-only replication looks like this diagram.

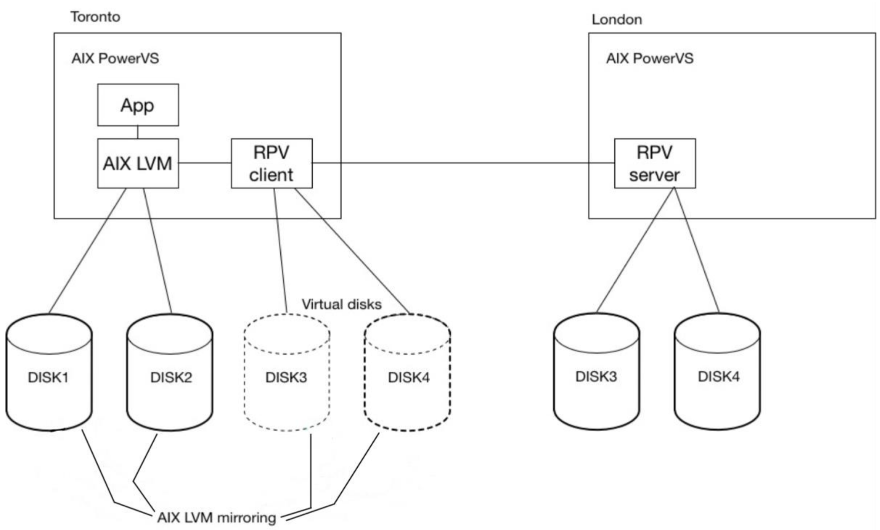


Figure 2.3.1.1 Starting state of AIX GLVM-only replication

Note that in the above diagram, only the London location PowerVS have RPV servers. We will add RPV servers to the Toronto PowerVS and RPV clients to the London PowerVS in order to present the drives from Toronto to London.

The final AIX GLVM configuration will look like the following diagram.

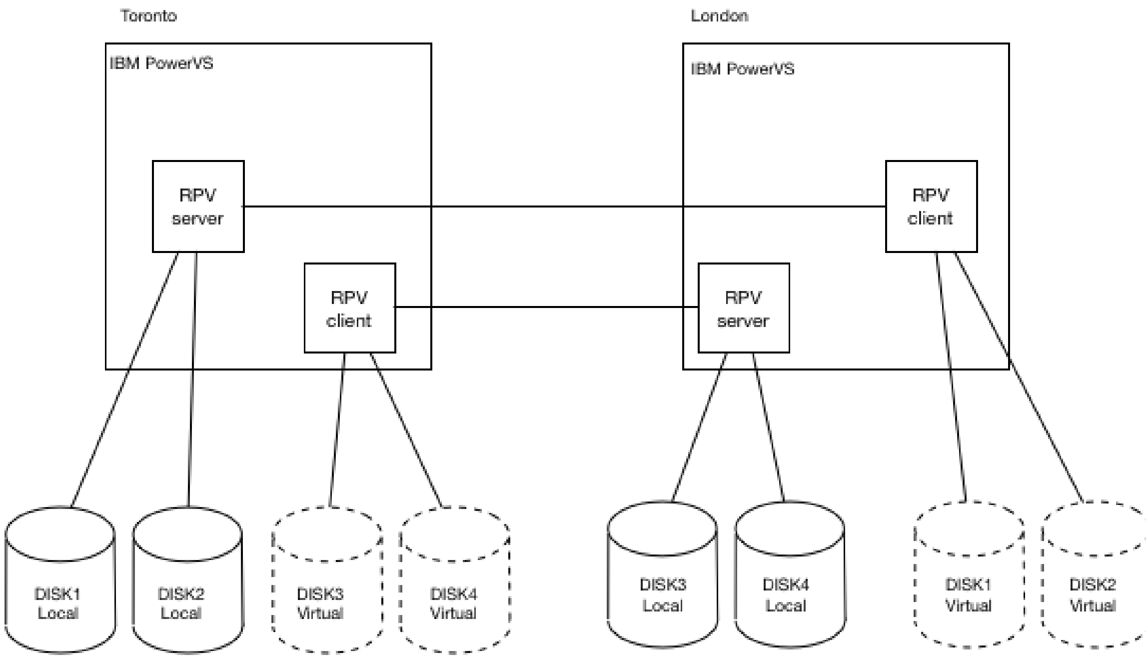


Figure 2.3.1.2 AIX GLVM replication in both directions

We proceed with the following steps

- *Determine for which drives to create RPV servers*
- *Bring the VGs offline*
- *Create the RPV servers on the primary location*
- *Create the RPV clients on the DR location*
- *Verify the configuration*
- *Import all VGs to remote PowerVS*

2.3.2 Update VGs to enhanced concurrent capable

PowerHA requires all of the shared VGs to be enhanced concurrent capable. The VGs can be updated to enhanced concurrent capable with the “chvg -C <VGNAME>” command. See the following diagram.

```
pc-lon06-glvm-01a:/ >
# chvg -C dbvg
```

Figure 2.3.2.1 Change VG to concurrent capable

```
VOLUME GROUP:       dbvg              VG IDENTIFIER:  00c8d44000004b000000017331
80f36e
VG STATE:           active            PP SIZE:        16 megabyte(s)
VG PERMISSION:      read/write        TOTAL PPs:      5100 (81600 megabytes)
MAX LVs:            256               FREE PPs:       4074 (65184 megabytes)
LVs:                5                 USED PPs:       1026 (16416 megabytes)
OPEN LVs:           0                 QUORUM:         3 (Enabled)
TOTAL PVs:          4                 VG DESCRIPTORS: 4
STALE PVs:          0                 STALE PPs:      0
ACTIVE PVs:         4                 AUTO ON:        no
Concurrent:         Enhanced-Capable  Auto-Concurrent: Disabled
VG Mode:            Non-Concurrent
MAX PPs per VG:     32768             MAX PVs:        1024
LTG size (Dynamic): 512 kilobyte(s)   AUTO SYNC:      no
HOT SPARE:          no                BB POLICY:      non-relocatable
MIRROR POOL STRICT: super
PV RESTRICTION:     none              INFINITE RETRY: no
DISK BLOCK SIZE:    512               CRITICAL VG:    no
FS SYNC OPTION:     no                CRITICAL PVs:   no
```

Figure 2.3.2.2 Showing Enhanced-Capable field

Note in the above diagram the VG has the “Concurrent” field as “Enhanced-Capable”.

2.3.3 Change filesystems to not automount

For PowerHA to manage the filesystems, they must not automatically mount. We change those filesystems using the “chfs -A no <FILESYSTEM>” command. See the following.

```
# for i in  1 2 3;do chfs -A no /appfs$i;done
pc-lon06-glvm-01a:/ >
# lsfs | sed 's/  / /g'
Name      Nodename  Mount Pt        VFS  Size  Options  Auto Accounting
/dev/hd4    --     /          jfs2 196608 --     yes no
/dev/hd1    --     /home        jfs2 65536  --     yes no
/dev/hd2    --     /usr         jfs2 4784128 --     yes no
/dev/hd9var   --     /var         jfs2 1966080 --     yes no
/dev/hd3    --     /tmp         jfs2 458752 --     yes no
/dev/hd11admin --     /admin         jfs2 262144 --     yes no
/proc      --     /proc         procfs --   --     yes no
/dev/hd10opt  --     /opt         jfs2 786432 --     yes no
/dev/livedump  --     /var/adm/ras/livedump jfs2 524288 --     yes no
/dev/repo00   --     /usr/sys/inst.images  jfs2 15335424 rw     yes no
/dev/toolslv  --     /tools        jfs2 2621440 rw     yes no
/dev/fslv00   --     /data01       jfs2 4194304 rw     no  no
/dev/fslv01   --     /data02       jfs2 4194304 rw     no  no
/dev/fslv02   --     /data03       jfs2 4194304 rw     no  no
/dev/fslv03   --     /data04       jfs2 4194304 rw     no  no
/dev/fslv07   --     /appfs1       jfs2 6291456 rw     no  no
/dev/fslv05   --     /appfs2       jfs2 6291456 rw     no  no
/dev/fslv06   --     /appfs3       jfs2 6291456 rw     no  no
```

Figure 2.3.3.1 Changing filesystems to not automount

2.3.4 Determine for which drives to create RPV servers

We note the VGs and the VG drives.

```
pc-tor01-glvm-01a: /tools >
# lsvg -p dbvg | sed 's/  / /g'
dbvg:
PV_NAME      PV STATE     TOTAL PPs  FREE PPs  FREE DISTRIBUTION
hdisk1      active      1275    1018    127..126..255..255..255
hdisk2      active      1275    1019    127..127..255..255..255
hdisk7      active      1275    1018    127..126..255..255..255
hdisk8      active      1275    1019    127..127..255..255..255
pc-tor01-glvm-01a: /tools >
# lsvg -p appvg | sed 's/  / /g'
appvg:
PV_NAME      PV STATE     TOTAL PPs  FREE PPs  FREE DISTRIBUTION
hdisk5      active      1275    1082    255..62..255..255..255
hdisk6      active      1275    891     63..63..255..255..255
hdisk9      active      1275    1082    255..62..255..255..255
hdisk10      active      1275    891     63..63..255..255..255
```

Figure 2.3.4.1 VGs and their disk drives

We also note the local drives versus the RPV client drives.

```
pc-tor01-glvm-01a: /tools >
# lsdev -Ccdisk
hdisk0  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk1  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk2  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk3  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk4  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk5  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk6  Available C7-T1-01 MPIO IBM 2076 FC Disk
hdisk7  Available          Remote Physical Volume Client
hdisk8  Available          Remote Physical Volume Client
hdisk9  Available          Remote Physical Volume Client
hdisk10 Available          Remote Physical Volume Client
pc-tor01-glvm-01a: /tools >
```

Figure 2.3.1.3.2 Determining local versus remote drives

Given the above, we determine that hdisk1, hdisk2 and hdisk5, hdisk6 will need to have RPV servers.

2.3.5 Bring the VGs offline

For safety, we vary off the volume groups dbvg, appvg.

```
pc-tor01-glvm-01a: /tools >
# varyoffvg dbvg
pc-tor01-glvm-01a: /tools >
# varyoffvg appvg
pc-tor01-glvm-01a: /tools >
```

Figure 2.3.5.1 VGs being brought offline

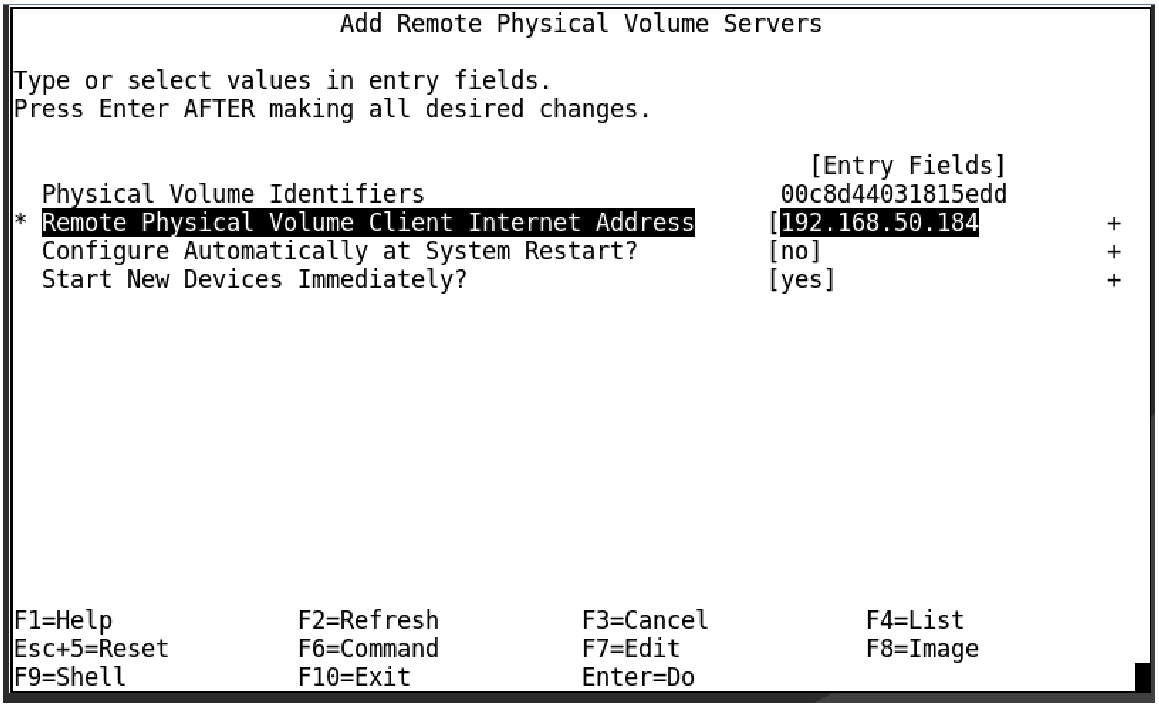
2.3.6 Create the RPV servers on the primary location

We proceed as previously to create those RPV servers for those drives using “smitty rpvserver -> Add Remote Physical Volume Servers”. We select the appropriate drive.

```
                         Remote Physical Volume Servers

Move cursor to desired item and press Enter.

  Remote Physical Volume Server Site Name Configuration
  List All Remote Physical Volume Servers
  Add Remote Physical Volume Servers
  Change / Show a Remote Physical Volume Server
   +--------------------------------------------------------------------------+
   |                       Physical Volume Identifiers                        |
   |                                                                          |
   | Move cursor to desired item and press F7.                                |
   |     ONE OR MORE items can be selected.                                   |
   | Press Enter AFTER making all selections.                                 |
   |                                                                          |
   |   # Physical Volume        Physical Volume Identifier                    |
   |   # ----------------------------------------------------                 |
   |   hdisk5           00c8d44031815edd                                      |
   |   hdisk6           00c8d44031815f5a                                      |
   |                                                                          |
   | F1=Help                F2=Refresh             F3=Cancel                  |
   | F7=Select              F8=Image               F10=Exit                   |
F1 | Enter=Do               /=Find                 n=Find Next                |
F9 +--------------------------------------------------------------------------+
```

Figure 2.3.6.1 Selecting RPV server drive

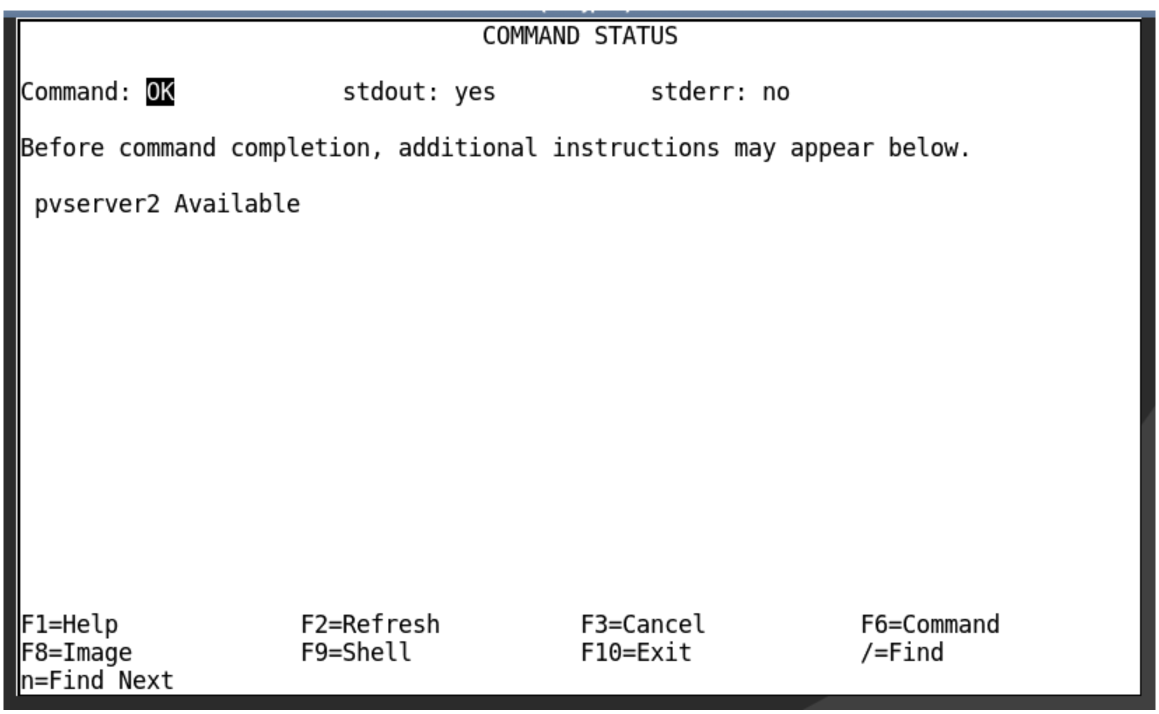
We select the appropriate drive and proceed to the RPV parameters screen where we add the IP address.



```
                        Add Remote Physical Volume Servers

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                         [Entry Fields]
  Physical Volume Identifiers                          00c8d44031815edd
* Remote Physical Volume Client Internet Address      [192.168.50.184         +
  Configure Automatically at System Restart?          [no]                    +
  Start New Devices Immediately?                      [yes]                   +

F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.6.2 Configuring RPV server parameters

And, resulting in the configured rpvserver. We repeat this process for all appropriate drives.



```
                                COMMAND STATUS

Command: OK            stdout: yes           stderr: no

Before command completion, additional instructions may appear below.

 pvserver2 Available

F1=Help             F2=Refresh          F3=Cancel           F6=Command
F8=Image            F9=Shell            F10=Exit            /=Find
n=Find Next
```

Figure 2.3.6.3 Configured RPV server

2.3.7 Create the RPV clients on the DR location

We proceed as previously to create those RPV clients for those drives using “smitty rpvserver -> Add Remote Physical Volume Clients”. We select the appropriate IPv6 option.

```
                       Add Remote Physical Volume Clients

Type or select a value for the entry field.
Press Enter AFTER making all desired changes.

                                                         [Entry Fields]
* Does data mirroring network use Internet Protocol    o                       +
  Version 6 (IPv6)?









F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.7.1 Selecting RPV client IPv6 option

We then select the RPV server IP address.

```
                         Add Remote Physical Volume Clients

Type or select a value for the entry field.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
* Remote Physical Volume Server Internet Address     []                      +

   ----------------------------------------------------------------------------
   |              Remote Physical Volume Server Internet Address              |
   |                                                                          |
   | Move cursor to desired item and press Enter.                             |
   |                                                                          |
   |   192.168.6.163    pc-tor01-glvm-01a                                     |
   |                                                                          |
   | F1=Help                F2=Refresh              F3=Cancel                 |
F1 | F8=Image               F10=Exit                Enter=Do                  |
Es | /=Find                 n=Find Next                                       |
F9 ----------------------------------------------------------------------------
```

Figure 2.3.7.2 Selecting RPV server address

Then we select the drive the RPV client is to access.

```
                         Add Remote Physical Volume Clients

Ty ----------------------------------------------------------------------------
Pr |                   Remote Physical Volume Server Disks                    |
   |                                                                          |
   | Move cursor to desired item and press F7.                                |
*  |     ONE OR MORE items can be selected.                                   |
   | Press Enter AFTER making all selections.                                 |
   |                                                                          |
   | [MORE...3]                                                               |
   |   # (The physical volume names are as they are known                     |
   |   # on the host named                                                    |
   |   # pc-tor01-glvm-01a)                                                   |
   |   #                                                                      |
   |   # Physical Volume        Physical Volume Identifier                    |
   |   # -------------------------------------------------------              |
   |     hdisk5                 00c8d44031815edd0000000000000000              |
   |     hdisk6                 00c8d44031815f5a0000000000000000              |
   | [BOTTOM]                                                                 |
   |                                                                          |
   | F1=Help                F2=Refresh              F3=Cancel                 |
F1 | F7=Select              F8=Image                F10=Exit                  |
Es | Enter=Do               /=Find                  n=Find Next               |
F9 ----------------------------------------------------------------------------
```

Figure 2.3.7.3 Select RPV client drive is to access

Lastly, we are presented with the RPV client parameters menu. For our example, we will leave parameters as default.

```
                      Add Remote Physical Volume Clients

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
  Remote Physical Volume Server Internet Address      192.168.6.163
  Remote Physical Volume Local Internet Address       192.168.50.184
  Physical Volume Identifiers                         00c8d44031815edd00000>
  I/O Timeout Interval (Seconds)                     [ 80]                    #
  Start New Devices Immediately?                     [yes]                   +

F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.7.4 RPV client parameters

We proceed with the additional RPV client configurations.

2.3.8 Verify the configuration

We can verify the RPV client configuration using the “lsdev -Cc disk” command as shown below.

```
pc-lon06-glvm-01a:/ >
# lsdev -Ccdisk
hdisk0  Available C4-T1-01 MPIO IBM 2076 FC Disk
hdisk1  Available C4-T1-01 MPIO IBM 2076 FC Disk
hdisk2  Available C4-T1-01 MPIO IBM 2076 FC Disk
hdisk3  Available C4-T1-01 MPIO IBM 2076 FC Disk
hdisk4  Available C4-T1-01 MPIO IBM 2076 FC Disk
hdisk5  Available C4-T1-01 MPIO IBM 2076 FC Disk
hdisk6  Available C4-T1-01 MPIO IBM 2076 FC Disk
hdisk7  Available          Remote Physical Volume Client
hdisk8  Available          Remote Physical Volume Client
hdisk9  Available          Remote Physical Volume Client
hdisk10 Available          Remote Physical Volume Client
pc-lon06-glvm-01a:/ >
```

Figure 2.3.8.1 Displaying RPV clients

Note the hdisks, hdisk7 to hdisk10, are shown as “Available” and are “Remove Physical Volume Client”.

2.3.9 Import all VGs to remote PowerVS

Once we verify that RPV servers, clients are defined, working and synchronized, we can import the VGs to the remaining PowerVS. All VGs that will be part of the PowerHA resource group must be available on all nodes.

We display the importvg command, “importvg -y appvg -V 101 hdisk9” setting the major number as 101 and reading the VG information from hdisk9. We repeat the similar command for “dbvg”.

```
pc-lon06-glvm-01a:/ >
# importvg -y appvg -V 101 hdisk9
appvg
```

Figure 2.3.9.1 Importing VGs to London PowerVS

2.3.10 Installing IBM PowerHA EE

The IBM PowerHA Enterprise Edition filesets will need to be installed on all AIX PowerVS instances that will be part of the cluster.

In our example, we placed the PowerHA EE filesets in a filesystem named “/tools”. We “cd” to that directory and execute “smitty install_latest”. Since we are in that directory, we can enter “.” As the “INPUT device”.

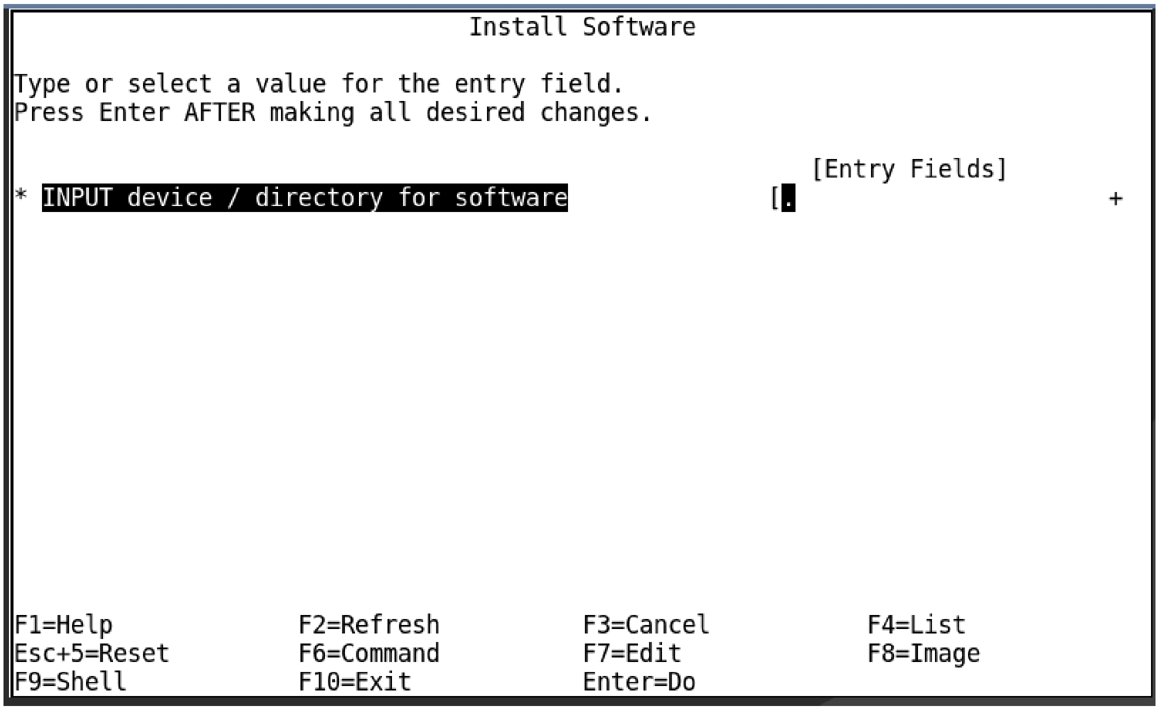


Figure 2.3.10.1 Directory of AIX PowerHA software location

The following filesets will be installed:

- *cluster.adt.es*
- *cluster.doc.en_US.assist*
- *cluster.doc.en_US.es*
- *cluster.doc.en_US.glvm*
- *cluster.es.client*
- *cluster.es.cspoc*
- *cluster.es.genxd*
- *cluster.es.server*
- *cluster.license*
- *cluster.man.en_US.es*
- *cluster.xd.base*
- *cluster.xd.glvm*
- *cluster.xd.license*

Note that there are many more additional packages that do not apply such as those for EMC, Hitachi. Also note that there may be additional packages that may apply to your configuration such as the Smart Assists. Selected the minimum packages for AIX GLVM.

```
                              Install Software

Ty
Pr                          SOFTWARE to install

[T  Move cursor to desired item and press F7. Use arrow keys to scroll.
*       ONE OR MORE items can be selected.
*   Press Enter AFTER making all selections.

    [MORE...100]
    > cluster.xd.base                                                  ALL
       + 7.2.4.0  PowerHA SystemMirror Enterprise Edition - Base Support.

    > cluster.xd.glvm                                                  ALL
       + 7.2.4.0  PowerHA SystemMirror Enterprise Edition GLVM RPV Support

    > cluster.xd.license                                               ALL
       + 7.2.4.0  PowerHA SystemMirror Enterprise Edition License Agreement
    [BOTTOM]
[M
    F1=Help                 F2=Refresh              F3=Cancel
F1  F7=Select               F8=Image                F10=Exit
Es  Enter=Do                /=Find                  n=Find Next
F9
```

Figure 2.3.10.2 Selecting PowerHA packages to install

We verify that “ACCEPT new license agreements?” field is set to “yes”.

```
                              Install Software

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

[MORE...1]                                             [Entry Fields]
* SOFTWARE to install                                  [cluster.adt.es     > +
  PREVIEW only? (install operation will NOT occur)      no                   +
  COMMIT software updates?                              yes                  +
  SAVE replaced files?                                  no                   +
  AUTOMATICALLY install requisite software?             yes                  +
  EXTEND file systems if space needed?                  yes                  +
  OVERWRITE same or newer versions?                     no                   +
  VERIFY install and check file sizes?                  no                   +
  Include corresponding LANGUAGE filesets?              yes                  +
  DETAILED output?                                      no                   +
  Process multiple volumes?                             yes                  +
  ACCEPT new license agreements?                        yes                  +
  Preview new LICENSE agreements?                       no                   +
[MORE...10]

F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.10.3 Verifying “ACCEPT new license agreements?” is “yes”

After proceeding, we verify the installation is completed successfully by scrolling through the SMIT output.

```
                          COMMAND STATUS

Command: OK           stdout: yes          stderr: no

Before command completion, additional instructions may appear below.

[MORE...470]
 luster.msg.en_US.glvm      7.2.4.0         USR         APPLY       SUCCESS
cluster.msg.en_US.es.server 7.2.4.0         USR         APPLY       SUCCESS
cluster.es.genxd.rte        7.2.4.0         USR         APPLY       SUCCESS
cluster.es.genxd.cmds       7.2.4.0         USR         APPLY       SUCCESS
cluster.es.genxd.rte        7.2.4.0         ROOT        APPLY       SUCCESS
cluster.es.genxd.cmds       7.2.4.0         ROOT        APPLY       SUCCESS
cluster.msg.en_US.genxd     7.2.4.0         USR         APPLY       SUCCESS

File /etc/environment has been modified.
File /etc/group has been modified.
File /etc/inittab has been modified.
File /etc/services has been modified.
[MORE...4]

F1=Help             F2=Refresh          F3=Cancel           F6=Command
F8=Image            F9=Shell            F10=Exit            /=Find
n=Find Next
```

Figure 2.3.10.4 Verifying installation output

Repeat the process for all cluster PowerVS.

2.3.11 Configuring PowerHA EE

As mentioned previously, we will configure a very simple PowerHA cluster with:

- *two nodes (one Toronto PowerVS, one London PowerVS)*
- *single resource group (we will call this RG01)*
- *no service IP*
- *no application controllers*
- *two VGs (dbvg, datavg)*

2.3.12 Verify /etc/cluster/rhosts entries

The file, /etc/cluster/rhosts, contains entries that are used for communication purposes. These entries correspond to the hostname of each of the PowerVS nodes. For our purposes, the file looks like this.

```
pc-tor01-glvm-01a: / >
# cat /etc/cluster/rhosts
pc-tor01-glvm-01a
pc-lon06-glvm-01a
pc-tor01-glvm-01a: / >
```

Figure 2.3.12.1 /etc/cluster/rhosts entries

That is assuming those entries are also located in the /etc/hosts file as shown below.

```
pc-tor01-glvm-01a: / >
# hostent -S
127.0.0.1               loopback localhost      # loopback (lo0) name/address
192.168.6.163  pc-tor01-glvm-01a tor01
192.168.50.184 pc-lon06-glvm-01a lon06
```

Figure 2.3.12.2 /etc/hosts entries

After changing the /etc/cluster/rhosts file, the daemon, clcomd, needs to be refreshed. This is done with the "stopsrc -s clcomd;startsrc -s clcomd" command as shown.

```
pc-tor01-glvm-01a: / >
# stopsrc -s clcomd;startsrc -s clcomd
0513-044 The clcomd Subsystem was requested to stop.
0513-059 The clcomd Subsystem has been started. Subsystem PID is 7930116.
```

Figure 2.3.12.3 Restarting "clcomd" daemon

Lastly, the communication between PowerVS images can be verified with the "cl_rsh" command. In this example, we add the "cl_rsh" directory to the PATH variable before executing the "cl_rsh" command.

```
pc-tor01-glvm-01a: / >
# export PATH=$PATH:/usr/es/sbin/cluster/utilities
pc-tor01-glvm-01a: / >
# cl_rsh pc-lon06-glvm-01a date
Fri Jul 17 22:41:00 CDT 2020
pc-tor01-glvm-01a: / >
```

Figure 2.3.12.4 Using “cl_rsh” to verify communications

2.3.13 Determine the PowerHA repository disk(s)

In our example configuration, we only have two VGs, dbvg and appvg. Any of the other LUNs can be used as repository disks. We note those drives on each of the PowerVS images.

```
pc-tor01-glvm-01a: / >
# lspv
hdisk0          none                                    None
hdisk1          00c8d4403180f273                        dbvg
hdisk2          00c8d4403180f319                        dbvg
hdisk3          00f6db0af58e9775                        rootvg          active
hdisk4          none                                    None
hdisk5          00c8d44031815edd                        appvg
hdisk6          00c8d44031815f5a                        appvg
hdisk7          00c8cf803fb0193a                        dbvg
hdisk8          00c8cf803fb02116                        dbvg
hdisk9          00c8cf803fb029cd                        appvg
hdisk10         00c8cf803fb03444                        appvg
```

Figure 2.3.13.1 Displaying Toronto available disks (hdisk0, hdisk4)

```
pc-lon06-glvm-01a:/ >
# lspv
hdisk0          none                                    None
hdisk1          00c8cf803fb0193a                        None
hdisk2          00c8cf803fb02116                        None
hdisk3          00f6db0af58e9775                        rootvg          active
hdisk4          00c8cf8049bac9fa                        None
hdisk5          00c8cf803fb029cd                        None
hdisk6          00c8cf803fb03444                        None
hdisk7          00c8d4403180f273                        dbvg
hdisk8          00c8d4403180f319                        dbvg
hdisk9          00c8d44031815edd                        None
hdisk10         00c8d44031815f5a                        None
pc-lon06-glvm-01a:/ >
```

Figure 2.3.13.2 Displaying London available disks (hdisk0, hdisk4)

For our purposes, we will select “hdisk4” on each of our PowerVS images.

2.3.14 Configure PowerHA topology

We begin the PowerHA configuration by executing "smitty sysmirror -> Cluster Nodes and Networks -> Multi Site Cluster Deployment -> Setup a Cluster, Nodes and Networks". We name the cluster "tor01lon06", set the site 1 name to "toronto01", the site 2 name to "london06". We select the "New Nodes" by pressing "F4" and selecting the appropriate node name.

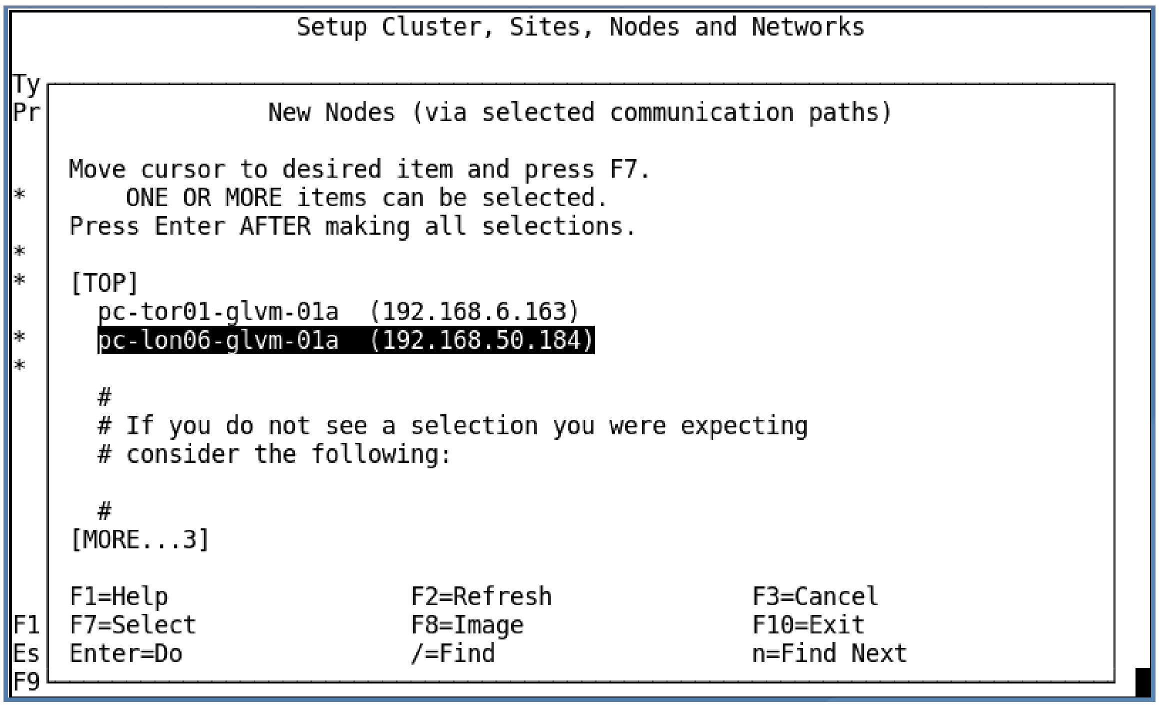
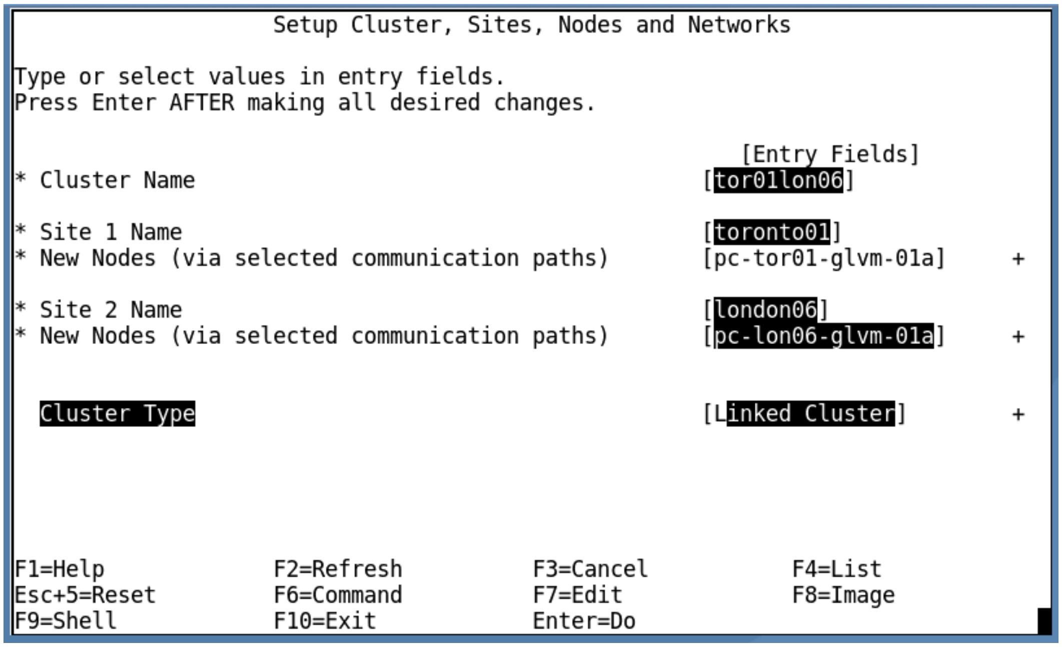


Figure 2.3.14.1 Select "New Nodes" in base PowerHA configuration

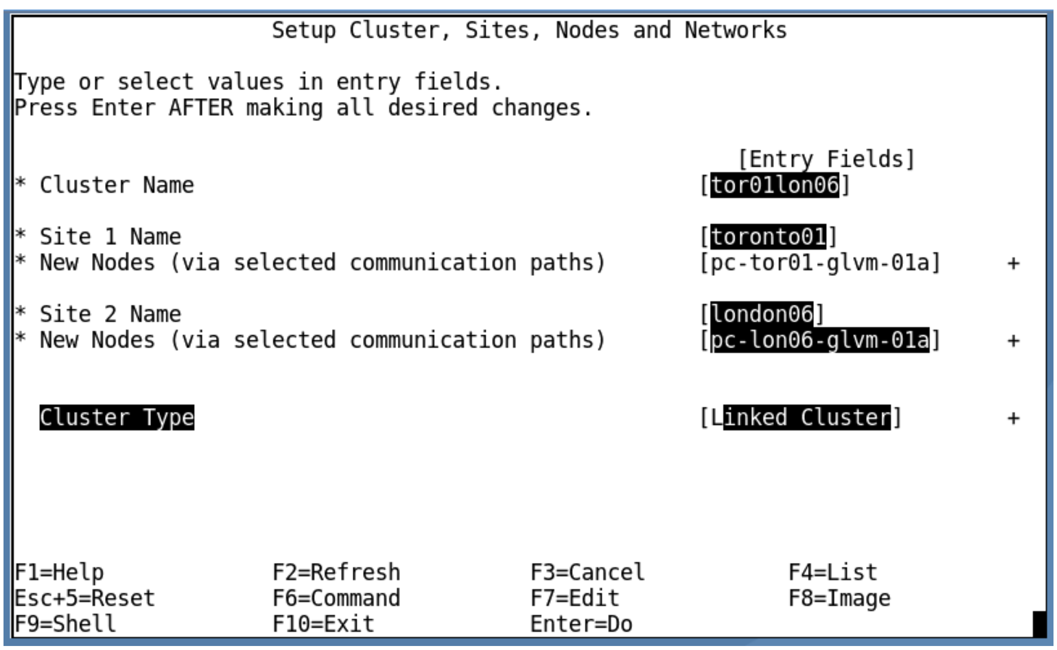
This leads to the following menu where we select the "Cluster Type" of "Linked Cluster".



```
                    Setup Cluster, Sites, Nodes and Networks

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                           [Entry Fields]
* Cluster Name                                          [tor01lon06]

* Site 1 Name                                           [toronto01]
* New Nodes (via selected communication paths)          [pc-tor01-glvm-01a]     +

* Site 2 Name                                           [london06]
* New Nodes (via selected communication paths)          [pc-lon06-glvm-01a]     +


  Cluster Type                                          [Linked Cluster]        +




F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.14.2 Configuring PowerHA nodes, sites, cluster type

The result should be the gathering of cluster data as shown in the following diagram.



```
                    Setup Cluster, Sites, Nodes and Networks

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                           [Entry Fields]
* Cluster Name                                          [tor01lon06]

* Site 1 Name                                           [toronto01]
* New Nodes (via selected communication paths)          [pc-tor01-glvm-01a]     +

* Site 2 Name                                           [london06]
* New Nodes (via selected communication paths)          [pc-lon06-glvm-01a]     +


  Cluster Type                                          [Linked Cluster]        +




F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.14.3 Output of base cluster configuration

2.3.15 Configure PowerHA repository disks

We proceed to configuring the PowerHA repository disks by executing “smitty sysmirror -> Cluster Nodes and Networks -> Multi Site Cluster Deployment -> Define the Repository Disk and Cluster IP Address”. We proceed to selecting the “Repository Disk” for each of the sites by pressing the “F4” key on those fields.

```
                 Multi Site with Linked Clusters Configuration

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
* Cluster Name                                        tor01lon06
* Heartbeat Mechanism                                 Unicast                 +

* Site Name                                           toronto01
* Repository Disk                                    []                       +
  Site Multicast Address                             []
  +--------------------------------------------------------------------------+
  |                            Repository Disk                               |
* |                                                                          |
* | Move cursor to desired item and press Enter.                             |
  |                                                                          |
  |   hdisk0 (00c8d440601a6595) on all nodes at site toronto01               |
  |   hdisk4 (00c8d440601a64c7) on all nodes at site toronto01               |
  |                                                                          |
  | F1=Help                 F2=Refresh              F3=Cancel                |
F1| F8=Image                F10=Exit                Enter=Do                 |
Es| /=Find                  n=Find Next                                      |
F9+--------------------------------------------------------------------------+
```

Figure 2.3.15.1 Selecting repository disks

We repeat this process until all of the repository disks are selected.

```
                  Multi Site with Linked Clusters Configuration

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                      [Entry Fields]
* Cluster Name                                      tor01lon06
* Heartbeat Mechanism                               Unicast                +

* Site Name                                         toronto01
* Repository Disk                                  [(00c8d440601a64c7)]    +
  Site Multicast Address                           []
      (used only for multicast heartbeat)

* Site Name                                         london06
* Repository Disk                                  [(00c8cf8049bac9fa)]    +
  Site Multicast Address                           []
      (used only for multicast heartbeat)


F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.15.2 Defining repository disks

The resulting output should look similar to this diagram.

```
                                COMMAND STATUS

Command: OK            stdout: yes           stderr: no

Before command completion, additional instructions may appear below.

[TOP]
 uccessfully added a primary repository disk.
To view the complete configuration of repository disks use:
"clmgr query repository" or "clmgr view report repository"
Successfully added a primary repository disk.
To view the complete configuration of repository disks use:
"clmgr query repository" or "clmgr view report repository"
Initial site configuration has been saved. You can now go on
to complete the rest of the configuration, including adding backup
repository disks (recommended), custom event notifications, resource
groups and applications, etc.

When you have entered all the basic information you can then use
[MORE...3]

F1=Help             F2=Refresh          F3=Cancel           F6=Command
F8=Image            F9=Shell            F10=Exit            /=Find
n=Find Next
```

Figure 2.3.15.3 Output of defining repository disks

2.3.16 Perform initial PowerHA verification

After defining the repository disks, we can perform the initial PowerHA verification. Before performing this, note that there is no CAA volume group.

```
pc-tor01-glvm-01a: / >
# lspv
hdisk0          00c8d440601a6595                    None
hdisk1          00c8d4403180f273                    dbvg
hdisk2          00c8d4403180f319                    dbvg
hdisk3          00f6db0af58e9775                    rootvg          active
hdisk4          00c8d440601a64c7                    None
hdisk5          00c8d44031815edd                    appvg
hdisk6          00c8d44031815f5a                    appvg
hdisk7          00c8cf803fb0193a                    dbvg
hdisk8          00c8cf803fb02116                    dbvg
hdisk9          00c8cf803fb029cd                    appvg
hdisk10         00c8cf803fb03444                    appvg
```

Figure 2.3.16.1 VGs before initial PowerHA verification

We proceed with the initial PowerHA verification by executing "smitty sysmirror -> Cluster Nodes and Networks -> Verify and Synchronize Cluster Configuration". This will present a verification screen.

```
                           Cluster Nodes and Networks

Move cursor to desired item and press Enter.

     ----------------------------------------------------------------------------
                  Verify and Synchronize Cluster Configuration

     Move cursor to desired item and press Enter. Use arrow keys to scroll.


       Any time you change the cluster configuration, those changes
       must be propagated to all nodes in the cluster. PowerHA SystemMirror w
       perform a set of verification checks to make sure the configuration
       is viable.

       Depending on the nature of the changes, this operation can disrupt
       the applications currently under PowerHA SystemMirror control.

       Press enter when you are ready to begin.

     F1=Help                 F2=Refresh              F3=Cancel
     F8=Image                F10=Exit                Enter=Do
F1   /=Find                  n=Find Next
F9   ----------------------------------------------------------------------------
```

Figure 2.3.16.2 Enter to begin PowerHA verification

The resulting output should look something like the following.

```
                              COMMAND STATUS

Command: OK            stdout: yes           stderr: no

Before command completion, additional instructions may appear below.

[TOP]

Verification to be performed on the following:
        Cluster Topology
        Cluster Resources

Verification will interactively correct verification errors.


Retrieving data from available cluster nodes.  This could take a few minutes.

        Start data collection on node pc-lon06-glvm-01a
        Start data collection on node pc-tor01-glvm-01a
[MORE...153]

F1=Help             F2=Refresh          F3=Cancel           F6=Command
F8=Image            F9=Shell            F10=Exit            /=Find
n=Find Next
```

Figure 2.3.16.3 Output of PowerHA verification

If PowerHA verification was successful, there should now be an additional volume group, “caavg_private”, on each PowerVS instance.

```
pc-tor01-glvm-01a: / >
# lspv
hdisk0          00c8d440601a6595                    None
hdisk1          00c8d4403180f273                    dbvg
hdisk2          00c8d4403180f319                    dbvg
hdisk3          00f6db0af58e9775                    rootvg          active
hdisk4          00c8d440601a64c7                    caavg_private   active
hdisk5          00c8d44031815edd                    appvg
hdisk6          00c8d44031815f5a                    appvg
hdisk7          00c8cf803fb0193a                    dbvg
hdisk8          00c8cf803fb02116                    dbvg
hdisk9          00c8cf803fb029cd                    appvg
hdisk10         00c8cf803fb03444                    appvg
```

Figure 2.3.16.4 “caavg_private” VG at Toronto PowerVS

```
pc-lon06-glvm-01a:/ >
# lspv | grep caa
hdisk4          00c8cf8049bac9fa                    caavg_private   active
pc-lon06-glvm-01a:/ >
```

Figure 2.3.16.5 “caavg_private” VG at London PowerVS

2.3.17 Defining an XD_data network

AIX GLVM can use a couple of specific networks, XD_data and XD_ip. These networks have these characteristics

- *XD_data - An IP-based network used by geographically mirrored volume groups in a PowerHA SystemMirror cluster for transferring the data between the RPV devices.*
- *XD_ip - An IP-based network used for participation in RSCT protocols, heartbeating, and client communication.*

PowerHA builds the default IP networks without configuring either XD_data or XD_ip networks. We will need to create the XD_data network and add the interfaces to it

To create the XD_data network, execute “smitty sysmirror -> Cluster Nodes and Networks -> Manage Networks and Network Interfaces -> Networks -> Add a Network”, then select “XD_data”.

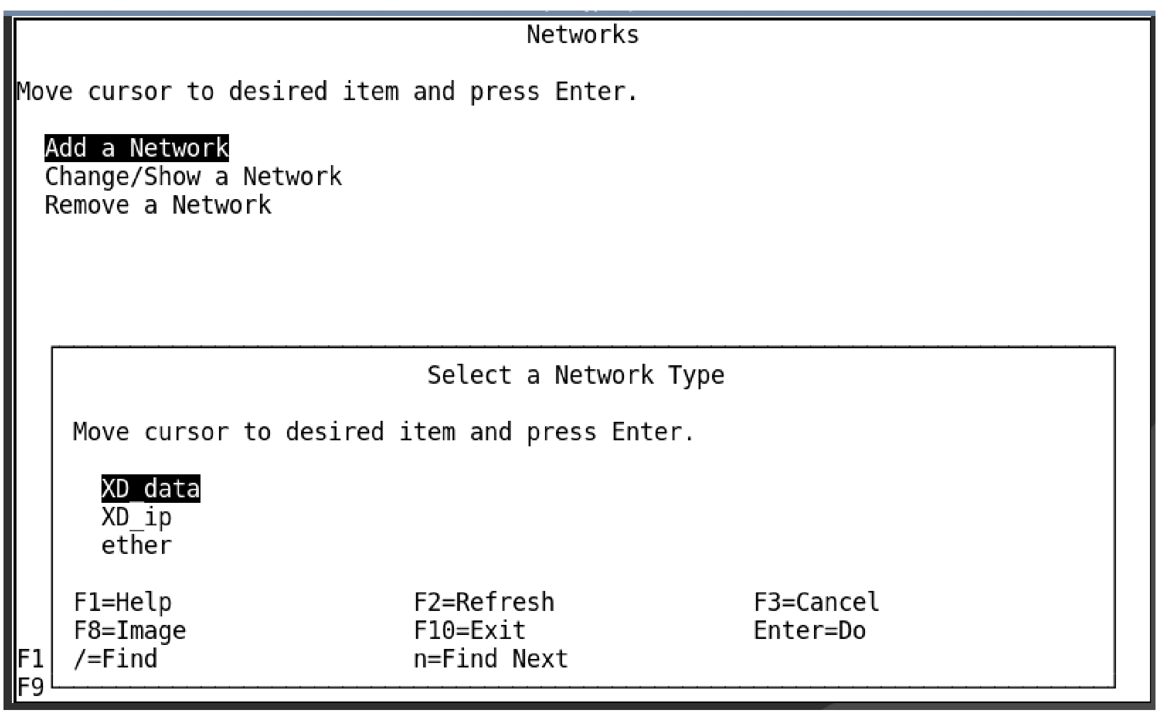


Figure 2.3.17.1 Selecting the XD_data network

Then verify the netmask is the same as the network interfaces.

```
                                 Add a Network

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
* Network Name                                        [ et_XD_data_01]
* Network Type                                         XD_data
* Netmask(IPv4)/Prefix Length(IPv6)                   [255.255.255.0]
* Network attribute                                    public              +
* Unstable Threshold                                  [3]                   #
* Unstable Period (seconds)                           [60]                  #








F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.17.2 XD_data network parameters

2.3.18 Moving network interfaces to XD_data network

In order to utilize the XD_data network that was created for the AIX GLVM replication, the network interfaces have to be moved to that network. Execute "smitty sysmirror -> Cluster Nodes and Networks -> Manage Networks and Network Interfaces -> Network Interfaces -> Change/Show a Network Interface", we select a network interface. Here, we select "en0" at "pc-lon06-glvm-01a"

```
                        Network Interfaces
Show certificate
Move cursor to desired item and press Enter.

  Add a Network Interface

            Select one or more network interfaces to change/show

    Move cursor to desired item and press Enter. Use arrow keys to scroll.

      # Node / Network
      #       Interface/Device  IP Label/Device Path             IP Address


      # pc-lon06-glvm-01a / net_ether_01
              en0               pc-lon06-glvm-01a                192.168.50

      # pc-tor01-glvm-01a / net_ether_03
              en0               pc-tor01-glvm-01a                192.168.6.

    F1=Help                  F2=Refresh               F3=Cancel
    F8=Image                 F10=Exit                 Enter=Do
F1  /=Find                   n=Find Next
F9
```

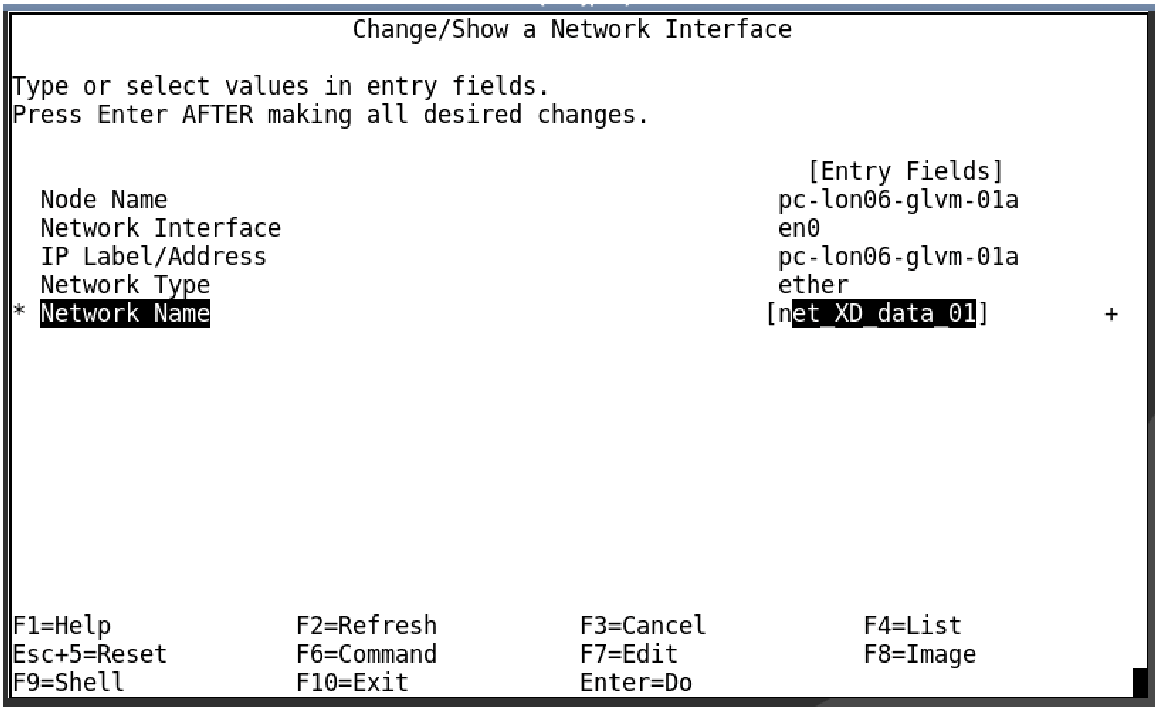
Figure 2.3.18.1 Selecting a network interface

We then get the following menu where we can select the network the interface is on.

```
                     Change/Show a Network Interface

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
  Node Name                                            pc-lon06-glvm-01a
  Network Interface                                    en0
  IP Label/Address                                     pc-lon06-glvm-01a
  Network Type                                         ether
* Network Name                                        [ et_ether_01]          +










F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.18.2 Changing “Network Name” from “net_ether_01”

We change the network name to the XD_data network that we created in the previous step.



```
                        Change/Show a Network Interface

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                      [Entry Fields]
  Node Name                                         pc-lon06-glvm-01a
  Network Interface                                 en0
  IP Label/Address                                  pc-lon06-glvm-01a
  Network Type                                      ether
* Network Name                                     [net_XD_data_01]      +

F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.18.3 Changing “Network Name” to “net_XD_data_01”

We get a confirmation menu and proceed to the rest of the interfaces.

2.3.19 Defining PowerHA resource group

As mentioned previously, the example configuration will include a single resource group. We define this resource group by executing “smitty sysmirror -> Cluster Applications and Resources -> Resource Groups -> Add a Resource Group“. On this menu, we give it a resource group name, RG01 for our example, as well as the participating nodes. We change the “Inter-Site Management Policy” to “Prefer Primary Site”. Lastly we select the “Fallback Policy” to “Never Fallback”.

```
                        Add a Resource Group (extended)

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                       [Entry Fields]
* Resource Group Name                                 [RG01]

  Inter-Site Management Policy                        [Prefer Primary Site]   +
* Participating Nodes from Primary Site               [pc-tor01-glvm-01a]     +
  Participating Nodes from Secondary Site             [pc-lon06-glvm-01a]     +

  Startup Policy                                       Online On Home Node O> +
  Fallover Policy                                      Fallover To Next Prio> +
  Fallback Policy                                      Never Fallback         +







F1=Help              F2=Refresh           F3=Cancel            F4=List
Esc+5=Reset          F6=Command           F7=Edit              F8=Image
F9=Shell             F10=Exit             Enter=Do
```

Figure 2.3.19.1 Define a PowerHA resource group

A successfully defined resource group should give the SMIT output similar to this.

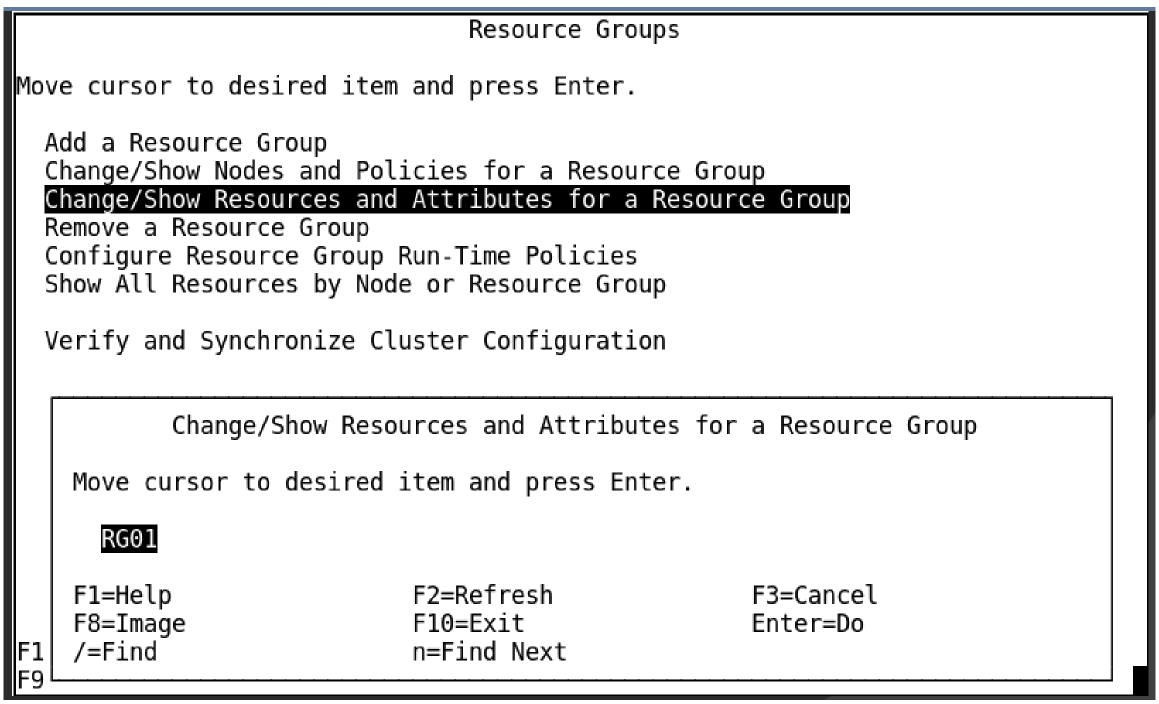
```
                                 COMMAND STATUS

Command: OK             stdout: no             stderr: no

Before command completion, additional instructions may appear below.

















F1=Help              F2=Refresh           F3=Cancel            F6=Command
F8=Image             F9=Shell             F10=Exit             /=Find
n=Find Next
```

Figure 2.3.19.2 Successfully defined a resource group

2.3.20 Adding resources to the PowerHA resource group

The example configuration will only include the VGs that are being replicated as the resources of the PowerHA resource group defined in the previous step. Again, for more complex PowerHA configuration, review the resources described in section “Chapter 4: Additional Resources”.

To add resources to the resource group, execute “smitty sysmirror -> Cluster Applications and Resources -> Resource Groups -> Change/Show Resources and Attributes for a Resource Group“. Select the appropriate resource group, “RG01” in our example.



```
                                Resource Groups

Move cursor to desired item and press Enter.

  Add a Resource Group
  Change/Show Nodes and Policies for a Resource Group
  Change/Show Resources and Attributes for a Resource Group
  Remove a Resource Group
  Configure Resource Group Run-Time Policies
  Show All Resources by Node or Resource Group

  Verify and Synchronize Cluster Configuration

          Change/Show Resources and Attributes for a Resource Group

    Move cursor to desired item and press Enter.

      RG01

    F1=Help                 F2=Refresh              F3=Cancel
    F8=Image                F10=Exit                Enter=Do
F1  /=Find                  n=Find Next
F9
```

Figure 2.3.20.1 Selecting RG to add resources

On the resource group fields, enter the appropriate VGs on the “Volume Groups” field by pressing “F4”.

```
        Change/Show All Resources and Attributes for a Resource Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

[TOP]                                                      [Entry Fields]
  Resource Group Name                                    RG01
  Inter-site Management Policy                           ignore
  Participating Nodes from Primary Site                  pc-tor01-glvm-01a
  Participating Nodes from Secondary Site                pc-lon06-glvm-01a
  +--------------------------------------------------------------------------+
  |                            Volume Groups                                 |
  |                                                                          |
  | Move cursor to desired item and press F7.                                |
  |     ONE OR MORE items can be selected.                                   |
  | Press Enter AFTER making all selections.                                 |
  |                                                                          |
  | > dbvg                                                                   |
  | > appvg                                                                  |
[M|                                                                          |
  | F1=Help                F2=Refresh             F3=Cancel                  |
F1| F7=Select              F8=Image               F10=Exit                   |
Es| Enter=Do               /=Find                 n=Find Next                |
F9+--------------------------------------------------------------------------+
```

Figure 2.3.20.2 Selecting VGs to add to resource group

In our example, we will leave the other fields as default including the "Service IP labels/Addresses" and "Application Controller Name" fields.

```
        Change/Show All Resources and Attributes for a Resource Group

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

[TOP]                                                      [Entry Fields]
  Resource Group Name                                    RG01
  Inter-site Management Policy                           ignore
  Participating Nodes from Primary Site                  pc-tor01-glvm-01a
  Participating Nodes from Secondary Site                pc-lon06-glvm-01a

  Startup Policy                                         Online On Home Node O>
  Fallover Policy                                        Fallover To Next Prio>
  Fallback Policy                                        Never Fallback

  Service IP Labels/Addresses                           []                      +
  Application Controller Name                           []                      +

  Volume Groups                                         [dbvg appvg]            +
[MORE...30]

F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.20.3 Adding VGs to resource group RG01

A successful modification should result in a similar screen to this.

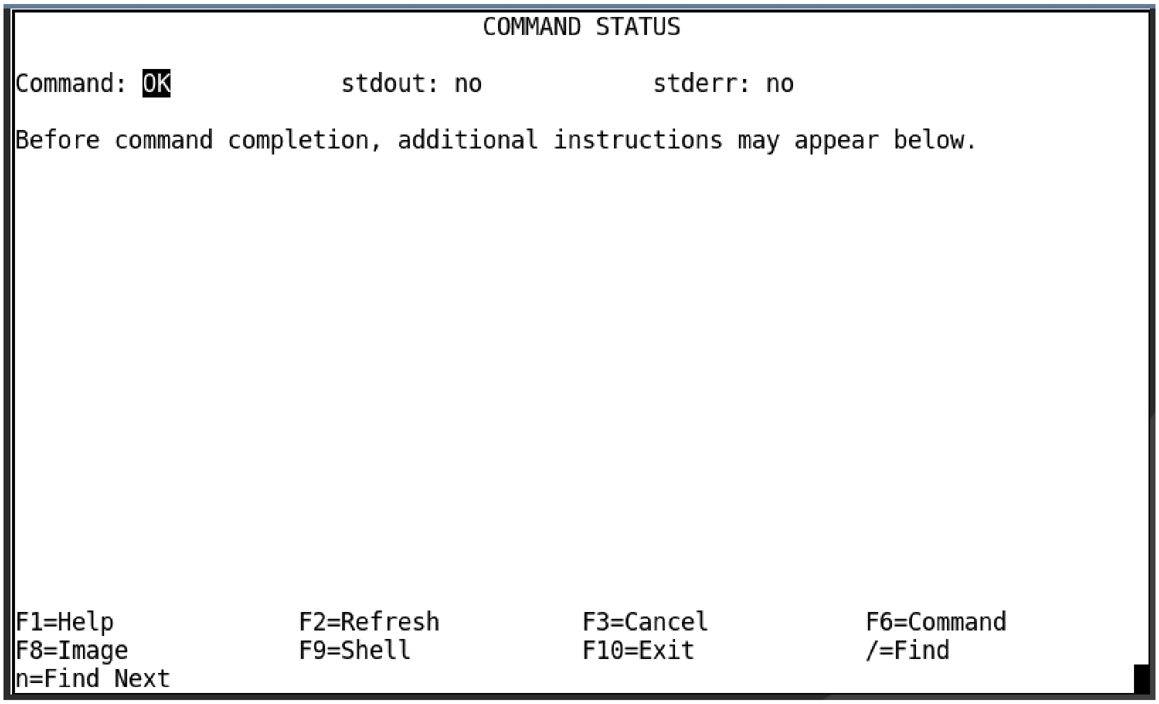


Figure 2.3.20.4 Successful RG change

2.3.21 Perform an additional PowerHA verification

We proceed with an additional PowerHA verification by executing "smitty sysmirror -> Cluster Nodes and Networks -> Verify and Synchronize Cluster Configuration". This will present a verification screen.

```
                        Cluster Nodes and Networks

Move cursor to desired item and press Enter.

   Verify and Synchronize Cluster Configuration

   Move cursor to desired item and press Enter. Use arrow keys to scroll.


     Any time you change the cluster configuration, those changes
     must be propagated to all nodes in the cluster. PowerHA SystemMirror w
     perform a set of verification checks to make sure the configuration
     is viable.

     Depending on the nature of the changes, this operation can disrupt
     the applications currently under PowerHA SystemMirror control.

     Press enter when you are ready to begin.

   F1=Help                 F2=Refresh              F3=Cancel
   F8=Image                F10=Exit                Enter=Do
F1 /=Find                  n=Find Next
F9
```

Figure 2.3.21.1 Enter to begin PowerHA verification

The resulting output should look something like the following.

```
                              COMMAND STATUS

Command: OK             stdout: yes           stderr: no

Before command completion, additional instructions may appear below.

[TOP]

Verification to be performed on the following:
        Cluster Topology
        Cluster Resources

Verification will interactively correct verification errors.


Retrieving data from available cluster nodes.  This could take a few minutes.

        Start data collection on node pc-lon06-glvm-01a
        Start data collection on node pc-tor01-glvm-01a
[MORE...153]

F1=Help               F2=Refresh            F3=Cancel             F6=Command
F8=Image              F9=Shell              F10=Exit              /=Find
n=Find Next
```

Figure 2.3.21.2 Output of PowerHA verification

2.3.22 Starting PowerHA EE

Once PowerHA EE is fully configured, we can start the cluster by starting cluster services. For our example, we start PowerHA by executing “smitty clstart” and change the fields “Startup Cluster Information Daemon” to “true” and “Automatically correct errors found during cluster start?” to “Yes”.

```
                             Start Cluster Services

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                        [Entry Fields]
* Start now, on system restart or both                now                     +
  Start Cluster Services on these nodes              [pc-tor01-glvm-01a]      +
* Manage Resource Groups                              Automatically           +
  BROADCAST message at startup?                       false                   +
  Startup Cluster Information Daemon?                 true                    +
  Ignore verification errors?                         false                   +
  Automatically correct errors found during           Yes                     +
  cluster start?







F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 2.3.22.1 Starting PowerHA services on primary node

The output of this command should be similar to the following screen.

```
                              COMMAND STATUS

Command: OK            stdout: yes          stderr: no

Before command completion, additional instructions may appear below.

[TOP]

Verifying Cluster Configuration Prior to Starting Cluster Services.

Verifying Cluster Configuration Prior to Starting Cluster Services.

There are no active cluster nodes to verify against.
Verifying node(s): pc-tor01-glvm-01a requested to start

WARNING: No backup repository disk is UP and not already part of a VG for nodes
:
WARNING: For PowerHA SystemMirror to perform monitoring over a network at least
two interfaces that reside on separate nodes must be defined to a
[MORE...37]

F1=Help             F2=Refresh          F3=Cancel           F6=Command
F8=Image            F9=Shell            F10=Exit            /=Find
n=Find Next
```

Figure 2.3.22.2 Output of starting PowerHA services

We repeat this process for all cluster nodes.

2.3.23 Verifying PowerHA EE is operating normally

After starting PowerHA EE on all nodes, the AIX GLVM resources, dbvg and appvg, should be on the appropriate node. We log into the primary PowerVS and perform a “df” command.

```
# df
Filesystem    512-blocks      Free %Used    Iused %Iused Mounted on
/dev/hd4          196608    105208   47%     3073    21% /
/dev/hd2         4784128    329872   94%    40770    50% /usr
/dev/hd9var      1966080   1646824   17%     1783     1% /var
/dev/hd3          458752    453696    2%       52     1% /tmp
/dev/hd1           65536     64784    2%        8     1% /home
/dev/hd11admin     262144    261384    1%        5     1% /admin
/proc                  -         -    -         -     - /proc
/dev/hd10opt      786432     85096   90%    11482    53% /opt
/dev/livedump     524288    523016    1%        5     1% /var/adm/ras/livedump
/dev/repo00     15335424     66288  100%     2533    25% /usr/sys/inst.images
/ahafs                 -         -    -        51     1% /aha
/dev/lv00        2621440    889232   67%       23     1% /tools
/dev/loop0        553760         0  100%   138440   100% /mnt
/dev/fslv07      6291456   5758640    9%     2092     1% /appfs1
/dev/fslv05      6291456   5313400   16%     3292     1% /appfs2
/dev/fslv06      6291456   4922056   22%     4189     1% /appfs3
/dev/fslv00      4194304   4084024    3%     1016     1% /data01
/dev/fslv01      4194304   3598480   15%     1945     1% /data02
/dev/fslv02      4194304   4000328    5%      826     1% /data03
/dev/fslv03      4194304   4193008    1%        4     1% /data04
```

Figure 2.3.23.1 Displaying shared VG mounted filesystems

Note on the above figure that the “dbvg” and “appvg” filesystems are mounted. An additional PowerHA command to display resource status”

- *clmgr q RG <RGNAME>*

```
pc-tor01-glvm-01a: / >
# clmgr q rg RG01 |  head -15
NAME="RG01"
CURRENT_NODE="pc-tor01-glvm-01a"
NODES="pc-tor01-glvm-01a"
STATE="ONLINE"
CURRENT_SECONDARY_NODE="pc-lon06-glvm-01a"
SECONDARYNODES="pc-lon06-glvm-01a"
SECONDARY_STATE="ONLINE SECONDARY"
TYPE="non-concurrent"
APPLICATIONS=""
STARTUP="OHN"
FALLOVER="FNPN"
FALLBACK="NFB"
NODE_PRIORITY_POLICY="default"
NODE_PRIORITY_POLICY_SCRIPT=""
NODE_PRIORITY_POLICY_TIMEOUT=""
```

Figure 2.3.23.2 Displaying resource group status

The above figure shows the resource group “RG01” being “ONLINE” on node “pc-tor01-glvm-01a” with secondary being “pc-lon06-glvm-01a”.

The “clmgr q cluster” command also displays the cluster status. The figure below shows that the cluster is in “STABLE” status.

```
r01-glvm-01a: / >
# clmgr q cluster | head -15
CLUSTER_NAME="tor01lon06"
CLUSTER_ID="1372642113"
STATE="STABLE"
TYPE="LC"
HEARTBEAT_TYPE="UNICAST"
VERSION="7.2.4.0"
VERSION_NUMBER="20"
EDITION="ENTERPRISE"
UNSYNCED_CHANGES="false"
FC_SYNC_INTERVAL="10"
RG_SETTLING_TIME="0"
RG_DIST_POLICY="node"
MAX_EVENT_TIME="180"
MAX_RG_PROCESSING_TIME="180"
TEMP_HOSTNAME="disallow"
pc-tor01-glvm-01a: / >
```

Figure 2.3.23.3 Querying the cluster status

2.3.24 Testing PowerHA

Once the cluster status is “STABLE” and all nodes are online and the RG is also online, we can perform a failover test.

For our scenario, we will simply reboot the primary node, pc-tor01-glvm-01a, using the “reboot -q” command. Note that we cannot use the “shutdown” command as PowerHA has a “hook” into the “shutdown” command and will know that was performed intentionally. Since PowerHA assumes a “shutdown” command is executed intentionally, it will not failover to the next available node. That is the reason we use the “reboot -q” command.

Again, before rebooting the primary node, pc-tor01-glvm-01a, we check to see the VGs are operational.

```
pc-tor01-glvm-01a: / >
# lsvg -o | grep -E "db|app";df | grep -E "appfs|data"
dbvg
appvg
/dev/fslv07      6291456   5758640    9%     2092     1% /appfs1
/dev/fslv05      6291456   5313400   16%     3292     1% /appfs2
/dev/fslv06      6291456   4922056   22%     4189     1% /appfs3
/dev/fslv00      4194304   4084024    3%     1016     1% /data01
/dev/fslv01      4194304   3598480   15%     1945     1% /data02
/dev/fslv02      4194304   4000328    5%      826     1% /data03
/dev/fslv03      4194304   4193008    1%        4     1% /data04
```

Figure 2.3.24.1 VGs operational at primary node

We also verify that the VGs are not operational on the standby node, pc-lon06-glvm-01a.

```
pc-lon06-glvm-01a:/ >
# lsvg -o | grep -E "db|app";df | grep -E "appfs|data"
```

Figure 2.3.24.2 VGs not operational at standby node

On the primary node, we execute the “reboot -q” command.

On the standby node, we watch that the node reacts by monitoring the “hacmp.out” log file using the command “tail -f /var/hacmp/log/hacmp.out”.

```
+RG01:clvaryonvg(169.302):appvg[updatefs:600] clodmget -q 'name = fslv07 and att
ribute = type and value = raw' -f value -n CuAt
+RG01:clvaryonvg(169.305):appvg[updatefs:600] [[ -n '' ]]
+RG01:clvaryonvg(169.305):appvg[updatefs:605] : Skip logical volumes for which g
etlvcb fails
+RG01:clvaryonvg(169.305):appvg[updatefs:607] /usr/sbin/getlvcb -f fslv07
+RG01:clvaryonvg(174.037):appvg[updatefs:607] fs_info=vfs='jfs2:log=/dev/loglv01
:options=rw:account=false:mountguard=yes '
+RG01:clvaryonvg(174.037):appvg[updatefs:608] cmd_rc=0
+RG01:clvaryonvg(174.037):appvg[updatefs:608] typeset -i cmd_rc
+RG01:clvaryonvg(174.037):appvg[updatefs:609] (( 0 != 0 ))
+RG01:clvaryonvg(174.037):appvg[updatefs:615] : Skip logical volumes not associa
ted with file systems
+RG01:clvaryonvg(174.037):appvg[updatefs:618] [[ -z vfs='jfs2:log=/dev/loglv01:o
ptions=rw:account=false:mountguard=yes ' ]]
+RG01:clvaryonvg(174.037):appvg[updatefs:618] [[ vfs='jfs2:log=/dev/loglv01:opti
ons=rw:account=false:mountguard=yes ' == *([[:space:]]) ]]
+RG01:clvaryonvg(174.037):appvg[updatefs:623] : Label and file system type from
LVCB on disk for fslv07
+RG01:clvaryonvg(174.038):appvg[updatefs:625] getlvcb -T -A fslv07
+RG01:clvaryonvg(174.038):appvg[updatefs:625] LC_ALL=C
+RG01:clvaryonvg(174.041):appvg[updatefs:625] egrep -w 'label =|type ='
+RG01:clvaryonvg(174.044):appvg[updatefs:625] paste -s - -
```

Figure 2.3.24.3 Watching “hacmp.out” on standby node

Eventually, PowerHA on the standby node finishes acquiring the resources and we can confirm that by looking at the status of the VGs status and the mounted filesystems.

```
pc-lon06-glvm-01a:/ >
# lsvg -o | grep -E "db|app";df | grep -E "appfs|data"
dbvg
appvg
/dev/fslv07      6291456   5758640    9%     2092     1% /appfs1
/dev/fslv05      6291456   5313400   16%     3292     1% /appfs2
/dev/fslv06      6291456   4922056   22%     4189     1% /appfs3
/dev/fslv00      4194304   4084024    3%     1016     1% /data01
/dev/fslv01      4194304   3598480   15%     1945     1% /data02
/dev/fslv02      4194304   4000328    5%      826     1% /data03
/dev/fslv03      4194304   4193008    1%        4     1% /data04
```

Figure 2.3.24.4 Displaying resources at DR node after failover

Chapter 3: Troubleshooting

The following are some possible problems and resolutions.

3.1 ioctl call failed

When attempting to manipulate disks, you may receive errors that indicate “ioctl call failed” such as the figure below.

```
pc-tor01-glvm-01a: / >
# extendvg -f -p appvg_lon06 appvg hdisk9 hdisk10
0516-1395 extendvg: The physical volume hdisk9, is not supported.
0516-1395 extendvg: The physical volume hdisk10, is not supported.
0516-1941 extendvg: ioctl call failed on hdisk9.
0516-1941 extendvg: ioctl call failed on hdisk10.
0516-792 extendvg: Unable to extend volume group.
```

Figure 3.1.1 ioctl call failed error

This may indicate the RPV server is not operational on the remote location. Log into the remote location PowerVS and verify the RPV server is operational.

Here we log into our remote PowerVS and restart the RPV servers.

```
pc-lon06-glvm-01a:/ >
# lsdev -Ccrpvserver
rpvserver0 Available  Remote Physical Volume Server
rpvserver1 Available  Remote Physical Volume Server
rpvserver2 Defined    Remote Physical Volume Server
rpvserver3 Defined    Remote Physical Volume Server
pc-lon06-glvm-01a:/ >
# mkdev -l rpvserver2
rpvserver2 Available
pc-lon06-glvm-01a:/ >
# mkdev -l rpvserver3
rpvserver3 Available
pc-lon06-glvm-01a:/ >
#
```

Figure 3.1.2 Changing “Defined” RPV servers to “Available”

3.2 Resuming a failed RPV client

If an RPV client has "failed" such as when we try to use it when the RPV server is down, it will stay in that "failed" state until it is resumed. In our example above (section 3.1), hdisk9 and hdisk10 failed due to the RPV server being down. The RPV servers were restarted and the RPV clients hdisk9 and hdisk10 still failed with the same message.

```
pc-tor01-glvm-01a: / >
# extendvg -f -p appvg_lon06 appvg hdisk9 hdisk10
0516-1395 extendvg: The physical volume hdisk9, is not supported.
0516-1395 extendvg: The physical volume hdisk10, is not supported.
0516-1941 extendvg: ioctl call failed on hdisk9.
0516-1941 extendvg: ioctl call failed on hdisk10.
0516-792 extendvg: Unable to extend volume group.
```

Figure 3.2.1 ioctl call failed error

Taking those two drives and updating them to "resume", we are able to utilized them after the "resume" is processed.

```
pc-tor01-glvm-01a: / >
# chdev -a resume=yes -l hdisk9
hdisk9 changed
pc-tor01-glvm-01a: / >
# chdev -a resume=yes -l hdisk10
hdisk10 changed
pc-tor01-glvm-01a: / >
# extendvg -f -p appvg_lon06 appvg hdisk9 hdisk10
pc-tor01-glvm-01a: / >
#
```

Figure 3.2.2 Resuming RPV clients with chdev command

3.3 When configuring RPV server, available disks are not displayed

An RPV server can only be configured when a disk has a PVID configured. If the PVID is not configured, the RPV configuration panel will not display the drive.

Say we have the following drives as shown on the following diagram.

```
pc-lon06-glvm-01a:/ >
# lspv
hdisk0          none                                None
hdisk1          00c8cf803fb0193a                    None
hdisk2          00c8cf803fb02116                    None
hdisk3          00f6db0af58e9775                    rootvg          active
hdisk4          none                                None
hdisk5          00c8cf803fb029cd                    None
hdisk6          00c8cf803fb03444                    None
pc-lon06-glvm-01a:/ >
```

Figure 3.3.1 Displaying available drives

We see that hdisk4 is available and want to setup an RPV server with that disk. We go into the SMIT panel to add that RPV server (smitty rpvserver->Add Remote Physical Volume Servers and receive the following message “There are no items of this type”.

```
                         Remote Physical Volume Servers

Move cursor to desired item and press Enter.

  Remote Physical Volume Server Site Name Configuration
  List All Remote Physical Volume Servers
  Add Remote Physical Volume Servers
  Change / Show a Remote Physical Volume Server
  Change Multiple Remote Physical Volume Servers
  Remove Remote Physical Volume Servers
  Configure Defined Remote Physical Volume Servers


                                ERROR MESSAGE

    Press Enter or Cancel to return to the
    application.

      1800-051 There are no items of this type.

    F1=Help                 F2=Refresh              F3=Cancel
F1  F8=Image                F10=Exit                Enter=Do
F9
```

Figure 3.3.2 SMIT does not find any available drives for an RPV server

We exit the SMIT panel and add a PVID to hdisk4 using the “chdev -a pv=yes -l hdisk4” command and note that the PVID has been assigned to that drive.

```
pc-lon06-glvm-01a:/ >
# chdev -a pv=yes -l hdisk4
hdisk4 changed
pc-lon06-glvm-01a:/ >
# lspv
hdisk0          none                                None
hdisk1          00c8cf803fb0193a                    None
hdisk2          00c8cf803fb02116                    None
hdisk3          00f6db0af58e9775                    rootvg          active
hdisk4          00c8cf8049bac9fa                    None
hdisk5          00c8cf803fb029cd                    None
hdisk6          00c8cf803fb03444                    None
pc-lon06-glvm-01a:/ >
```

Figure 3.3.3 Displaying new PVID on hdisk4

When we go back to the RPV server panel and try to select a drive to assign to an RPV server, we now get the following.

```
                         Remote Physical Volume Servers

Move cursor to desired item and press Enter.

  Remote Physical Volume Server Site Name Configuration
  List All Remote Physical Volume Servers
  Add Remote Physical Volume Servers
  Change / Show a Remote Physical Volume Server
  Change Multiple Remote Physical Volume Servers

                          Physical Volume Identifiers

    Move cursor to desired item and press F7.
        ONE OR MORE items can be selected.
    Press Enter AFTER making all selections.

      # Physical Volume        Physical Volume Identifier
      # ----------------------------------------------------
      hdisk4           00c8cf8049bac9fa

    F1=Help                F2=Refresh             F3=Cancel
    F7=Select              F8=Image               F10=Exit
F1  Enter=Do               /=Find                 n=Find Next
F9
```

Figure 3.3.4 Displaying available disks for an RPV server

We note that hdisk4 is now available as it now has a PVID configured. We can proceed to configuring the RPV server.

Chapter 4: Additional Resources

4.1 AIX Geographic Logical Volume Manager (GLVM) resources

AIX Geographic Logical Volume Manager (GLVM) is a software-based technology for real time geographic data mirroring over standard TCP/IP networks. Listed below are some additional resources.

- *https://www.ibm.com/support/knowledgecenter/en/SSPHQG_7.2/glvm/ha_glvm_glvm.html*
- *https://www.ibm.com/support/knowledgecenter/SSPHQG_7.2/glvm/hacmpgeolvm_pdf.pdf*

4.2 IBM PowerHA resources

AIX Geographic Logical Volume Manager (GLVM) is a software-based technology for real time geographic data mirroring over standard

- *https://www.ibm.com/support/knowledgecenter/SSPHQG_7.2/glvm/ha_glvm_plan_glvm_mirror.htm*
- *http://www.redbooks.ibm.com/redbooks/pdfs/sg248434.pdf*

4.3 Other resources

- *IBM Cloud Power Virtual Server offering:*
  - *https://cloud.ibm.com/docs/power-iaas?topic=power-iaas-getting-started*