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# A. Health and Safety Instructions

1. Prior to entering the server room the system is to be turned manual only and upon leaving reinstated to auto/manual.

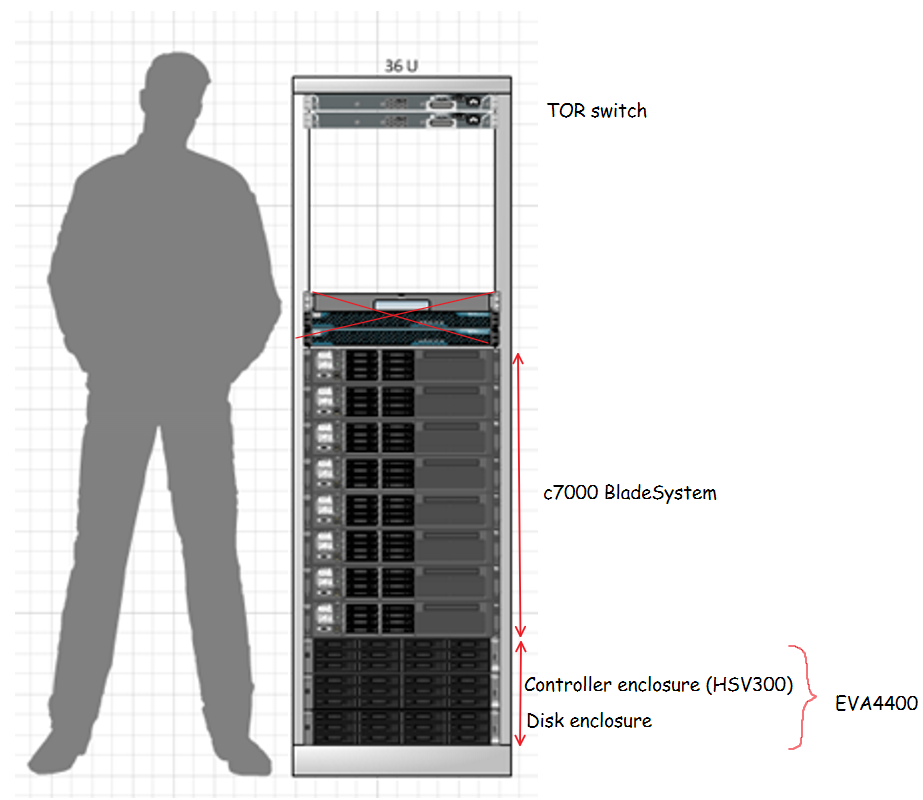
2. Not more than 6 people at a time may be in the server room.

3. Each person may not spend more than 1.5 hrs at a stretch inside. Take a 15 minute break every 1.5 hours.

4. Keep the door to the server room open.

5. Keep area tidy (no food and drinks or any other activity that create any sort of fine dust).

# B. Racking Diagram



# 1. First set of steps

[Power distribution](#_1.1_Power_distribution)

[Identification of Management Interfaces](#_1.2_Identification_of)

[Getting to grips with the EVA4400](#_Getting_to_grips)

[Windows Server installation](#_1.4_Windows_Server)

### 1.1 Power distribution

Rack Power Distribution Labelling Exercise:

* 1. Read pages 20 – 24 of the HP 4400 Enterprise Virtual Array User Guide
  2. Take pictures of the rack in order to label the components identified in pages 20 – 24. Almost all the components in these pages may be found in the rack and in the power sources that feed it.

### 1.2 Identification of Management Interfaces

 The "Management Network" is used to interact with all the management modules in the systems which we will be using. The network address is to be assigned to us by IT Services.

1. Connect to each of the interfaces listed below, then log on and log off. This will ensure that you are able to connect to useful management points in the infrastructure.
   1. Onboard Administrator Module
      1. Browser-based (https)
      2. IP Address: <Assign an IP address on the "management network">
      3. Credentials: Administrator/JUXAV9V2 (Administrator with a capital A)
   2. Blade Server HP Bl460c iLOs (Integrated Lights Out)
      1. Browser-based (https)
      2. IP Address: <Assign an IP address on the "management network">
      3. Credentials: Same as onboard administrator module if OA admin account is used.
   3. Management Server: Use the stand-alone micro-tower cased computer
      1. Browser-based (https)
      2. IP Address: <Assign an IP address on the "management network">
         1. Address as on 24/11/2016: 10.0.0.3/24
      3. Credentials: Same as onboard administrator module if OA admin account is used.

### 1.3 Getting to grips with the EVA4400

**Preamble**

The EVA4400 is a ***Storage System***. The term is emphasised to draw attention to a convention that is in widespread use in the application of Information Technology. The EVA4400 is referred to as a storage system because its components are organised to provide abstraction of the physical mass storage units. This abstraction meets at least the following functional specification, expressed in comparison to the individual physical storage units:

* Enhanced reliability
* Better storage space utilisation
* Greater input/output operations per second (IOPS) for a reference benchmark

The improvement depends on the chosen organisation of the physical storage units. Certain organisations enhance one of the elements of the specification at the cost of other elements. For example, IOPS may be traded off against reliability. Storage space utilisation may also be traded off against reliability.

**Exercise**

Read pages 134-136 and 145-146 (use the pdf’s page numbering, not the document’s) of "Integrating and Managing HP BladeSystem Solutions" before attempting this exercise:

* + Take pictures of the EVA4400 systems in the server room.
  + Use the pictures of the front of the system to indicate the maximum number of disk groups into which each EVA4400 system can be divided.

### 1.4 Windows Server installation

* 1. Connect DVD drive / USB with bootable ISO of Windows Server 2012 R2 to the blade server.
  2. Connect to the blade's console through the iLO.
  3. Install FC HBA in the blade server.
  4. Install Windows Server 2012 R2 with GUI.

# 2. Second set of steps

1. [Capacity impact of Vraid and DG Protection Level](#_2.1_Capacity_impact)
2. [Host Registration](#_2.2_Host_Registration)
3. [Virtual Disk Creation](#_2.3_Virtual_Disk)
4. [Discovery and Multipathing](#_2.4_Discovery_and)
5. [Performance: Vraid5](#_2.5_Performance:_Vraid5)
6. [Performance: Vraid0](#_2.6_Performance:_Vraid0)
7. [Performance: Vraid1](#_2.7_Performance:_Vraid1)

## 2.1 Capacity impact of Vraid and DG Protection Level

**Reading**

(a) Pages 5,6 of the document titled "Best Practices - HP StorageWorks 4400-6400-8400 Enterprise Virtual Array Configuration.pdf"

(b) Pages 148,149 of the document titled "Integrating and Managing HP BladeSystem Solutions.pdf"

1. For each of the snips shown, determine the disk group protection level.

1. By comparing the Vraid5 capacity with the Vraid0 capacity shown in each snip, derive the number of strips of data which the XCS firmware uses to compute the parity strip.

Machine generated alternative text:
Tot* 
A r location level O % 
This disk group is 
(estn&d) 
vraido 1634 
vraidl: 8160B 
vrai•s: 1307 

Snip 1

Machine generated alternative text:
go los 
go Ego L 
go ogg 
go LgeL 
(papw!lsa) 
papoolle dnoa5 sul 
go sgeL 
u0!E0011F 
:paE0011F 
:le101 
Aaewwns 
Avoedeo 

Snip 2

Machine generated alternative text:
Capacity 
Summary 
Total: 
Allocated: 
Allocation level: 
logl Ga 
This disk group is 0% allocated 
Available (estimated) 
VraidO: 
Vraidl: 
VraidS: 
VraidE: 
1088 Ga 
543 Ga 
870 Ga 
725 Ga 

Snip 3

## 2.2 Host Registration

 To present storage capacity from a storage system to hosts in a SAN, the hosts must be registered with the storage system.

Use Command View EVA to register all hosts (all blades) with the storage system. Choose one of the hosts as a point of reference in order to carry out steps that test the storage. This host will be referred to as "your host" in future references.

### Configuration example: Registration of blade1

Machine generated alternative text:
HP P6000 Command View Software - Mozilla Firef0N 
File Edit View History $ookmarks 
1001s Help 
HP PSOOO Command View Software 
localhost 
:23741SPoG1 
user: 
err v e 
Google 
anagem nt Group: 
p 
r-r-r- 
4 
HP StorageWorks 440„ 
BladeSystem Manage„ 
iSCSl 
oaD:130a18 
FCoE 
5001-4380-02gF 
Custom mode 
(this system) 
HP PEDDD Command Vievv Sftvare 
Storage Systems 
Storage Network 
STORAGESYSTEMI 
Virtual Disks 
3 
Vdisk2 S 
Hosts 
blade4 
Disk Groups 
Default Disk Group 
Llngrouped Disks 
Data Replication 
Hardware 
iSCSl Devices 
Controller Enclosure 
Controller I 
Controller 2 
Management Module 
Disk Enclosure I 
Hosts 
Add a Host 
Add Host 
Required ) 
asic Settings 
Manaaement 
Confirm Add Host 
Review your new host's main attributes and click Add Host to complete the addtion process 
Cancel 
New Host Attributes 
Name 
New Host HEA Ports 
Connection Type 
Fibre Channel 
Operating System 
Microsoft VMndows 
Total HEA Ports 
bladel 
Fibre channel 
5001-4380-02gF-35C2 
Microsoft VMndows 
Name: 
Port 
Operating 
dvanced Settings 
Add the Host to These Storage Systems 
Name'VVorId VMde Name 
1 STORAGESYSTEMI (this system) 
5001-4380-025A-3E00 
Port World VMde Name 
5001-4380-02gF 
Add to storage systems: 
17 
STORAGESYSTEMI 
Host nameAP address: 
Comments: 
License Alerts: 
HP HP "6000 command View, HP "6000 Business copy and HP "6000 conti 
valid license key configuration to be in compliance with the end-user-lice 
See online hel for more details. 

Machine generated alternative text:
HP P6000 Command View Software - Mozilla Firef0N 
File Edit View History $ookmarks 
1001s Help 
HP PSOOO Command View Software 
localhost 
:23741SPoG1 
user: 
err v e 
Google 
anagem t Group: 
p 
r-r-r- 
4 
HP StorageWorks 440„ 
BladeSystem Manage„ 
oaD:130a18 
HP PEDDD Command Vievv Sftvare 
Storage Systems 
Storage Network 
STORAGESYSTEMI 
Virtual Disks 
3 
Vdisk2 S 
Hosts 
bladel 
blade4 
Disk Groups 
Default Disk Group 
Llngrouped Disks 
Data Replication 
Hardware 
iSCSl Devices 
Controller Enclosure 
Controller I 
Controller 2 
Management Module 
Disk Enclosure I 
Hosts 
Add Host Results 
The results of your Add Host request are shown belovw 
New host name: bladel 
Successful Operations 
Manaaement 
Host Port 
5001-4380-02gF 
5001-4380-02gF 
Status 
Host and port addecL 
Port added to host 
O 
O 
Storage System 
N am enwm 
STORAGESYSTEMI 
5001-4380-025A-3E00 
STORAGESYSTEMI 
5001-4380-025A-3E00 
License Alerts: 
HP HP P6000 Command View, HP P6000 Business Copy and HP P6000 Continuous Access require a 
valid license key configuration to be in compliance with the end-user-license-agreement (EULA). 
See online help for more details. 
The Instant-On license for this system expires on 4 Apr 2015 

## 2.3 Virtual Disk Creation

* 1. Use Command View EVA on the Management Server to create a 75GB Vraid1 Virtual Disk

* 1. Use discovery in your host's disk management (diskmgmt.msc). Do you see any new disk?

* 1. Use LUN masking to grant access to the virtual disk only to your host

### 2.3.1 Configuration

### 

Machine generated alternative text:
HP P6000 Command View Software - Mozilla Firef0N 
File Edit View History $ookmarks 
1001s Help 
HP PSOOO Command View Software 
localhost 
:23741SPoG1 
oaD:130a18 
user: a d m o 
instrat 
err v e 
Google 
anagem nt Group: 
p 
r-r-r- 
4 
HP StorageWorks 440„ 
BladeSystem Managæ„ 
HP PEDDD Command Vievv Sftvare 
Storage Systems 
Storage Network 
STORAGESYSTEMI 
Virtual Disks 
Hosts 
Disk Groups 
Default Disk Group 
Llngrouped Disks 
Data Replication 
Hardware 
iSCSl Devices 
Controller Enclosure 
Controller I 
Controller 2 
Management Module 
Disk Enclosure I 
Virtual Disks 
Redundancy: 
Disk group: 
Name 
Manaaement 
75 
VraidE 
g07 Ga avail 
vraids CGB) 
Read only 
VraidO 
1361 Ga avail 
Vraidl 
Ga avail 
Vrai do 
VraidS 
1 oag Ga avail 
Vraidl Vrai dS 
1089 
Readhmrte 
Default Disk Group 
Presentation: 
Select Hosts 
Advanced Settings 
VRfrtte Cache policy: 
Read Cache policy: 
OS Unt ID: 
Preferred pathhode: 
World VMde Name: 
VRfrte-back 
On 
No preference 
Default "AIName 
Management lock: 
Unlocked 
(format: Exxx-xxxx-xxxx-xxxx-xxxx-xxxx-xxxx-xxxx) 
Comments: 
License Alerts: 
HP HP P6000 Command View, HP P6000 Business Copy and HP P6000 Continuous Access require a 
valid license key configuration to be in compliance with the end-user-license-agreement (EULA). 
See online help for more details. 
The Instant-On license for this system expires on 4 Apr 2015 

### 2.3.2 Response

Machine generated alternative text:
HP P6000 Command View Software - Mozilla Firef0N 
File Edit View History $ookmarks 
1001s Help 
HP PSOOO Command View Software 
localhost 
:23741SPoG1 
err v e 
Google 
anagem t Group: 
p 
r-r-r- 
4 
HP StorageWorks 440„ 
BladeSystem Managæ„ 
oaD:130a18 
user: a d m o 
instrat 
HP PEDDD Command Vievv Sftvare 
Storage Systems 
Storage Network 
STORAGESYSTEMI 
Virtual Disks 
Hosts 
Disk Groups 
Default Disk Group 
Llngrouped Disks 
Data Replication 
Hardware 
iSCSl Devices 
Controller Enclosure 
Controller I 
Controller 2 
Management Module 
Disk Enclosure I 
Virtual Disks 
Create Vdisks Results 
Create More Vdisks 
The results of your Create Vdisks request are shown belovw Click the Create More Vdisks button to create more 
Manaaement 
Vdisk& 
Successful Operations 
Name 
O 
Vdisk2 S 
License Alerts: 
Status 
Vdisk createcL Allocation in progress 
HP HP P6000 Command View, HP P6000 Business Copy and HP P6000 Continuous Access require a 
valid license key configuration to be in compliance with the end-user-license-agreement (EULA). 
See online help for more details. 
The Instant-On license for this system expires on 4 Apr 2015 

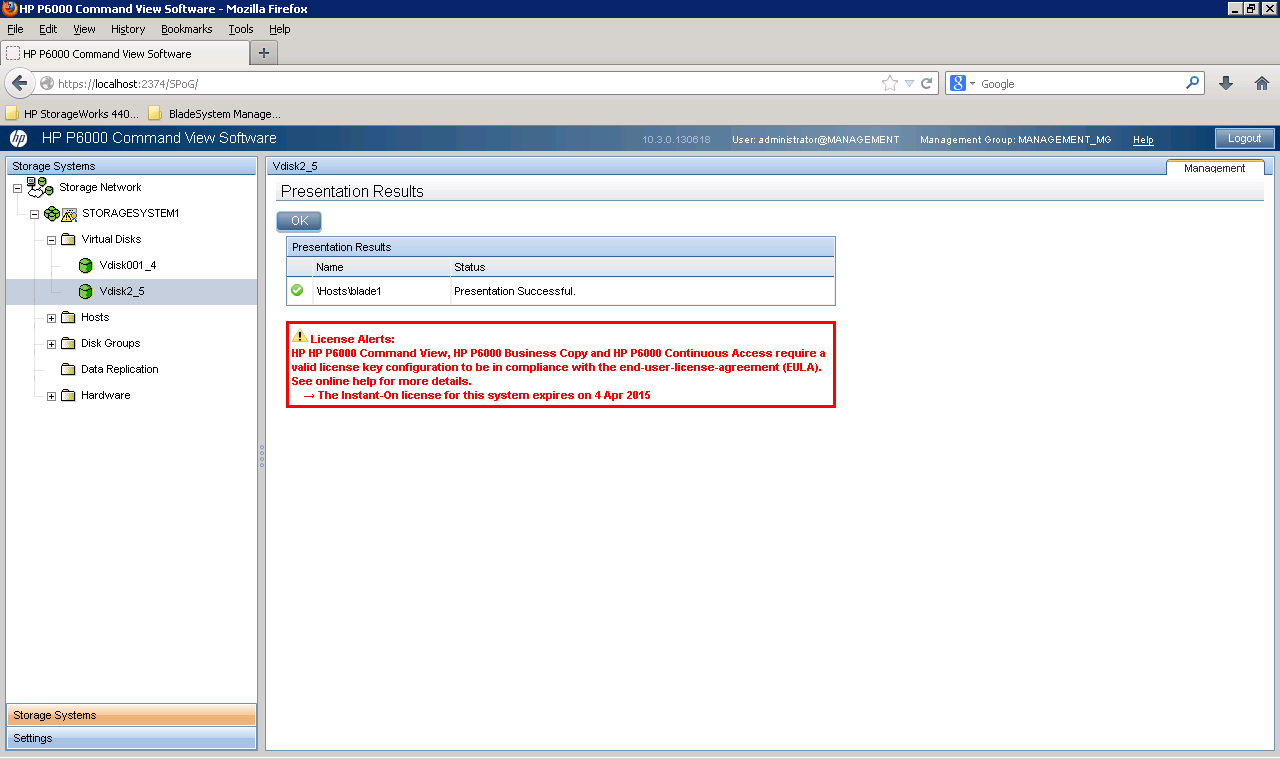
### 2.3.3 Virtual disks view at completion

Machine generated alternative text:
HP P6000 Command View Software - Mozilla Firef0N 
File Edit View History $ookmarks 
1001s Help 
HP PSOOO Command View Software 
localhost 
:23741SPoG1 
user: 
oaD:130a18 
Create Mirrorclone 
err v e 
Google 
anagem nt Group: 
p 
r-r-r- 
4 
HP StorageWorks 440„ 
BladeSystem Managæ„ 
HP PEDDD Command Vievv Sftvare 
ata Replic Ion 
Create Snapclone 
Storage Systems 
Storage Network 
STORAGESYSTEMI 
Virtual Disks 
3 
Vdisk2 S 
Hosts 
Disk Groups 
Default Disk Group 
Llngrouped Disks 
Data Replication 
Hardware 
iSCSl Devices 
Controller Enclosure 
Controller I 
Controller 2 
Management Module 
Disk Enclosure I 
Vdisk2 S 
Vdisk Properties 
Manaaement 
General 
resentatlon 
Create Snapshot 
Move 
Good 
Cig-Feb-2015 1 
On 
Mirrored 
VRfrte-back 
VRfrte-through 
Unlocked 
onveflTo Container 
Identification 
CondtionEtate 
Operational state: 
Dateffime 
Created: 
Cache Policies 
Read cache: 
Mirror cache: 
VRfrtte cache: 
Requested: 
Actual: 
Management Lock: 
State: 
Name: 
World VMde 
LLIN Name: 
UUID: 
Attributes 
Capacity 
Comments 
Vdisk2 S 
soos-08b4-0008-e2ae-oooo-7000-003c-ooo 
BOOS-OBb4-0008- 
e2ae-oooo-7000-003c-oooo 
Disk group: 
Redundancy: 
Requested: 
Allocated: 
Original 
Default Disk Group 
Vraidl 
75 
75 Ga 
License Alerts: 
HP HP P6000 Command View, HP P6000 Business Copy and HP P6000 Continuous Access require a 
valid license key configuration to be in compliance with the end-user-license-agreement (EULA). 
See online help for more details. 
The Instant-On license for this system expires on 4 Apr 2015 

### 2.3.4 Masking

Machine generated alternative text:
Vdisk2 
Vdisk Properties 
Presentation 
ata Replication 
The Vdisk is not presented • 
LUN ID"SCSI Path 
Presentations 
More 
Save Changes 
Host Presentations 
Type Folder 
Host Name 
Advanced Settings 
Fibre Channel Path 
Preferred pathhode: 
Managing controller: 
OS unt ID: 
Host Access 
Not presented 
VRfrtte Protect 
No 
No preference 
Controller I 

Machine generated alternative text:
HP P6000 Command View Software - Mozilla Firef0N 
File Edit View History $ookmarks 
1001s Help 
HP PSOOO Command View Software 
localhost 
:23741SPoG1 
user: adm 
err v e 
Google 
p 
r-r-r- 
4 
HP StorageWorks 440„ 
BladeSystem Managæ„ 
oaD:130a18 
Presentations 
Operating System 
icrosoft VMndow 
Microsoft VMndows 
HP PEDDD Command Vievv Sftvare 
Cancel 
anagem t Group: 
Storage Systems 
Storage Network 
STORAGESYSTEMI 
Virtual Disks 
3 
Vdisk001 
3 
Vdisk2 S 
Hosts 
bladel 
blade4 
Disk Groups 
Default Disk Group 
Llngrouped Disks 
Data Replication 
Hardware 
iSCSl Devices 
Controller Enclosure 
Controller I 
Controller 2 
Management Module 
Disk Enclosure I 
Vdisk2 S 
present V disk 
Confirm Selections 
Manaaement 
Not Filtered 
Condtions: 
Type 
Folder 
Host Name 
blade 
blade4 
More 
License Alerts: 
HP HP P6000 Command View, HP P6000 Business Copy and HP P6000 Continuous Access require a 
valid license key configuration to be in compliance with the end-user-license-agreement (EULA). 
See online help for more details. 
The Instant-On license for this system expires on 4 Apr 2015 
https:1110 O O sg 23721hsv300vog001VDPresent?guid-14kggFnAt11 tUMhscRcjJ201As141 SMi1xZFp3sqaow-asessionid-A6S330 0-07-10-60050884-0008E2AE-00007000-003cooooaldad1D-0100-07-10-60050884-0008E2AE-00007000-001 Eooooaaction-wait# 



## 2.4 Discovery and Multipathing

1. [Discovery](#_2.4.1_Discovery)
2. [Multipathing](#_2.4.2_Multipathing)

### 2.4.1 Discovery

**Note from Command View's online help:**

After a virtual disk is presented to your host, use the host OS to verify that the disk is visible to the host. Presentation does not include:

* partitioning,
* formatting with a file system, or
* mounting on the host.

You will need to perform additional steps on the host to complete the above-mentioned three steps.

* 1. Use discovery in your host's disk management (diskmgmt.msc) to find the virtual disk created in exercise 3. What do you see?

BEFORE:

Machine generated alternative text:
File Action 
Volume 
View Help 
Basic 
em 
NTFS 
NTFS 
Status 
Healthy 
Healthy (S... 
136.35 
350 MB 
Disk Mana ement 
% Free 
25 % 
Free S 
127.39 
Simple 
Simple 
System Reserved 
350 MB NTFS 
System Reserved 
Basic 
136.70 
Online 
136.35 NTFS 
Healthy (Boot, Page File, Crash Dump, Primary Partition) 
Activate Windows 
Go to System in Control Panel to activate 
Healthy (System, Active, Primary Partition) 
• 
Unallocated Primary partition 

AFTER:

Machine generated alternative text:
File Action 
Volume 
View Help 
Disk Mana 
% Free 
25 % 
ement 
Simple 
Simple 
System Reserved 
350 MB NTFS 
Basic 
em 
NTFS 
NTFS 
Status 
Healthy 
Healthy (S... 
136.35 
350 MB 
Free S 
127.39 
136.35 NTFS 
ate 
System Reserved 
Basic 
136.70 
Online 
Disk 1 
Unknown 
75.00 
Offline 
Disk 2 
Unknown 
7500 
Offline 
Disk 3 
Unknown 
7500 
Offline 
Disk 4 
Unknown 
7500 
Healthy (System, Active, Primary Partition) 
7500 
Unallocated 
7500 
Unallocated 
7500 
Unallocated 
7500 
Healthy (Boot, Page File, Crash Dump, Primary Partition) 
Go to System in Control Panel to act 
Windows. 
• 
Unallocated Primary partition 

### 2.4.2 Multipathing

* 1. Install the multipathing driver on your host.
     + Use [this](https://technet.microsoft.com/en-us/library/ee619752(v=ws.10).aspx) web page as a guide.

* 1. Review the disk management window. What do you see?
     + Use the mpclaim command to corroborate what you see in the disk management window.

* 1. Claim the disk for control by MPIO. Use the Control Panel MPIO applet to claim the disk.

* 1. Review the disk management window. What do you see?
     + Use the same mpclaim command as before to corroborate the output of the disk management window.

## 2.5 Performance: Vraid5

Iometer Worker 1 only; do not use other worker threads for this test

* 1. [Disk target](#_2.5.1_Disk_target)
  2. [Test setup](#_2.5.2_Test_setup)
  3. [Access specifications](#_2.5.3_Access_specifications)
  4. [Results display](#_2.5.4_Results_display)

### 2.5.1 Disk target

* + HP HSV300

### 2.5.2 Test setup

* 1. Use LUN masking to present the virtual disk only to your host
  2. Use Disk Management to turn the logical disk online.
  3. **Iometer**
     + Ramp-up time for purely sequential I/O=60 seconds
     + Ramp-up time for partially random cases of I/O=150 seconds
     + Duration=2 minutes

### 2.5.3 Access specifications

* 1. Carry out the following IOMeter tests (same as before) with a 4KiB request size
     1. 100% raw read sequential
     2. 100% raw write sequential
     3. 50% raw read-write sequential
     4. 50% raw read-write random
     5. 100% raw read random
     6. 100% raw write random
  2. Carry out the same tests with a 64KiB request size.

### 2.5.4 Results display

* + Set update frequency to 1 second (allows inspection of dynamic behaviour)

## 2.6 Performance: Vraid0

Iometer Worker 1 only; do not use other worker threads for this test.

1. [Disk target](#_2.6.1_Disk_target)
2. [Test setup](#_2.6.2_Test_setup)
3. [Access specifications](#_2.6.3_Access_specifications)
4. [Results display](#_2.6.4_Results_display)

### 2.6.1 Disk target

* + HP HSV300

### 2.6.2 Test setup

* 1. Delete the 75 GB Vraid5 virtual disk.
  2. Create a 75 GB Vraid0 virtual disk.
  3. Use LUN masking to present the virtual disk only to your host
  4. Use Disk Management to turn the logical disk online.
  5. **Iometer**
     + Ramp-up time for purely sequential I/O=60 seconds
     + Ramp-up time for partially random cases of I/O=150 seconds
     + Duration=2 minutes

### 2.6.3 Access specifications

* 1. Carry out the following IOMeter tests (same as previous two test groups) with a 4KiB request size
     1. 100% raw read sequential
     2. 100% raw write sequential
     3. 50% raw read-write sequential
     4. 50% raw read-write random
     5. 100% raw read random
     6. 100% raw write random
  2. Carry out the same tests with a 64KiB request size.

### 2.6.4 Results display

* + Set update frequency to 1 second (allows inspection of dynamic behaviour)

## 2.7 Performance: Vraid1

Iometer Worker 1 only; do not use other worker threads for this test.

1. [Disk target](#_2.7.1_Disk_target)
2. [Test setup](#_2.7.2_Test_setup)
3. [Access specifications](#_2.7.3_Access_specifications)
4. [Results display](#_2.7.4_Results_display)

### 2.7.1 Disk target

* + HP HSV300

### 2.7.2 Test setup

* 1. Delete the 75 GB Vraid0 virtual disk.
  2. Create a 75 GB Vraid1 virtual disk.
  3. Use LUN masking to present the virtual disk only to your host
  4. Use Disk Management to turn the logical disk online.
  5. **Iometer**
     + Ramp-up time for purely sequential I/O=60 seconds
     + Ramp-up time for partially random cases of I/O=150 seconds
     + Duration=2 minutes

### 2.7.3 Access specifications

* 1. Carry out the following IOMeter tests with a 4KiB I/O size.
     1. 100% raw read, 100% sequential
     2. 100% raw write, 100% sequential
     3. 50% raw read, 100% sequential
     4. 50% raw read, 100% random
     5. 100% raw read, 100% random
     6. 100% raw write, 100% random
  2. Carry out the same tests with a 64KiB I/O size.

### 2.7.4 Results display

* + Set update frequency to 1 second (allows inspection of dynamic behaviour)

## 2.8 IOPS and Throughput Comparison

**IOPS Comparison**

* 1. Use the Vraid0 as a reference for this exercise
  2. Organise the test points such that the **IOPS** are in ascending order and plot the results as a line curve (Cartesian axes).
  3. Superpose the results for Vraid1 and Vraid5 on the same pair of axes

**Throughput Comparison**

* 1. Use the Vraid0 as a reference for this exercise.
  2. Organise the test points such that the **throughput** is in ascending order and plot the results as a line curve (Cartesian axes).
  3. Superpose the results for Vraid1 and Vraid5 on the same pair of axes.

# 3. Third set of steps

1. [Install the Hyper-V role](#_3.1_Install_the)
2. [General prerequisites](#_3.2_General_prerequisites)
3. [Failover clustering - A Windows Feature](#_3.3_Failover_clustering)
4. [Prepare networking for VMs](#_3.4_Prepare_networking)
5. [Validate the cluster configuration](#_3.5_Validate_the)

## 3.1 Install the Hyper-V role

 Use Powershell on each blade server to:

* 1. With a single command (per blade server): Rename the blade server according to its position in the enclosure and immediately restart the server.
  2. With a single command: Install the Hyper-V role; include the management tools for the Hyper-V role; restart the server

**A "Control Domain"**

 Once the Hyper-V role is installed, the operating system is reserved for the specific role of "management operating system".

The operating system, henceforth referred to as the "management operating system" is now no longer in control of all machine resources but only those resources which form part of a "root partition". Among other functions, the management operating system provides the means to create other partitions of system resources, i.e.: other VMs.

## 3.2 General prerequisites

The purpose of this set of exercises is to build a Failover Cluster for the Hyper-V role.

This provides the non-functional specifications of high availability and scalability to the service provided by Hyper-V: namely, the provision of virtual machines.

### 3.2.1 Networking

The prerequisites consist of physical and logical connectivity to all networks. Apart from the "Management Network", which has already been introduced:

* 1. One network for intra-cluster communication ("Cluster network")
     1. This network is an internal network; it is only accessible by components of the virtualisation platform which is being built.
     2. Please ensure that the network address selected is a private IPv4 address space within the set of ranges allowed by RFC 1918.

* 1. One network for communication with clients ("Client network")
     1. In this case, the clients are the users who will be using the Virtual Machines installed on the Hyper-V servers. This must be provided by IT services (one of the three networks: one for management, one for client traffic and one for Internet access)
  2. One network for storage traffic
     1. In this case, the storage traffic of interest to the cluster is that destined to the virtual hard disk drives, i.e. the virtual hard disk drives of the VMs.
     2. This is an internal network. In our case, it is a Fibre Channel network and therefore does not need IP addresses.
     3. Since all physical hosts may need to host the VM, then all physical hosts may need to write to the volume where the virtual hard disk drives are stored.
     4. The mechanism for shared access is in place: the SAN provides the facility to setup logical paths to logical units created in the storage system.
     5. Therefore, LUN masking must now be modified to set up at least one logical unit that is accessible by all hosts which are destined to form the cluster.

### 3.2.2 Other prerequisites

Other prerequisites will be exposed as the exercise unfolds.

Ignoring these prerequisites is not good practice but is done in order to introduce them within the context in which they are required.

In particular, the role of a single reference for authentication and authorisation will become apparent.

## 3.3 Failover clustering - A Windows Feature

Read the "technical background" sub-page to familiarise with the function of the failover cluster.

The objectives of implementing Windows Failover Clustering are two:

* 1. to provide alternative hosts on which to run virtual machines should there be the loss of the host on which the VMs are running. This is referred to as the provision of high availability.
  2. to host VMs on the "alternative" host, should the need arise. This is referred to as the provision of scalability.

### 3.3.1 Technical background

"A failover cluster is a group of independent computers that work together to increase the availability and scalability of **clustered roles**…The clustered servers are connected together by **physical cable** and by **software**…Failover clusters also provide cluster shared volume functionality that provides a consistent, distributed namespace that clustered roles can use to access shared storage from all nodes."

<https://technet.microsoft.com/en-us/library/hh831579.aspx?f=255&MSPPError=-2147217396>

"Failover clusters provide high availability and scalability to… Microsoft Exchange Server, Hyper-V, Microsoft SQL Server and file servers."

- <https://technet.microsoft.com/en-us/library/hh831579.aspx?f=255&MSPPError=-2147217396>

"All clustering technologies are considered Features, as they are infrastructure that enable roles to be made highly available"

- <http://blogs.msdn.com/b/clustering/archive/2012/04/06/10291601.aspx>

### 3.3.2 Install the Feature

Use Powershell on your blade server to:

1. With a single command: Install the Failover Clustering feature

## 3.4 Prepare networking for VMs

In this step, an "external virtual switch" will be deployed.

This is used to provide virtual machines created on the hyper-v host with the facility to connect to the network **outside** of the confines of the hyper-v host, i.e. the physical network to which the hyper-v host itself connects. This physical network will host several logical layer 2 networks (VLANs):

1. The "Management Network"
2. The "Client Network"
3. The "Internet-connected Network"
4. The "Cluster Network" (only used by the virtualisation platform)

Use a single Powershell command to create an external virtual switch and prevent the network interface to which it connects from being used by the management operating system.

## 3.5 Validate the cluster configuration

1. [Join a common authentication source](#_3.5.1_Join_a)
2. [Pre-flight check (PFC)](#_3.5.2_Pre-flight_check)

### 3.5.1 Join a common authentication source

Since there is more than one node in a cluster, then all nodes must have a common source for validation of credentials in order to carry out tasks that require authentication on the nodes.

If the nodes were to exist in a separate "realm" of authentication, then the credentials used on one node would not be recognised on the other node(s) in the cluster.

**Hence the need for a common source for validation of credentials.** In Microsoft technology, this common source is referred to as "Active Directory". In principle, this is an implementation of a Directory technology and there is some incorporation of open standards in this technology. For example, Active Directory supports the use of Lightweight Directory Access Protocol (LDAP) for clients to access the content of the database that stores authentication data and objects related to authentication.

The physical hosts (the blade servers) must be joined to an Active Directory domain:

* You will need to set your blades' servers to use the DNS server on the management server.
* You will need to join the domain fict.local

### 3.5.2 Pre-flight check (PFC)

Prior to creating the cluster, a "pre-flight check" built into the management software can be executed. The GUI "Failover Cluster Manager" can be used for this purpose.

# 4. Fourth set of steps

1. [Create the Cluster](#_4.1_Create_the)
2. [Background Information](#_4.2_Background_Information)
3. [Adding a witness](#_4.3_Adding_a)
4. [Adding a CSV](#_4.4_Adding_a)
5. [Create a Windows VM template](#_4.5_Create_a)
6. [Create an HA VM](#_4.6_Create_an)

## 4.1 Create the Cluster

By now, all the blades that will be nodes in the cluster should be part of the fict.local Active Directory domain.

Use the "Create Cluster Wizard" to set up a cluster comprising all the blades. Ensure that any IP address which you assign in the process is not already in use.

## 4.2 Background Information

[Processor Configuration](#_4.2.1_Processor_Configuration)

[CSV: Cluster Network Configuration Considerations](#_4.2.2_CSV:_Cluster)

[CSV: Storage and disk configuration requirements](#_4.2.3_CSV:_Storage)

[Arrangement of CSVs and VHD-files](#_4.2.4_Arrangement_of)

[Quorum Background Information](#_4.2.5_Quorum_Background)

[Witness Background Information](#_4.2.6_Witness_Background)

[Considerations for creating a virtual machine that is highly available](#_4.2.7_Considerations_for)

[Clustered Roles](#_4.2.8_Clustered_Roles)

### 4.2.1 Processor Configuration

In order to run Hyper-V, the processors must have Data Execution Prevention (aka "Execute Disable Bit") and Intel VT-x (aka "Intel Virtualization Technology") enabled.

### 4.2.2 CSV: Cluster Network Configuration Considerations

**Ownership of the CSV**

"Cluster shared volumes (CSV) enable multiple nodes in a failover cluster to simultaneously have read-write access to the same LUN (disk) that is provisioned as an NTFS volume."

 "With CSV, clustered roles can fail over quickly from one node to another node without requiring a change in drive ownership, or dismounting and remounting a volume."

"Windows Server 2012 R2 introduces additional functionality, such as distributed CSV ownership…"

**Network Configuration: Requirement #1**

**"Network adapter properties**. In the properties for all adapters that carry cluster communication, make sure that the following settings are enabled:

* **Client for Microsoft Networks** and **File and Printer Sharing for Microsoft Networks**. These settings support Server Message Block (SMB) 3.0, which is used by default to carry CSV traffic between nodes. To enable SMB, also ensure that the Server service and the Workstation service are running and that they are configured to start automatically on each cluster node."

 From <[*https://technet.microsoft.com/en-us/library/jj612868.aspx*](https://technet.microsoft.com/en-us/library/jj612868.aspx)>

**Network Configuration: Requirement #2**

**Microsoft Failover Cluster Virtual Adapter Performance Filter**. This setting improves the ability of nodes to perform I/O redirection when it is required to reach CSV, for example, when a connectivity failure prevents a node from connecting directly to the CSV disk. For more information, see the notes about I/O synchronisation and I/O redirection further down on this page.

From <[*https://technet.microsoft.com/en-us/library/jj612868.aspx*](https://technet.microsoft.com/en-us/library/jj612868.aspx)>

**I/O Synchronisation in CSV Communication**

**I/O synchronization**   CSV enable multiple nodes to have simultaneous read-write access to the same shared storage. When a node performs disk input/output (I/O) on a CSV volume, the node communicates directly with the storage, for example, through a storage area network (SAN). However, at any time, a single node (called the coordinator node) “owns” the physical disk resource that is associated with the LUN. The coordinator node for a CSV volume is displayed in Failover Cluster Manager as **Owner Node** under **Disks**. It also appears in the output of the [Get-ClusterSharedVolume](https://technet.microsoft.com/library/hh847282) Windows PowerShell cmdlet.

From <[*https://technet.microsoft.com/en-us/library/jj612868.aspx*](https://technet.microsoft.com/en-us/library/jj612868.aspx)>

When certain small changes occur in the file system on a CSV volume, this metadata must be synchronized on each of the physical nodes that access the LUN, not only on the single coordinator node…These metadata update operations occur in parallel across the cluster networks by using SMB 3.0. These operations do not require all the physical nodes to communicate with the shared storage.

From <[*https://technet.microsoft.com/en-us/library/jj612868.aspx*](https://technet.microsoft.com/en-us/library/jj612868.aspx)>

**I/O Redirection in CSV Communication**

Storage connectivity failures and certain storage operations can prevent a given node from communicating directly with the storage. To maintain function while the node is not communicating with the storage, the node redirects the disk I/O through a cluster network to the coordinator node **where the disk is currently mounted**

***Instructor's note:***

***On the coordinator, Disk Management shows that the volume is reserved. In the other cluster nodes, Disk Management shows that the volume is offline and reserved elsewhere*.**

If the current coordinator node experiences a storage connectivity failure, all disk I/O operations are queued temporarily while a new node is established as a coordinator node.

From <[*https://technet.microsoft.com/en-us/library/jj612868.aspx*](https://technet.microsoft.com/en-us/library/jj612868.aspx)>

The server uses one of the following I/O redirection modes, depending on the situation:

* **File system redirection**   Redirection is per volume—for example, when CSV snapshots are taken by a backup application when a CSV volume is manually placed in redirected I/O mode.
* **Block redirection**   Redirection is at the file-block level—for example, when storage connectivity is lost to a volume. Block redirection is significantly faster than file system redirection.

In Windows Server 2012 R2, you can view the state of a CSV volume on a per node basis. For example, you can see whether I/O is direct or redirected, or whether the CSV volume is unavailable. If a CSV volume is in I/O redirected mode, you can also view the reason. Use the Windows PowerShell cmdlet **Get-ClusterSharedVolumeState** to view this information.

From <[*https://technet.microsoft.com/en-us/library/jj612868.aspx*](https://technet.microsoft.com/en-us/library/jj612868.aspx)>

### 4.2.3 CSV: Storage and disk configuration requirements

To use CSV, your storage and disks must meet the following requirements:

* **File system format**. In Windows Server 2012 R2, a disk or storage space for a CSV volume must be a basic disk that is partitioned with NTFS or ReFS.    
    
  A CSV has the following additional requirements:
  + In Windows Server 2012 R2, you cannot use a disk for a CSV that is formatted with FAT or FAT32.
  + If you want to use a storage space for a CSV, you can configure a simple space or a mirror space. In Windows Server 2012 R2, you can also configure a parity space. (In Windows Server 2012, CSV does not support parity spaces.)
  + A CSV cannot be used as a quorum witness disk.
  + After you add a disk as a CSV, it is designated in the CSVFS format (for CSV File System). This allows the cluster and other software to differentiate the CSV storage from other NTFS or ReFS storage. Generally, CSVFS supports the same functionality as NTFS or ReFS. However, certain features are not supported. For example, in Windows Server 2012 R2, you cannot enable compression on CSV. In Windows Server 2012, you cannot enable data deduplication or compression on CSV.
* **Resource type in the cluster**. For a CSV volume, you must use the Physical Disk resource type. By default, a disk or storage space that is added to cluster storage is automatically configured in this way.
* **Choice of CSV disks or other disks in cluster storage**. When choosing one or more disks for a clustered virtual machine, consider how each disk will be used. If a disk will be used to store files that are created by Hyper-V, such as VHD files or configuration files, you can choose from the CSV disks or the other available disks in cluster storage. If a disk will be a physical disk that is directly attached to the virtual machine (also called a pass-through disk), you cannot choose a CSV disk, and you must choose from the other available disks in cluster storage.
* **Path name for identifying disks**. Disks in CSV are identified with a path name. Each path appears to be on the system drive of the node as a numbered volume under the **\ClusterStorage** folder. This path is the same when viewed from any node in the cluster. You can rename the volumes if needed.

From <[*https://technet.microsoft.com/en-us/library/jj612868.aspx*](https://technet.microsoft.com/en-us/library/jj612868.aspx)>

### 4.2.4 Arrangement of CSVs and VHD-files

***Instructor's note:***

***A VHD is a file stored on a filesystem which stores the content of the Hyper-V virtual machine's (virtual) hard disk drive.***

To make the best use of CSV to provide storage for clustered virtual machines, it is helpful to review how you would arrange the LUNs (disks) when you configure physical servers. When you configure the corresponding virtual machines, try to arrange the VHD files in a similar way.

Consider a physical server for which you would organize the disks and files as follows:

* System files, including a page file, on one physical disk
* Data files on another physical disk

For an equivalent clustered virtual machine, you should organize the volumes and files in a similar way:

* System files, including a page file, in a VHD file on one CSV
* Data files in a VHD file on another CSV

If you add another virtual machine, where possible, you should keep the same arrangement for the VHDs on that virtual machine.

From <[*https://technet.microsoft.com/en-us/library/jj612868.aspx#BKMK\_planning*](https://technet.microsoft.com/en-us/library/jj612868.aspx#BKMK_planning)>

### 4.2.5 Quorum Background Information

**1. What is a Quorum?**

Wikipedia gives this definition:

The [minimum](http://en.wiktionary.org/wiki/minimum) number of [members](http://en.wiktionary.org/wiki/member) [required](http://en.wiktionary.org/wiki/require) for a group to officially conduct [business](http://en.wiktionary.org/wiki/business) and to cast [votes](http://en.wiktionary.org/wiki/vote), often but not necessarily a [majority](http://en.wiktionary.org/wiki/majority) or [supermajority](http://en.wiktionary.org/wiki/supermajority).

From <[*http://en.wiktionary.org/wiki/quorum*](http://en.wiktionary.org/wiki/quorum)>

In this context, the quorum is the minimum number of nodes required for this set of nodes to conduct the business of the cluster.

**2. Why configure the quorum?**

To increase the high availability of the cluster, and the roles that are hosted on that cluster, it is important to set the cluster quorum configuration appropriately.

The cluster quorum configuration has a direct effect on the high availability of the cluster, for the following reasons:

* It helps ensure that the failover cluster can start properly or continue running when the active cluster membership changes. Membership changes can occur because of planned or unplanned node shutdown, or when there are disruptions in connectivity between the nodes or with cluster storage.
* When a subset of nodes cannot communicate with another subset of nodes (a split cluster), the cluster quorum configuration helps ensure that only one of the subsets continues running as a cluster. The subsets that do not have enough quorum votes will stop running as a cluster. The subset that has the majority of quorum votes can continue to host clustered roles. This helps avoid partitioning the cluster, so that the same application is not hosted in more than one partition.
* Configuring a witness vote helps the cluster sustain one extra node down in certain configurations. For more information about configuring a quorum witness, see [Witness configuration](https://technet.microsoft.com/en-us/library/jj612870.aspx#BKMK_witness) later in this topic.

From <[*https://technet.microsoft.com/en-us/library/jj612870.aspx*](https://technet.microsoft.com/en-us/library/jj612870.aspx)>

***Instructor's note:***

***The "quest for a quorum" is the mechanism by which the nodes of a cluster determine how to handle the inevitable eventuality of a fault resulting in loss of communication within the cluster.***

**3. Voting elements**

The quorum for a cluster is determined by the number of voting elements that must be part of active cluster membership for that cluster to start properly or continue running. By default, every node in the cluster has a single quorum vote.

***Instructor's note:***

***This means that, at this stage of development of your cluster, there are as many voting elements as there are nodes in the cluster.***

In addition, a quorum witness (when configured) has an additional single quorum vote. You can configure one quorum witness for each cluster. A quorum witness can be a designated disk resource or a file share resource. Each element can cast one “vote” to determine whether the cluster can run. Whether a cluster has quorum to function properly is determined by the majority of the voting elements in the active cluster membership.

From <[*https://technet.microsoft.com/en-us/library/jj612870.aspx*](https://technet.microsoft.com/en-us/library/jj612870.aspx)>

***Instructor's note:***

***In either of these two conditions, the voters which can still communicate amongst themselves must determine whether they have a majority of voters in their set, or not. The majority of votes, therefore, is the "quorum". If they do have a quorum, then the cluster operates with the reduced set. If they do not have a quorum, then the cluster ceases to operate.***

***Since there is initially no witness, then the following extract describes the initial state of the quorum:***

Only nodes have votes. No quorum witness is configured. The cluster quorum is the majority of voting nodes in the active cluster membership.

From <[*https://technet.microsoft.com/en-us/library/jj612870.aspx*](https://technet.microsoft.com/en-us/library/jj612870.aspx)>

***After a witness is added to the cluster, the state of the quorum changes to become:***

Nodes have votes. In addition, a quorum witness has a vote. The cluster quorum is the majority of voting nodes in the active cluster membership plus a witness vote.

A quorum witness can be a designated disk witness or a designated file share witness.

From <[*https://technet.microsoft.com/en-us/library/jj612870.aspx*](https://technet.microsoft.com/en-us/library/jj612870.aspx)>

### 4.2.6 Witness Background Information

**1. Which component of infrastructure can be designated as a witness?**

***Instructor's note:***

***The extract below has been shown in the page titled "Quorum Background Information" but has been reproduced here because of its relevance to this context.***

A quorum witness can be a designated disk resource or a file share resource. Each element can cast one “vote” to determine whether the cluster can run. Whether a cluster has quorum to function properly is determined by the majority of the voting elements in the active cluster membership.

From <[*https://technet.microsoft.com/en-us/library/jj612870.aspx*](https://technet.microsoft.com/en-us/library/jj612870.aspx)>

**2. Witness configuration**

As a general rule when you configure a quorum, the voting elements in the cluster should be an odd number. Therefore, if the cluster contains an even number of voting nodes, you should configure a disk witness or a file share witness. The cluster will be able to sustain one additional node down. In addition, adding a witness vote enables the cluster to continue running if half the cluster nodes simultaneously go down or are disconnected.

From <[*https://technet.microsoft.com/en-us/library/jj612870.aspx*](https://technet.microsoft.com/en-us/library/jj612870.aspx)>

2.1 Description

* + Dedicated LUN that stores a copy of the cluster database
  + Most useful for clusters with shared (not replicated) storage

From <[*https://technet.microsoft.com/en-us/library/jj612870.aspx*](https://technet.microsoft.com/en-us/library/jj612870.aspx)>

2.2 Requirements and recommendations

* + Size of LUN must be at least 512 MB
  + Must be dedicated to cluster use and not assigned to a clustered role
  + Must be included in clustered storage and pass storage validation tests
  + Cannot be a disk that is a Cluster Shared Volume (CSV)
  + Basic disk with a single volume
  + Does not need to have a drive letter
  + Can be formatted with NTFS or ReFS
  + Can be optionally configured with hardware RAID for fault tolerance
  + Should be excluded from backups and antivirus scanning

From <[*https://technet.microsoft.com/en-us/library/jj612870.aspx*](https://technet.microsoft.com/en-us/library/jj612870.aspx)>

### 4.2.7 Considerations for creating a virtual machine that is highly available

* + Choose the shared storage as the location to store the virtual machine and the virtual hard disk. Otherwise, you will not be able to make the virtual machine highly available. To make the shared storage available to the virtual machine, you must create the virtual machine on the physical computer that is the node which owns the storage.
  + Specify the CSV volume as the location of both the virtual machine and the virtual hard disk.

From <[*https://technet.microsoft.com/en-us/library/jj863389.aspx#BKMK\_step7*](https://technet.microsoft.com/en-us/library/jj863389.aspx#BKMK_step7)>

### 4.2.8 Clustered Roles

The notion of a clustered role is vital to understand the interaction between Failover Clustering and applications that run on the nodes that form the cluster.

The clustered role was introduced in the "Technical background" page of the third set of exercises. It is singled out here to emphasise its importance in the development of your skill in building clusters.

The first extract has already been presented but its importance makes repetition bearable:

*A failover cluster is a group of independent computers that work together to increase the availability and scalability of clustered roles (formerly called clustered applications and services).*

 From <[*https://technet.microsoft.com/en-us/library/hh831579.aspx*](https://technet.microsoft.com/en-us/library/hh831579.aspx)>

Therefore, a clustered role is a clustered application - or a clustered service.

The second extract gives a comprehensive list of examples:

| **Clustered Role** | **Role or Feature Prerequisite** |
| --- | --- |
| DFS Namespace Server | DFS Namespaces (part of File Server role) |
| DHCP Server | DHCP Server role |
| Distributed Transaction Coordinator (DTC) | None |
| File Server | File Server role |
| Generic Application | Not applicable |
| Generic Script | Not applicable |
| Generic Service | Not applicable |
| Hyper-V Replica Broker | Hyper-V role |
| iSCSI Target Server | iSCSI Target Server (part of File Server role) |
| iSNS Server | iSNS Server Service feature |
| Message Queuing | Message Queuing Services feature |
| Other Server | None |
| Virtual Machine | Hyper-V role |
| WINS Server | WINS Server feature |

From <[*https://technet.microsoft.com/en-us/library/dn505754.aspx#BKMK\_CreateRole*](https://technet.microsoft.com/en-us/library/dn505754.aspx#BKMK_CreateRole)>

The text highlighted in the table shows the clustered role that is of interest. Creating a Virtual Machine as a clustered role therefore creates a highly-available and scalable VM. There is more than one method to create an HA VM. The saliencies of two methods are shown below; other methods, using Powershell, maybe used too:

(a) A VM may be created in Hyper-V Manager first, then converted to a clustered role using the Failover Cluster Manager.

(b) Failover Cluster Manager may be used to create a VM, after which it automatically proceeds to encapsulate it within a clustered role.

Method (a) is beneficial to the learner, as it distinguishes between a VM and a clustered role. The VM is created first and then a clustered role is created to encapsulate the VM and ensure that, should the physical node on which the VM is executing fail, then the VM may be restarted on another physical node within the cluster.

Method (a) requires the creation of a VM using Hyper-V Manager; the use of Failover Cluster Manager for the second phase is described briefly within the text shown below. In this case, the clustered role is the clustered VM.

* 1. In Failover Cluster Manager, expand the cluster name, right-click **Roles**, and then click **Configure Role**.
  2. Follow the steps in the High Availability Wizard to create the clustered role.
  3. To verify that the clustered role was created, in the **Roles** pane, make sure that the role has a status of **Running**. The Roles pane also indicates the owner node. To test failover, right-click the role, point to **Move**, and then click **Select Node**. In the **Move Clustered Role** dialog box, click the desired cluster node, and then click **OK**. In the **Owner Node** column, verify that the owner node changed.

From <[*https://technet.microsoft.com/en-us/library/dn505754.aspx#BKMK\_CreateRole*](https://technet.microsoft.com/en-us/library/dn505754.aspx#BKMK_CreateRole)>

## 4.3 Adding a witness

1. [Prerequisites](#_4.3.1_Prerequisites)
2. [Determine the node vote assignment](#_4.3.2_Determine_the)
3. [Add a witness on a disk resource](#_4.3.3_Add_a)
4. [Validate the Cluster Quorum Configuration](#_4.3.4_Validate_the)

### 4.3.1 Prerequisites

Read the background information about witnesses carefully.

Carry out any tasks required to create a disk resource suited for use as a witness.

### 4.3.2 Determine the node vote assignment

Use a single Powershell command to determine the names and votes assigned to nodes in the cluster and present the output in tabular form. Your output should have the headings shown below:

C:\AC8214E5\3B2D5CC9-5E83-47BB-AFFE-E7EA89A4FBCF_files\image020.png

### 4.3.3 Add a witness on a disk resource

Use a single Powershell command to find the name of the disk resource created earlier.

Use a single Powershell command to add this disk resource as a witness, to form part of the cluster's quorum.

### 4.3.4 Validate the Cluster Quorum Configuration

Run a cluster quorum validation test using a single Powershell command.

## 4.4 Adding a CSV

1. [Prerequisites](#_4.4.1_Prerequisites)
2. [Add a CSV](#_4.4.2_Add_a)

### 4.4.1 Prerequisites

Read the CSV network and storage configuration pages carefully.

Then, proceed to verify whether the configuration of the cluster communication network and the storage meets the prerequisites.

### 4.4.2 Add a CSV

Use a single Powershell command to determine whether any disk lies in the cluster's available storage pool.

If there is no disk in the available storage pool, use a single Powershell command to add the disk to the pool.

Confirm that the disk has been added to the available storage pool using the command previously executed to determine whether the disk is in the available storage pool.

Add the disk as a Cluster Shared Volume using a single Powershell command.

## 4.5 Create a Windows VM template

1. [Change Hyper-V defaults](#_4.5.1_Change_Hyper-V)
2. [VM's virtual hard disk drives](#_4.5.2_VM's_virtual)
3. [Create the VM that leads to the template](#_4.5.3_Create_the)
4. [Generalise the operating system](#_4.5.4_Generalise_the)
5. [Export the VM holding the generalised OS](#_4.5.5_Export_the)

### 4.5.1 Change Hyper-V defaults

A VM is defined by its configuration file; its operating system is installed on its virtual hard disk drive. Hyper-V uses one directory to store the configuration files and another directory to store the virtual hard disk drives.

After installation of Hyper-V, the location is not set to the clustered storage's (CSV's) location. In this step, you will change the default location and set it to a directory (which you will create beforehand) on the clustered storage.

Use Powershell to:

* 1. Change the default location for storage of VM configuration files.
  2. Change the default location for storage of virtual hard disk drives.

Ensure that you carry out this step on hypervisors of all clustered nodes. These steps are carried out in order to fulfill the requirements specified in the page titled ""

### 4.5.2 VM's virtual hard disk drives

***Instructor's note***

***To the text shown on the page titled "Arrangement of CSVs and VHD-files", Microsoft adds the disclaimer below. Use your knowledge of EVA4400 vdisks and disk groups to decide whether the recommendation to create separate CSVs for {paging files; system files} and {data files} should be taken or dropped.***

Ask your storage vendor for recommendations about how to configure your specific storage unit for CSV. If the recommendations from the storage vendor differ from information in this topic, use the recommendations from the storage vendor.

From <[*https://technet.microsoft.com/en-us/library/jj612868.aspx#BKMK\_planning*](https://technet.microsoft.com/en-us/library/jj612868.aspx#BKMK_planning)>

### 4.5.3 Create the VM that leads to the template

Carry out these steps on \*\*\*only one\*\*\* of the nodes in the cluster:

1. Download the Windows 8.1 Professional Edition ISO and save it to local storage.
2. Refer to <https://technet.microsoft.com/en-us/library/hh846766.aspx> to create a VM with the following specifications:
   1. Generation 2
   2. 2 GiB RAM, using dynamic memory
   3. 20GB HDD

### 4.5.4 Generalise the operating system

The notion of a generalised operating system is that of an uncommitted operating system. Generalisation is the detachment of commitment: the hardware and the SIDs previously installed are removed.

1. The operating system has not detected the hardware on which it is installed
2. The operating system has not created security identifiers (SIDs)

For information about the significance of the SID, read <http://en.wikipedia.org/wiki/Security_Identifier> or <https://msdn.microsoft.com/en-us/library/windows/desktop/aa379571(v=vs.85).aspx>

Generalisation is carried out using a utility named sysprep that is bundled with Windows 8.1 PE. It is found in the directory %WINDIR%\system32\sysprep. (Microsoft refers to this as a "sysprepped OS").

Use the instructions below to carry out the process. The first bullet refers to a graphical method (deprecated in Windows 8.1 - which means that future releases of Windows may be expected to lack the graphical method), invoked by moving to the sysprep directory. The second bullet refers to a command-line method.

* In the **System Preparation Tool** window, click **Generalize**, click **Shutdown**, and then click **OK**. The computer generalizes the image and shuts down.  
  - or -
* Open a Command Prompt window as an administrator, and then move to the**%WINDIR%\system32\sysprep** directory. Use the **Sysprep** command together with the **/generalize**, **/shutdown**, and **/oobe** options. For example:  
    
  Sysprep /generalize /shutdown /oobe  
    
  The computer generalizes the image and shuts down.

 From <[*https://technet.microsoft.com/en-us/library/hh824938.aspx*](https://technet.microsoft.com/en-us/library/hh824938.aspx)>

### 4.5.5 Export the VM holding the generalised OS

Create a directory on the clustered storage where to save an export of the VM holding the generalised OS. This export is the template.

Use Hyper-V manager to export the VM. The location of the export is the directory which has just been created. Navigate the right sidebar to find the appropriate control.

After this step, a copy of the virtual hard disk drive (which stores the generalised OS) may be found under the directory created to hold the template.

## 4.6 Create an HA VM

1. [Create the VM](#_4.6.1_Create_the)
2. [Create the clustered role](#_4.6.2_Create_the)
3. [Test failback](#_4.6.3_Test_failback)

### 4.6.1 Create the VM

1. Refer to <https://technet.microsoft.com/en-us/library/hh846766.aspx> to create a VM with the following specifications:
   1. Generation 2
   2. 2 GiB RAM, using dynamic memory
2. Do not attach a HDD.
3. Copy the template's virtual hard disk drive into an appropriately-named folder (the name should reflect the name of the VM) under the default location for storage of virtual hard disk drives. Rename the copy to an appropriate name (the name should reflect the name of the VM).
4. Use Hyper-V Manager to attach this copy to the VM.

### 4.6.2 Create the clustered role

Use Method (a) referred to in the page titled "Clustered roles" to create the HA VM. The report produced at the end of the method's execution should show success.

Use Method (a) to test failover to the other node(s) in the cluster.

### 4.6.3 Test failback

Configure the clustered role to prompt an immediate failback of the VM to the node on which it was being executed prior to the failover.