NUUO®

The Intelligent Surveillance Solution

NUUO Crystal™ VM

Quick Installation Guide (I)

Table of Contents

I. Introduction

NUUO Crystal™ VM is a VM-ready, linux-based, pure software version of our award-winning[1] Video Management System. Open VMware Format (OVF) image is chosen for fast deployment.
NUUO is an open-platform company and has integrated more than 2700 camera models. You can enjoy 4 camera licenses with a 30 days trial period right after the software is deployed.

II. Audience:

The reader is expected to have basic knowledge of VMware's vSphere and vCenter applications.

III. Glossary

vCenter: This is an application from VMware, which provides a centralized platform for managing VMware vSphere environments.

IV. Recommendations

System Integrators (SI)

VMware certification program is highly recommended in order to enjoy all the benefits brought by VMware. This document only focuses on introduction of VMware's important features which includes

1. VMware failover mechanism, including High-availability (HA), Fault-tolerance (FT), and vMotion
2. Alarm mechanism
3. Virtual Network mechanism

It is recommended to use server and storage, which can be found at VMware compatibility Guide at http://www.vmware.com/resources/compatibility/search.php and http://www.vmware.com/resources/compatibility/search.php?deviceCategory=san, respectively.

System Adminstrator (SA)

Before deployment, system administrator should decide if VMware's failover mechanism, including HA, FT, and vMotion should be applied. VMware vCenter is required to run the failover mechanism.

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[1] NUUO Crystal™ is the winner of Security Industry Association (SIA) award in the best Video Surveillance Management System category. This award is presented in Los Vegas, at ISC West 2014.

Once the system architecture is decided, system administrator should also decide on server's capability and storage size based on project requirement. NUUO calculator (http://www.nuuo.com/calculator) is the best tool to assist such a task.

NUUO Crystal™ VM recording server uses
- 64 channels of record at 250Mbps
- 128 channels of liveview
- 16 channels of playback as a deployment unit.

A recommended virtual machine configuration is:

Resource Name	Suggested Resource
CPU	2 Sockets (4,500MHz)
RAM	4GB

Table 1: Suggested Virtual Machine Resources

V. Basic Installation

NUUO Crystal™ VM Deployment:

NUUO Crystal™ VM is a server image (in OVA format) which includes Management server, Recording server, and Metadata server. This section focuses on how to deploy an OVF image into a virtual machine through VSphere WebClient.

Deploy OVF template through vCenter

1. Download NUUO Crystal™ VM from NUUO's website or VMware's virtual appliance market at
2. Open browser and connect to the vCenter host which you would like to deploy NUUO Crystal™ VM.
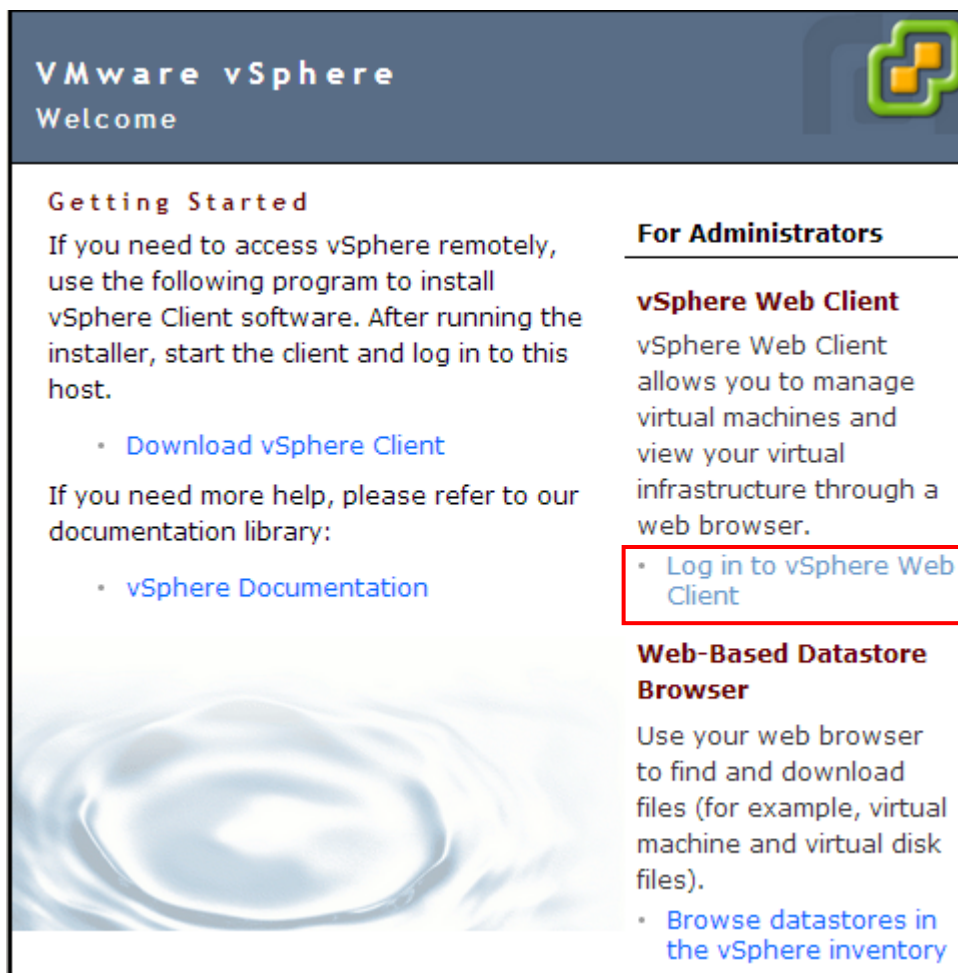3. After connecting to the host, please select vSphere Web Client as show in figure 1.

Figure 1: Welcome page of vSphere host

4. Log in into the server using administrator's username and password. Figure 2 shows the welcome page after a successful login. Follow 「vCenter」 → 「Hosts and Clusters」 → 「localhost」 to browse to the host server where you would like to have your virtual machine deployed.
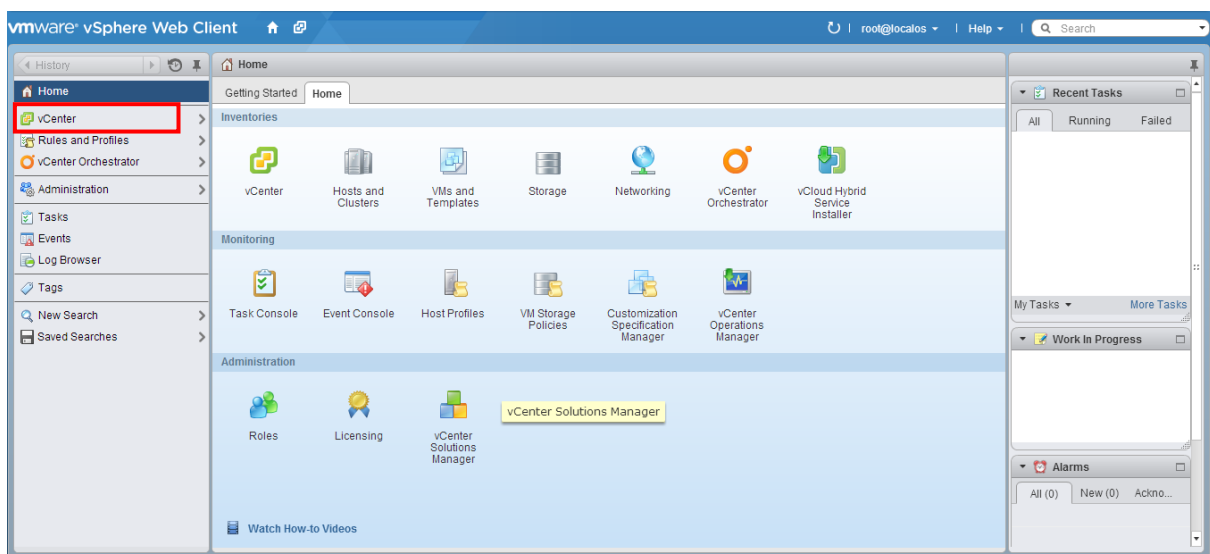

Figure 2: Welcome page of vCenter

5. After selecting the host server, choose 「Deploy OVF Template」… from the 「Actions」 button,. This opens the Deploy OVF Template wizard. You may be prompted to install a 「Client Integration Plug-in」 in order to run the wizard correctly.
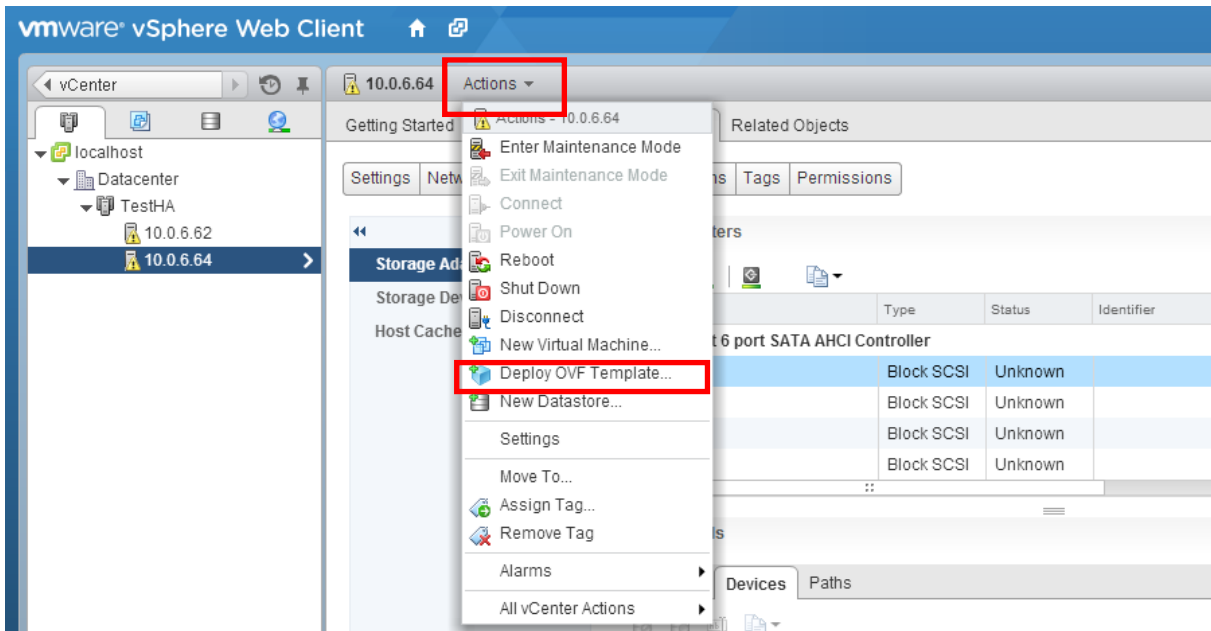

Figure 3: Location to Deploy OVF Template

6. Click 「Browse」 button and navigate to NUUO Crystal™ OVF image file you saved from Step 1. Click 「Next」 to the next step.
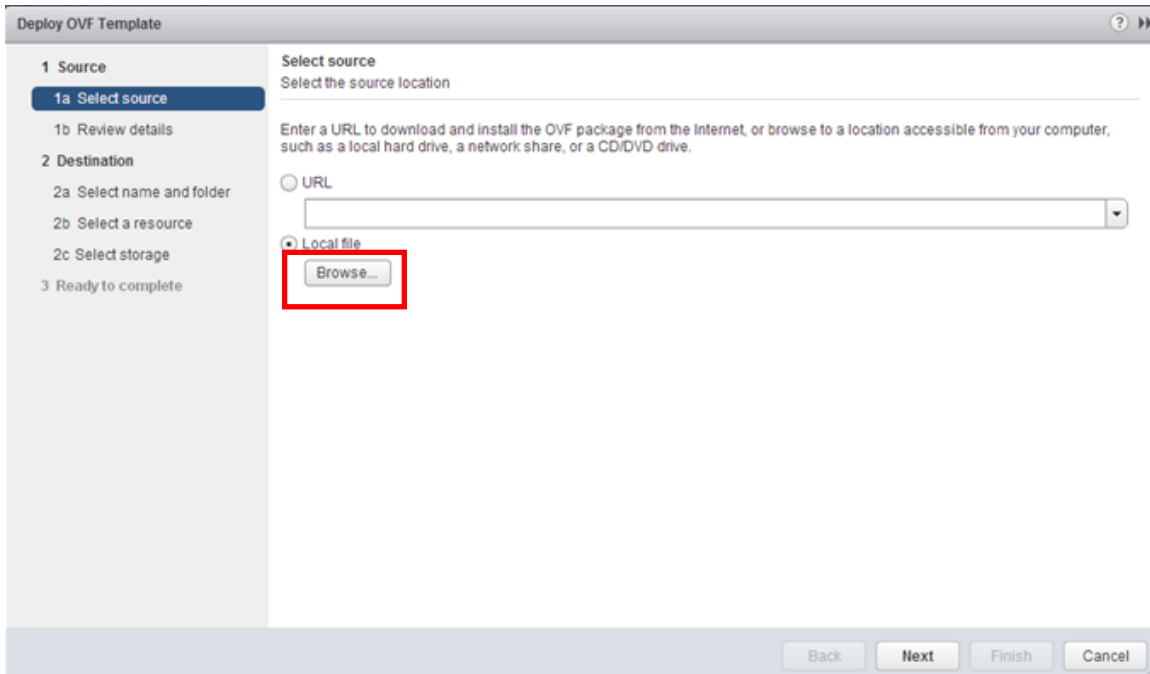

Figure 4: Select OVF Template Source

7. You would find two pieces of information in 「Size of disk」. The first size indicates the executables (our application) and the second one is the storage space reserved for our application initially. Please confirm the correctness of the information and then click
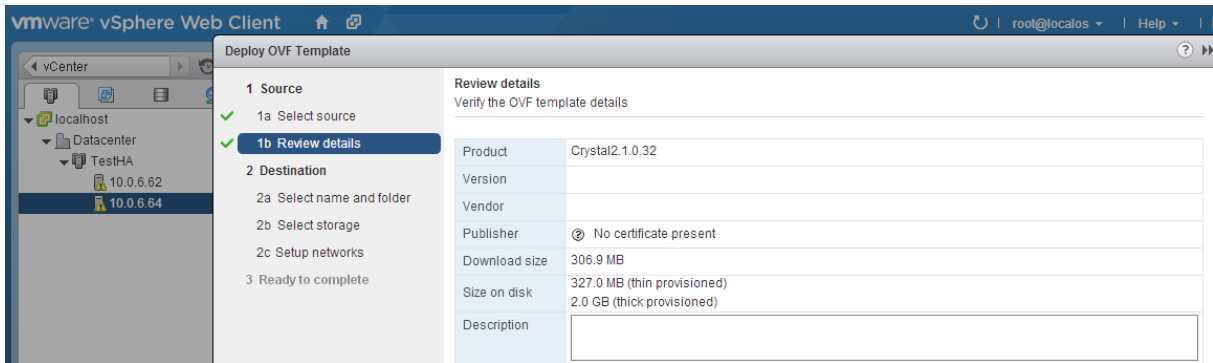
4

「Next」.

Figure 5: Review OVF Template Source

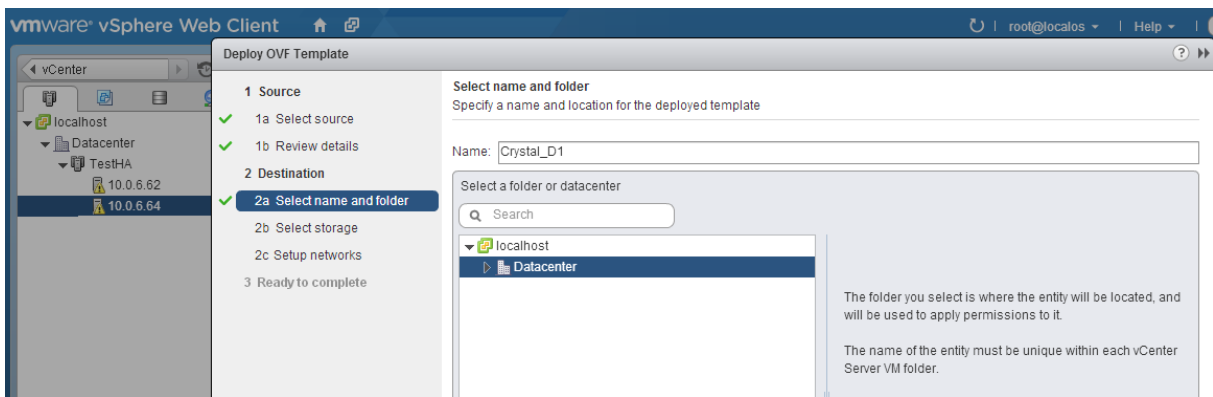8. Provide a name for your virtual machine and then click「Next」.

Figure 7: Name the deployed virtual machine

9. Choose the storage where the image file is kept. Virtual disk format with「Thick Provision Eager Zeroed」is recommended for better performace.
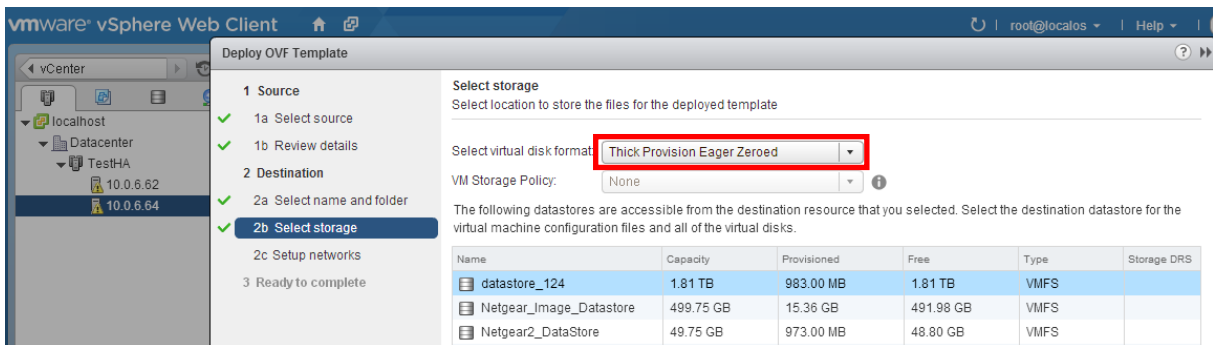

Figure 8: Select the storage and virtual disk format for OVF source

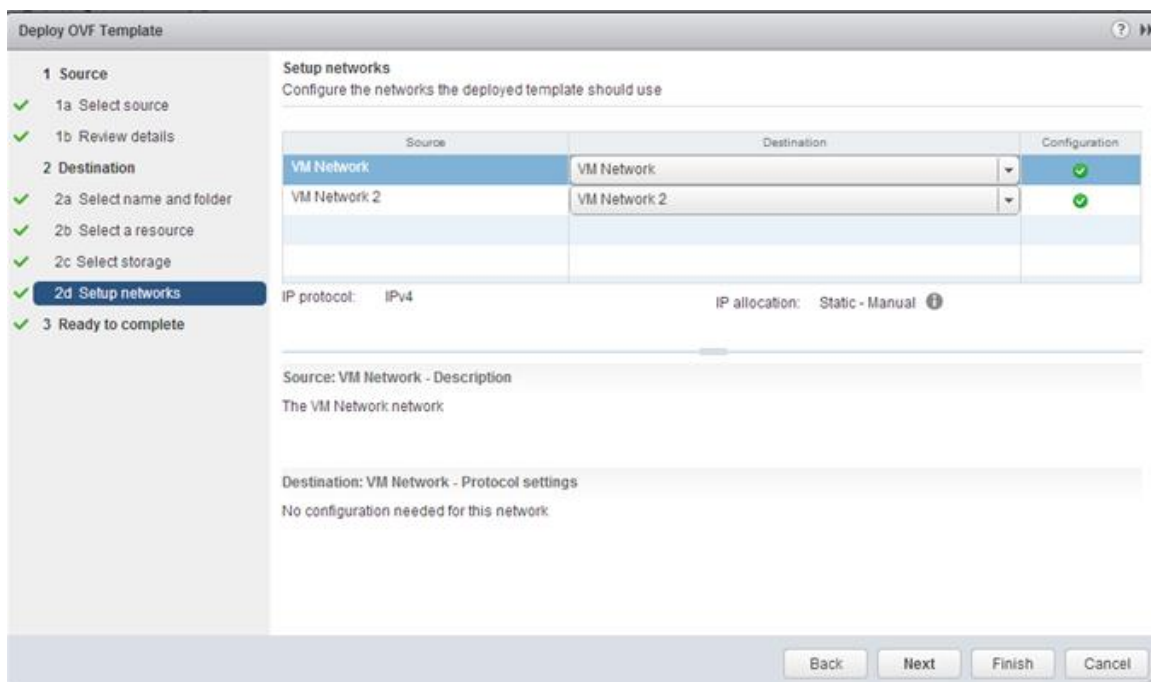10. Choose VM network for Setup networks and click next.

5

Figure 9: Configure VM network

11. With Ready to complete, review the setting and confirm all information is correct. Check
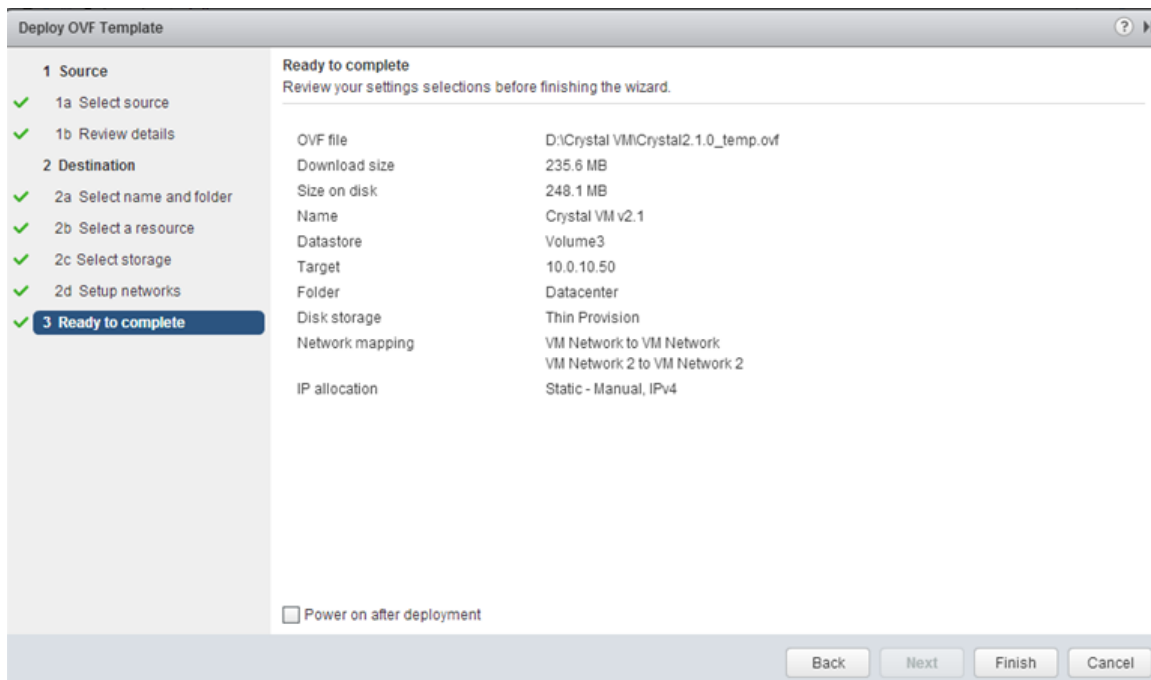「Power on after deployment」 if you want to start NUUO Crystal™ VM immediately.

Figure 10: Review all the selections

12. Please repeat the same process for any additional virtual machine deployment.

Deploy OVF template through vSphere Client

Although vCenter is a preferred way of configuring NUUO Crystal™ VM solution, it is also
possible to deploy to vSphere server without vCenter installed. vSphere Client is

recommended for such a deployment.

1. Open web browser and connect to host where vSphere is installed. On the welcome page, please download vSphere Client.
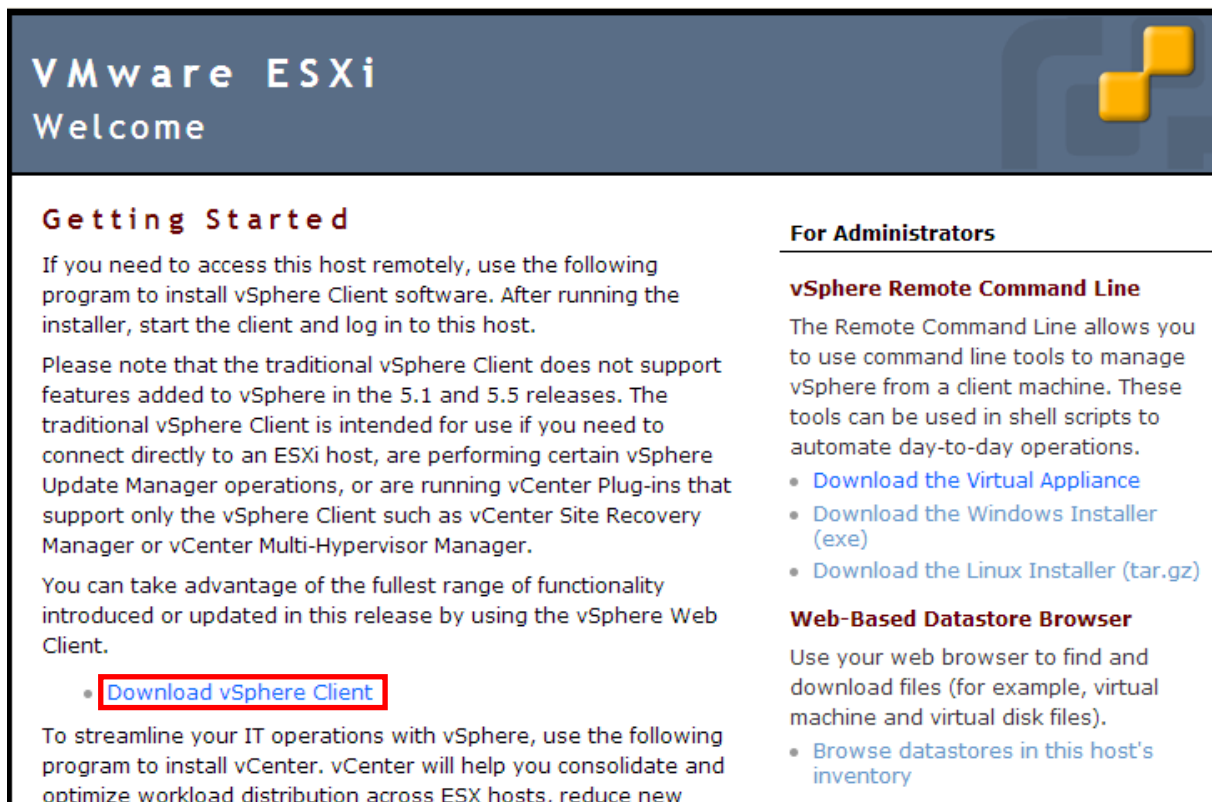

Figure 11: Welcome page for vSphere server

2. Type the ip address of the vSphere host. Login with a valid username and password.
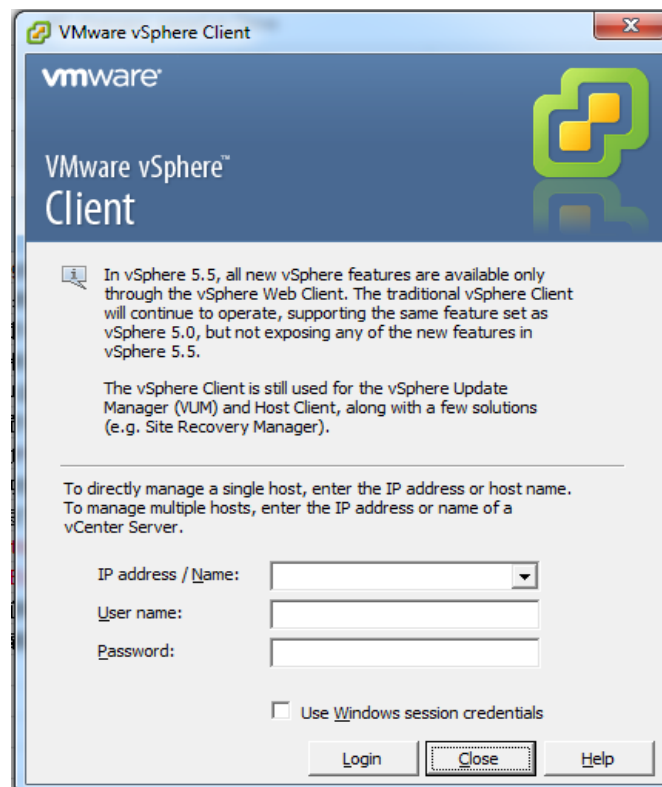

Figure 12: Login page of vSphere Client

7

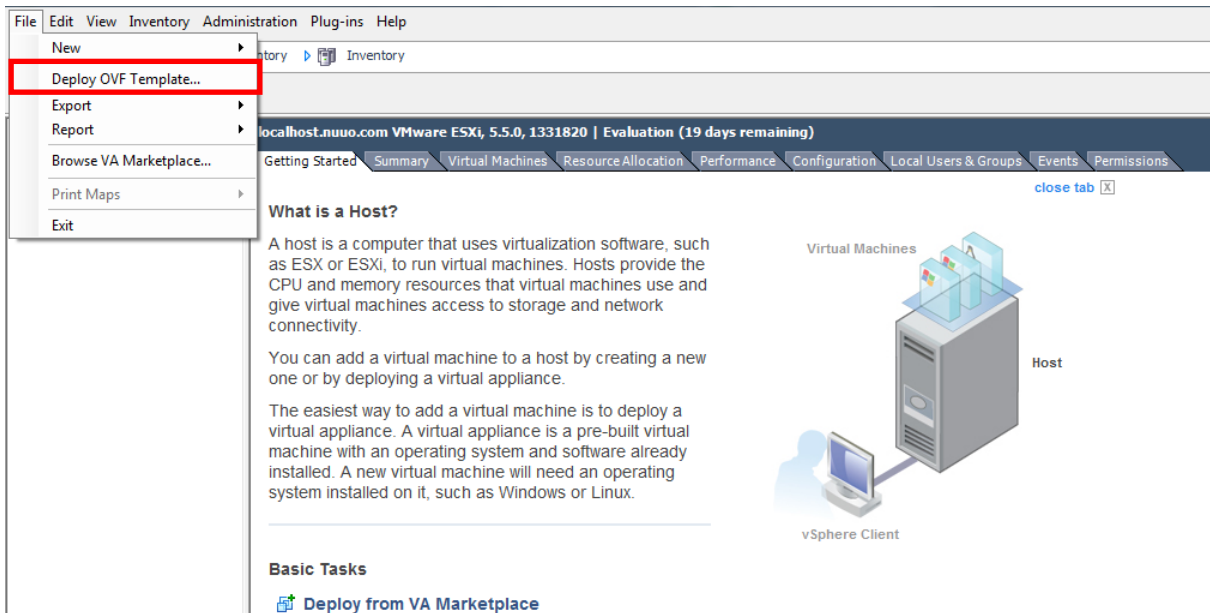3. Choose「File」→「Deploy OVF Template」to start 「Deploy OVF Wizard」.

Figure 13: Welcome page of vSphere Client

4. Choose the source file location and then click 「Next」to review OVF Template Details.
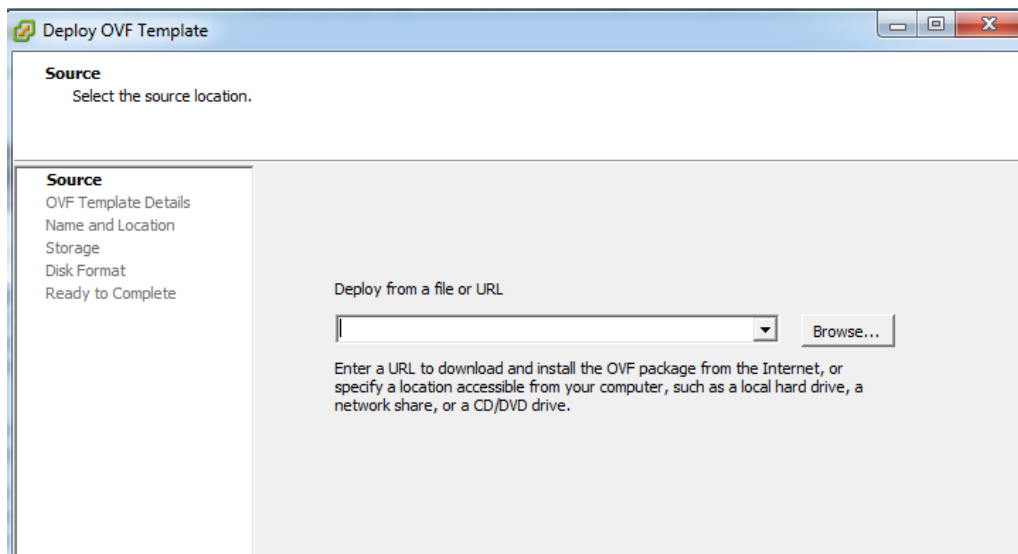
Figure 14: Deploy OVF page at vSphere Client

5. Specify the name of the deployment.
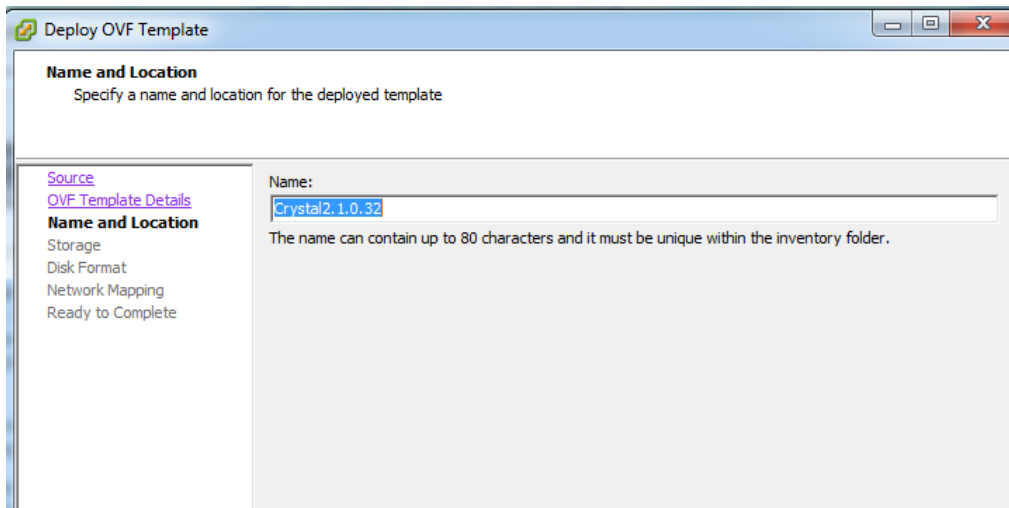
Figure 15: Name the deployed virtual machine

6. Specify the storage for the OVF deployment. Notice that this storage is intended for storing the OVF image files and temporary files generated by the image but not for the recorded video data. If you hope to activate vSphere's HA, FT, or vMotion capability, an external storage is required to populate the OVF image.
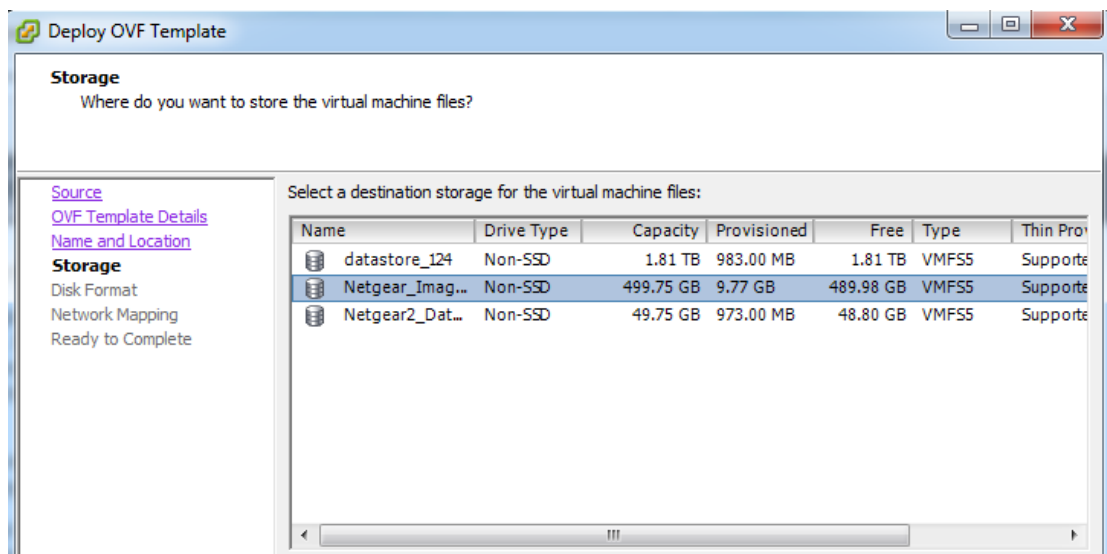
Figure 16: Select the storage to carry the deployed virtual machine

7. Select disk format for this deployment. 「Thick Provision Eager Zeroed」 is recommend for better performance.
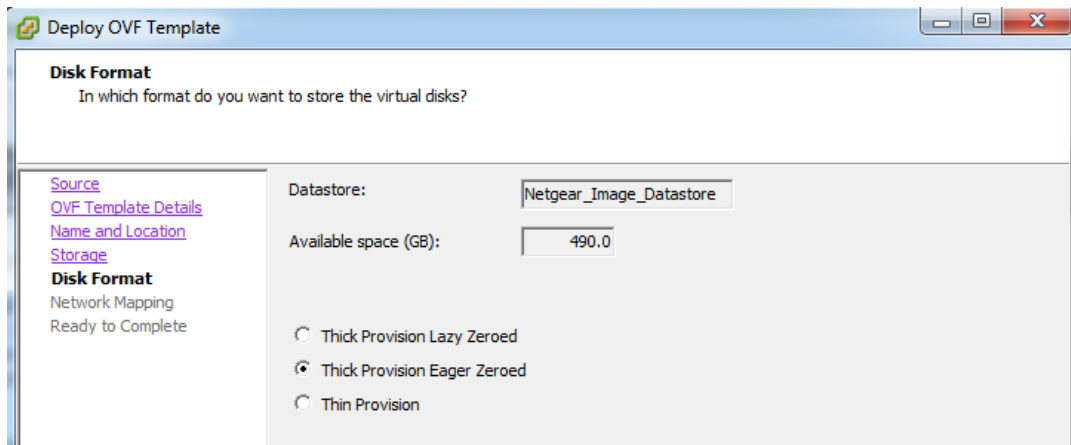
Figure 17: Specify the format of the deployed disk

8. NUUO's OVF Template includes two vSwitch networks, 「VM Network」 and 「VM Network 2」. It is recommended to have two physical network interface cards (NIC) to map to the two vSwitch networks. Select network mapping according to your preference.
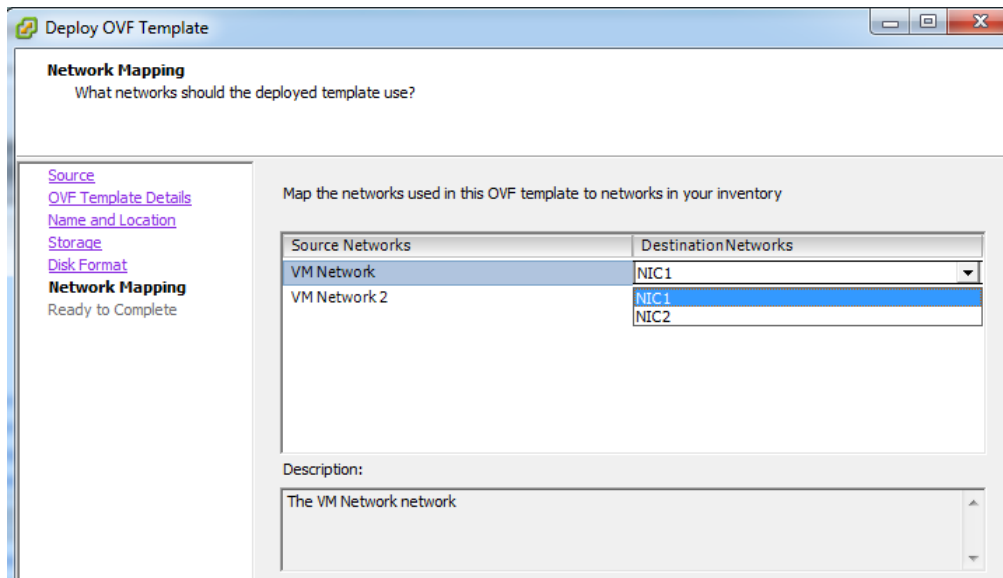
Figure 18: Map network between virtual machine and the virtual switches at the host

9. Have a final review of the deployment. Click 「Next」 to kick off the deployment.

Figure 19: A summay of the deployment

NUUO Crystal™ VM Configuration:

Virtual Machine (Server):

After the virtual machine is deployed, go to 「Action」→「Edit Settings」to change the default parameters. The current default value is listed in table 1 for reference.

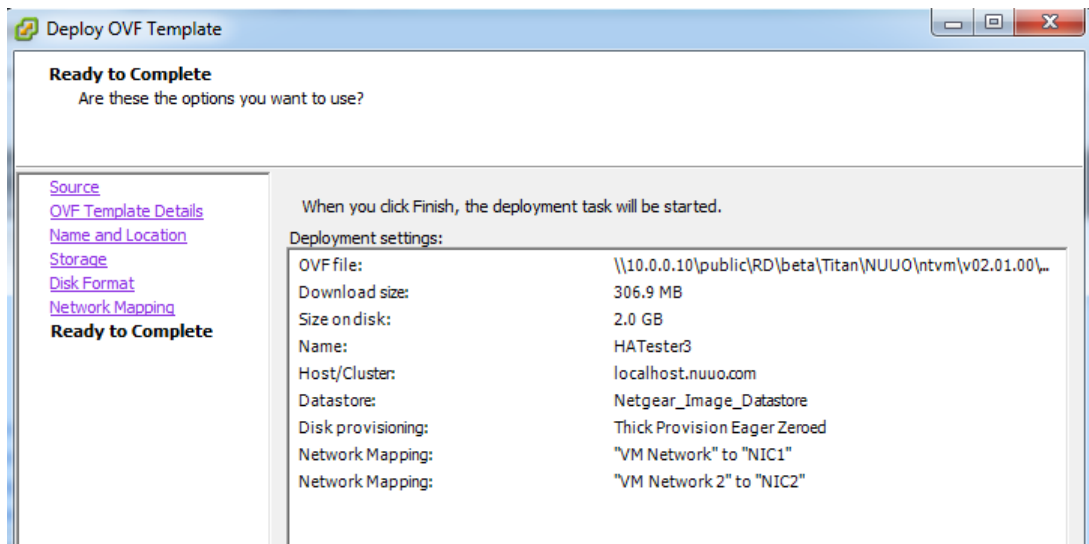| Item	SubItem	Default Value
CPU	Number of virtual socket	1
	Number of cores per socket	2
Memory	Memory size	4 GB
Video card	Number of displays	1
	Total video memory	4 MB
SCSI controller	SCSI controller type	LSI logic parallel
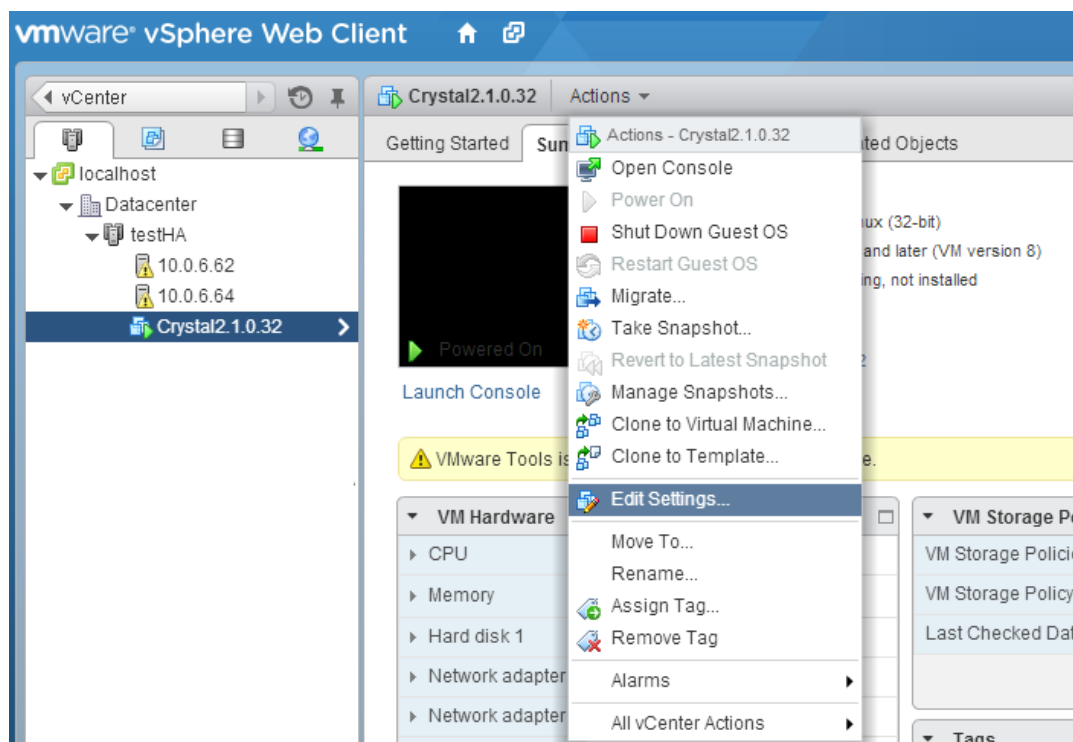
Figure 20: Configure settings of a virtual machine

1. CPU:

The recommended configuration is 2 sockets (around 4.5 GHz is sufficient) for a recording server of 64 channels, 128 channels liveviewing, and 16 channels playback. Please refer to the white paper for the typical CPU utilization.

For users who intended to accommodate more recording channels, a new virtual machine is suggested rather than tuning up the CPU numbers.

For a management and metadata server, the recommended configuration remains the same due to the possible expansion of the future project.

Figure 21: Configure CPU resource of a virtual machine

2. Memory:

Follow a similar path as CPU configuration to configure RAM. 4 GB is recommended for 64 channels recording server, management server and metadata server.

Virtual Storage:

For each virtual machine, single default storage in VMDK embedded in the OVF/OVA image, which is for NUUO Crystal™ VM application. If this application is intended to be configured as a recording server or me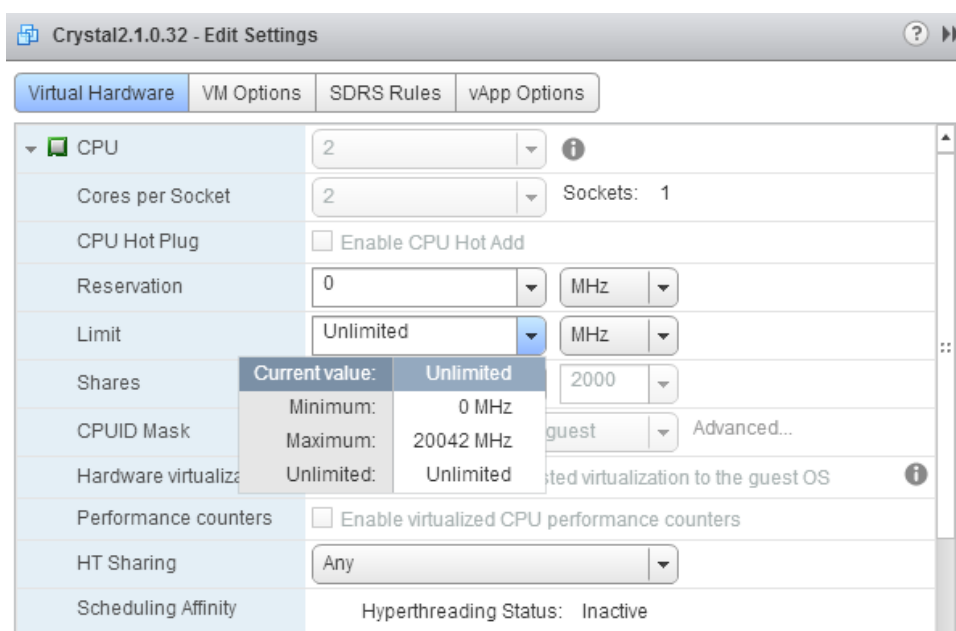tadata server, an additional storage is required which can be either an external or internal storage. Note that external storage is required by VMware for any of the failover functionalities, including (but not limited to) vMotion, HA, HA Monitoring, and FT.

1. External Storage:

IP (Internal protocol) and FC (fiber channel) SAN (storage area network) is recommended for NUUO Crystal™ VM. IP SAN is based on iSCSI protocol and is normally suggested when the storing bandwidth reaches around 1Gbps (bits per second) for its cost-effectiveness. FC SAN is based on fiber and is suggested when the storaging bandwidth is more than 2Gbps for its robust performance.

VMware supports two storage formats, including RDM (Raw device mapping) and VMDK (Virtual machine disk). NUUO recommends RDM over VMDK according to our test. Please follow these few steps to complete RDM settings for your video storage:

(1) Configure LUNs (logical unit number) at external storage by following storage's user manual.

(2) Configure network configuration at external storage. Note that total channel bandwidth

must be able to accommodate total recording throughput. Please use NUUO's calculator[2] for estimating the throughput for planning. The true throughput can be checked using NuClient's device overview capability.

(3) Connect to IP-SAN : There are two different ways to connect between server and external IP-SAN storage.

    a. Connect through NUUO's Web Client: Using iSCSI initiator to connect to iSCSI target. This connection requires no RDM mapping at VMware.
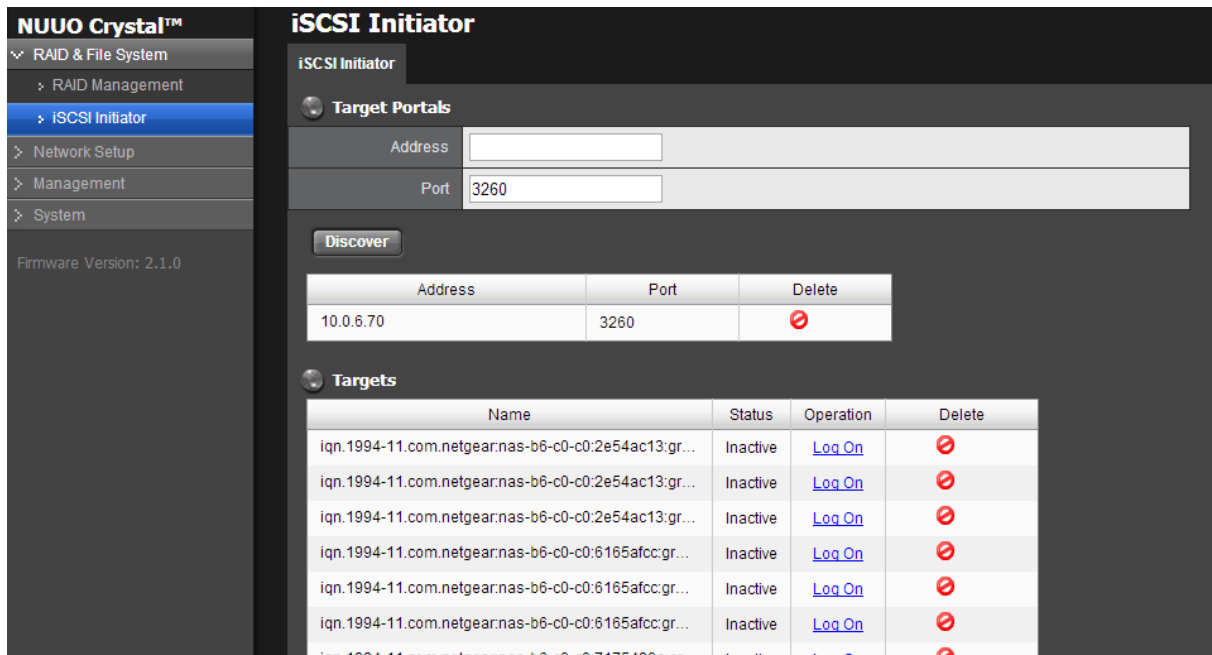
Figure22: iSCSI initiator interface at NUUO Web

    b. Connect through VMware's Storage adapter: VMware supports iSCSI HBA initiator, software iSCSI initiator, and hardware assisted initiators[3]. iSCSI HBA is recommended for its capability of offloading CPU utilization and high reliability. Figure 23 shows the location in vSphere Web Client where you can add an IP-SAN storage.

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[2] http://www.nuuo.com/calculator/#
[3] http://vinfrastructure.it/vdesign/vstorage-software-vs-hardware-iscsi/
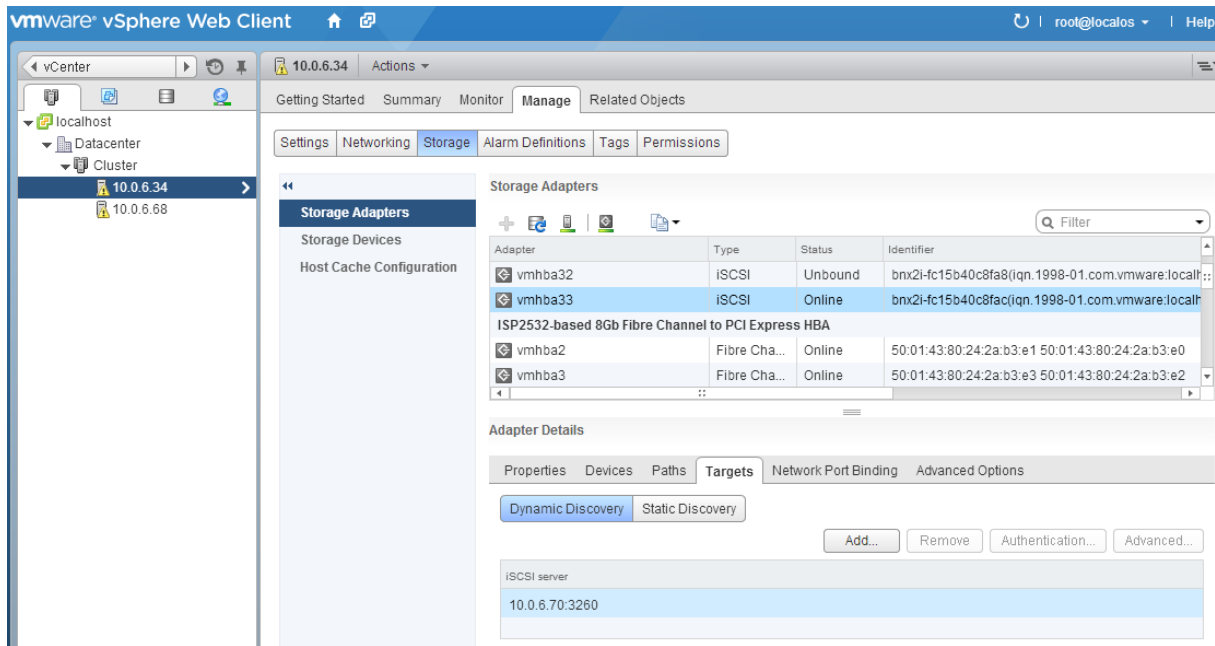
Figure23: VMware IP-SAN interface of iSCSI HBA

(4) Connect to FC-SAN: Once the host equips with a fiber channel HBA card, supported by VMware, vSphere Web Client can be used to check the LUN created at FC-SAN.

Figure 24: VMware storage adapter interface of FC-SAN

(5) Add RDM disk into virtual machine:
    a. Browse the virtual machine deployed from OVF image using vSphere Web Client.
    b. Go to 「Action」 Tab and click 「Edit Settings」.
    c. Under 「New Device」 Tab, click to add 「RDM Disk」 as shown in figure 25. Note that any RDM disk should be dedicated to one virtual machine.

Figure 25: Add new RDM disk into a virtual machine

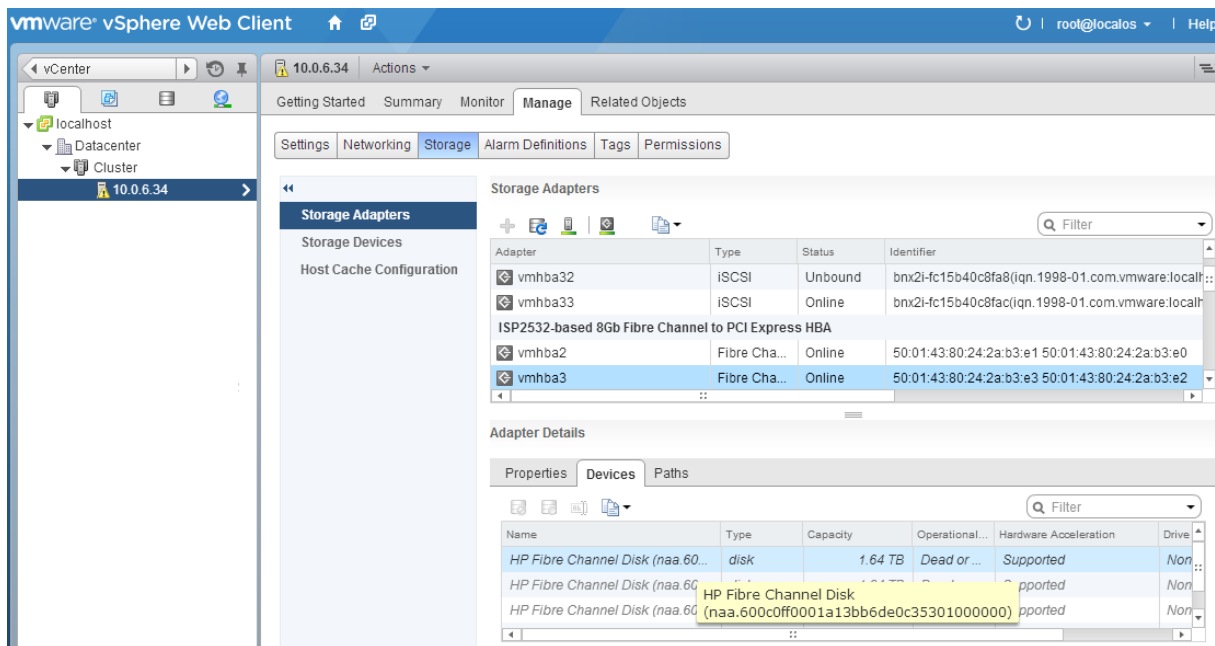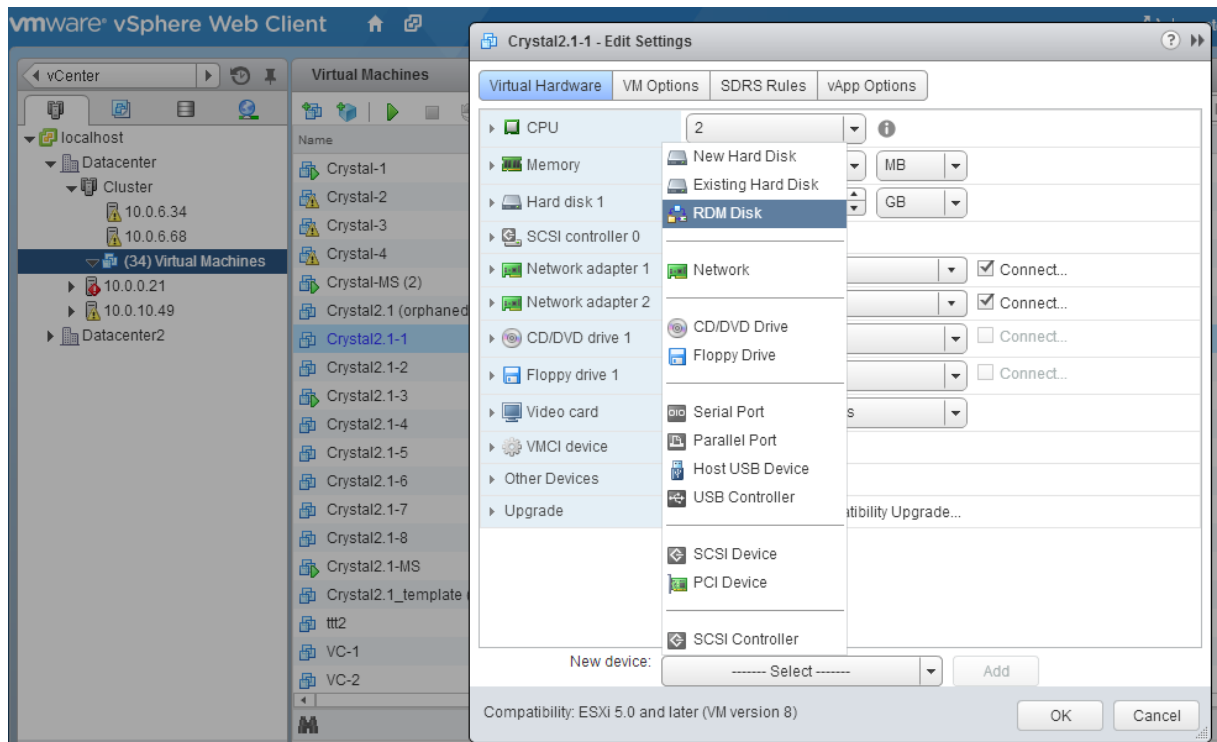2. Internal Storage: Normally, local diskettes and DAS (direct attached storage) are both considered as internal storage. In order to provide the best recording performance, passthrough RDM (Raw device mapping) is highly recommended. The following instruction can assist setting up a local passthrough RDM.

   (1) Connect to VMware host: Use ssh tool (e.g. Putty) to connect to VMware host which has local harddiskettes for recording.

   (2) Use vmkfstools –z commands, provided by VMware to create a passthrough RDM device. It is recommended to place the resulting vmdk file under the datastore folder under vmfs path (e.g. /vmfs/volumes/your_datastore_name).

   (3) Login to vSphere client and find the corresponding VMware host.

   (4) Select the virtual machine you wish to add the recording storage from the list.

   (5) Go toVMware Hardware setting and click 「Edit」.

   (6) Select「Existing Hard Disk」from the bottom of the page and click「Add」button.

   (7) Browse to the folder which contains the newly created vmdk file as shown below.
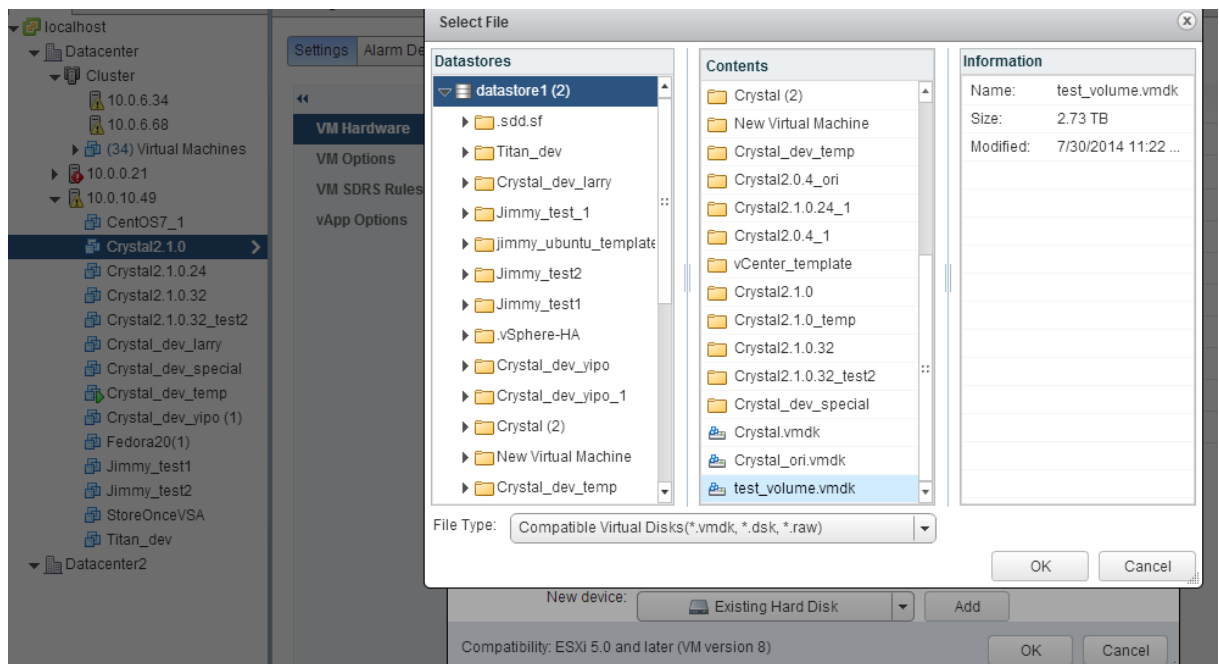
Figure 26: Using vSphere Web Client to add new internal storage

Virtual Network:

Conceptually, VMware host provides virtual switches to accommodate network port requirements from all virtual machines. Each virtual switch requires connections to at least 1 physical network adapters.
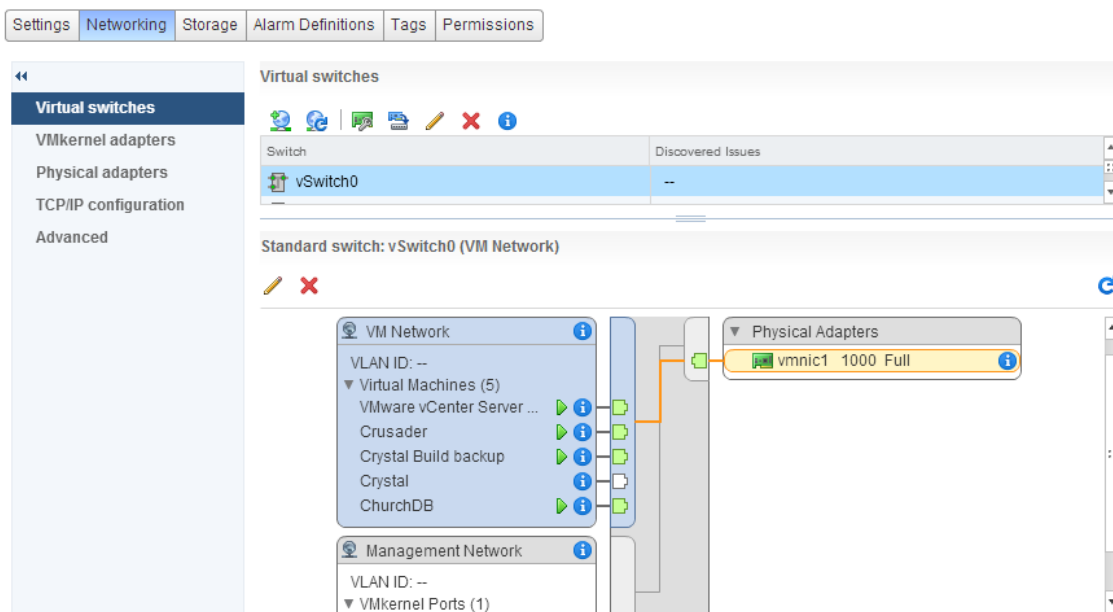
Figure 27: A sample of vSwitch Interface

The virtual machine, created by NUUO Crystal™ VM's image, comes with two network ports. The two network ports are intended to be used as:

1. Administrating network (Client): This port is for client viewing and configuration.
2. Surveillance network (Cameras): This port is to isolate camera traffic to the server.

In addition to the two network ports, it is highly recommended to segregate its traffic to

17

secure iSCSI's performance[4].

To serve the purpose above, three virtual switches with individual physical adapter are recommended, as shown in figure 28(upper). If not available, VLAN is a possible alternative as shown in figure 28(lower).
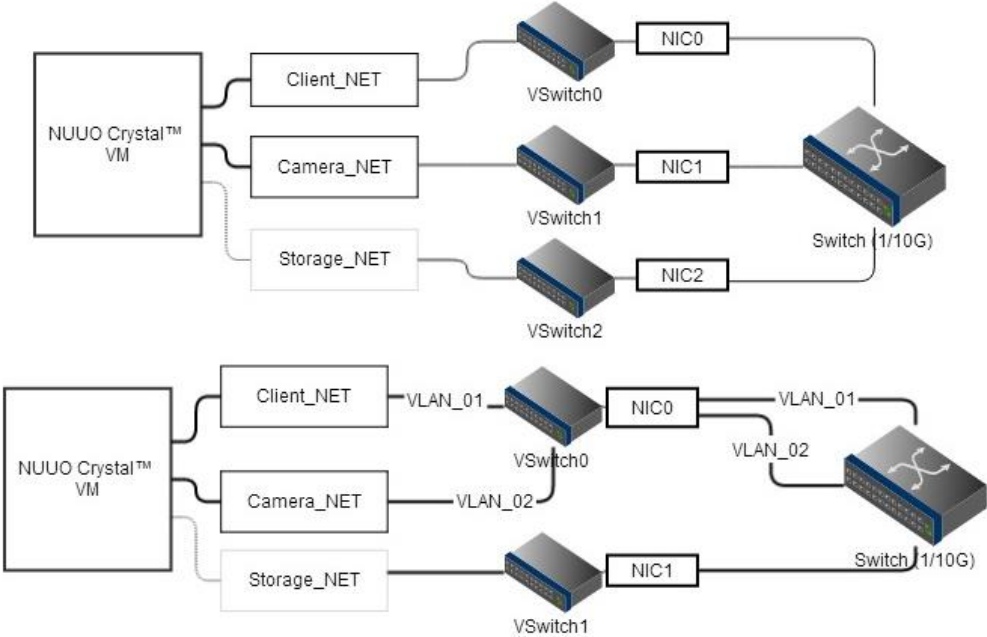

Figure 28 (Upper): Recommended network configuration,

(Lower) Network configuration when only two available physical adaptors

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NUUO Crystal™ VM Service Configuration

Once the Virtual machine is deployed and started, NUUO Crystal™ VM Services are opened for configuration. Figure 29 shows a step-by-step configuration flow. Please refer to 「Crystal_user_manual.pdf」 which you can found inside NuClient installation package.

Figure 29: Configuration Flow of a NUUO Crystal™ Service

Network Setting:

Unlike some network equipment (e.g. routers) whose ip address is pre-configured, NUUO crystal's network service is configured to obtain IP address automatic using Dynamic Host Configuration Protocol (DHCP) by default. The first task is to identify the server's IP address. There are two methods to discover this information

1. Console Page at Local Display: Server's IP address can be displayed and configured through server's local display. In VMware web client, click 「Launch Console」 to observe the console page.
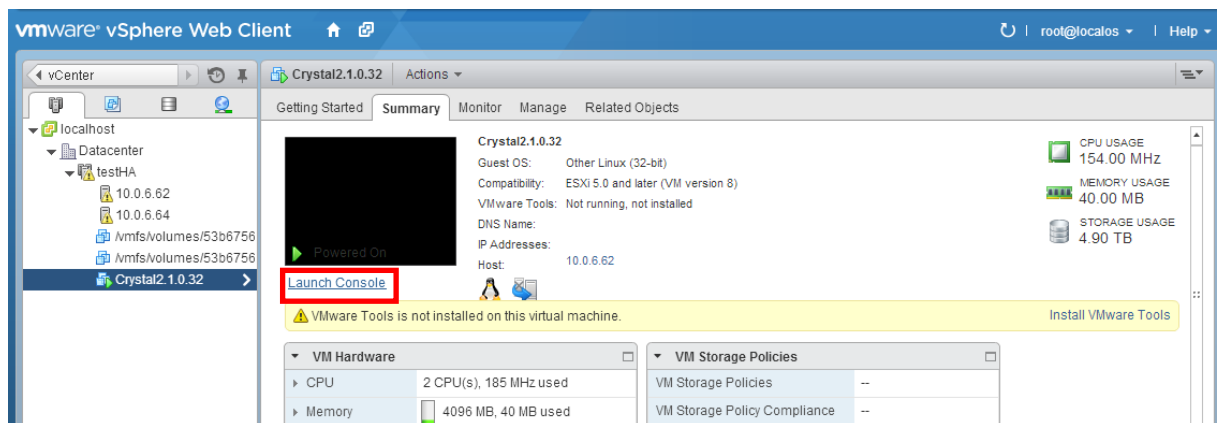

Figure 30: Network adaptor information can be checked from the console page

After Console page presents, please login with 「admin」 as username and presetted password (default: admin).
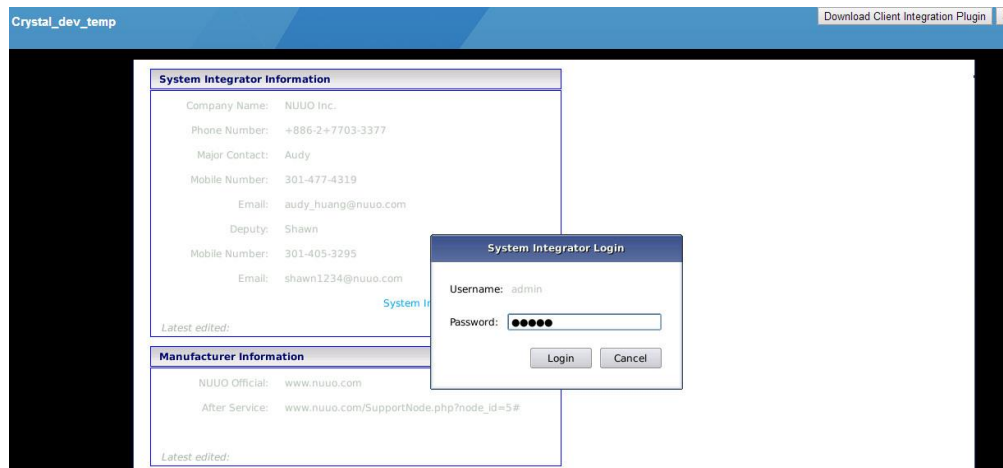
19

Click 「Network Information」and you are able to configure the IP address manually or automatically with a DHCP service.
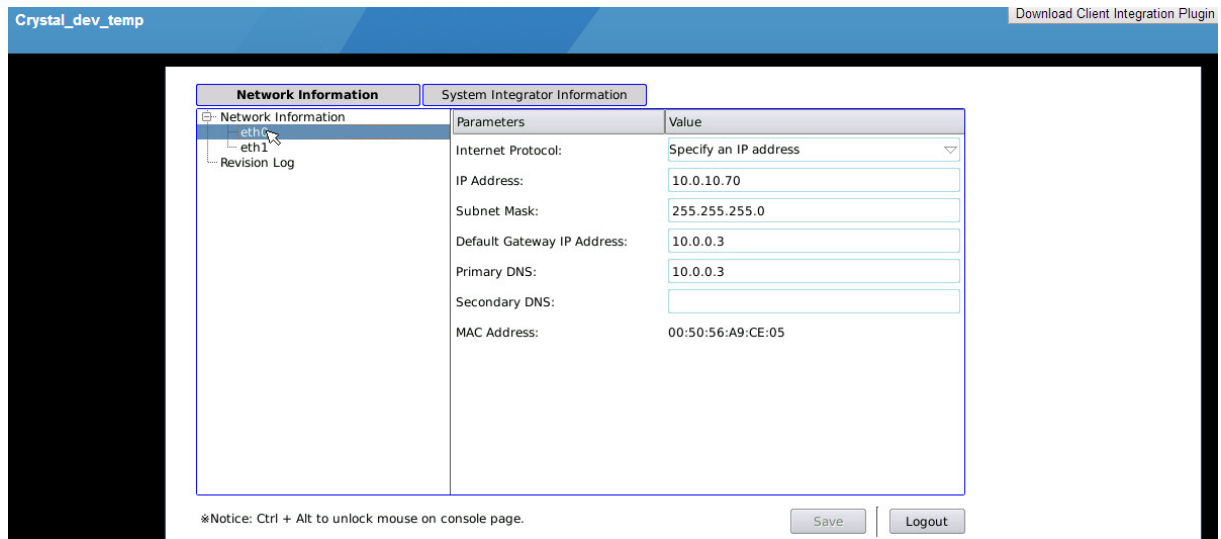
Figure 32: Page to modify network information

2. NUUO Crystal™ Installation Wizard: This wizard is included in NuClient installation package which supports broadcasting mechanism to discover server's ip address automatically. It is a convenient tool to manage multiple VMs (servers) within the LAN (local area network). However, if your network is complicated (e.g. VLAN) and may block broadcast packets, this method would fail. If you fail to detect your desired server, please use「Console page at Local Display」as described previously.

Figure 33: Network setup page in NUUO Crystal™ Installation Wizard

Service Setting

NUUO Crystal™ VM contains three services for user to choose from, including management, recording, and metadata. NUUO Crystal™ Installation wizard, included in NuClient installation package, can assist choosing the services. Figure 34 demonstrates if the management service should be enabled in this NVR. Figure 35 shows if recording and metadata services should both be opened and its corresponding port.

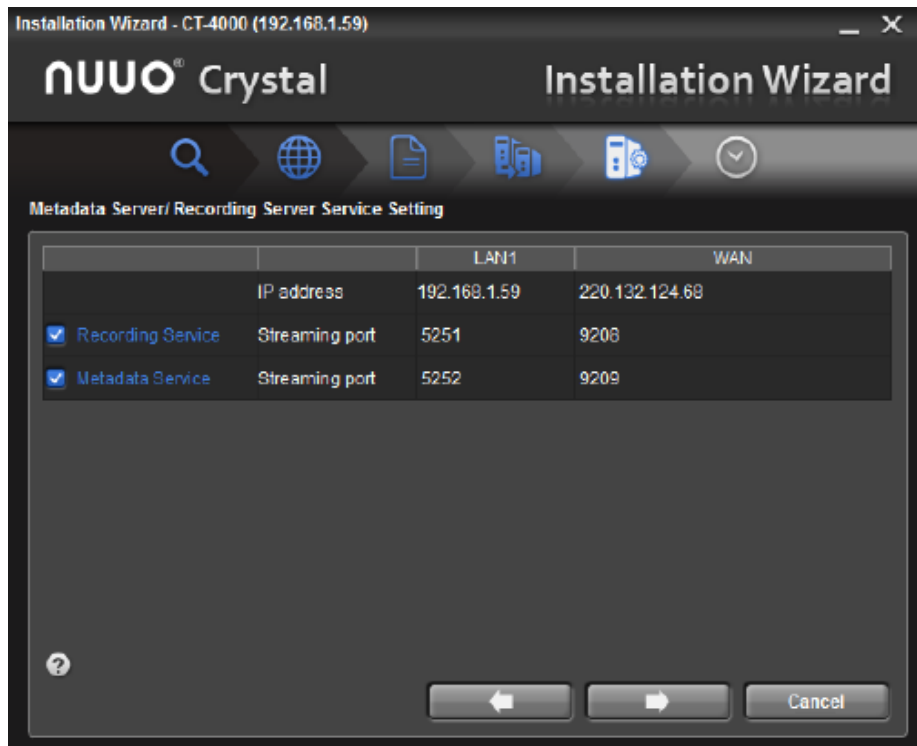**Figure 34: A config page to enable management service**

Figure 35: A config page to enable recording and metadata services

Disk Setting:

In「Virtual storage」section, we mentioned adding recording disks with both external and internal storages. The added disks would appear in our Web page as one of the raw disk. This page provides RAID functionalities, including create, status monitoring, modify, delete, and format.

1. Creation: RAID 0, 1, 5, and 10, is supported. One or many raw disks can be selected into a RAID. Each RAID is defined as a volume, which is further used in ConfigClient. Note that a volume is still needed to be created even if a RAID has been configured by the config UI of the external storage. For such a case, one disk (created as a RAID in external storage) is directly assigned to one volume.

Figure 36: Config page to add disks into a RAID group

2. Status monitoring: This page shows the status of a single RAID. Table 2 shows the meaning of each tag in the status column when a volume is selected in the list column. Table 3 shows the meaning of each tag in the status column when a disk is selected in the list column.
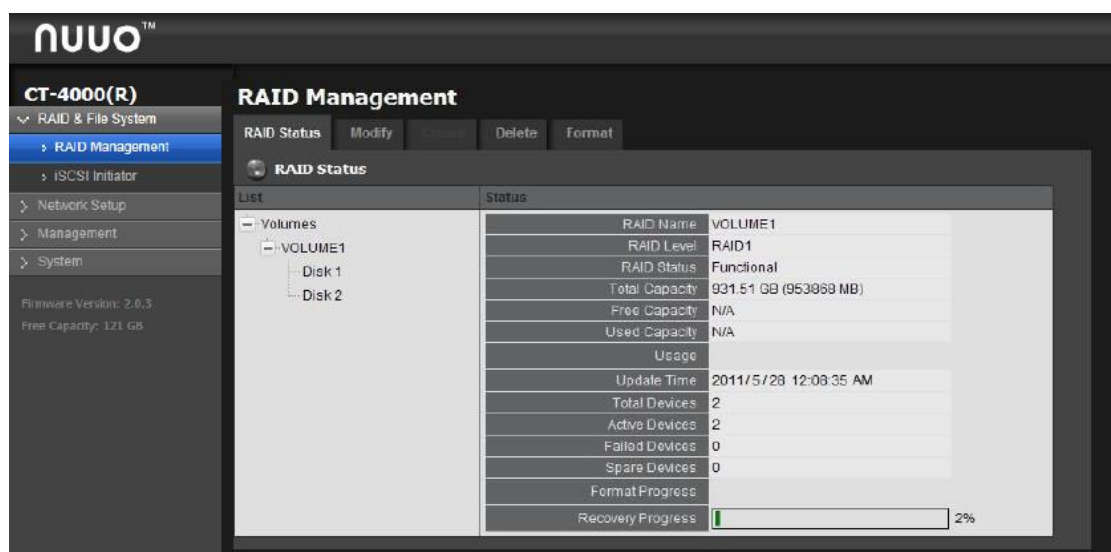

Figure 37: RAID status monitoring page

Name	Meaning	Action
RAID Name	Name of the volume	N/A
RAID Level	Level of RAID	N/A
RAID Status	Functional: Under normal operation.	N/A
	Critical: Video data is in place and the recording can be continued.	Call SI for service
	Offline/ File System Error: Video data cannot be accessed and the recording cannot continue.	Call SI immediately
Free Capacity	Free space of the volume	N/A
Used Capacity	Used space of the volume	N/A
Usage	Percentage of the volume usage	N/A
Update Time	The time when volume is updated or created	N/A
Total Devices	Number of disks in the volume, including active, failed, and spared ones	N/A
Active Devices	Number of active disks	N/A
Failed Devices	Number of failed disks	N/A
Spare Devices	Numer of spared devices	N/A
Format Progress	Formating progress of the volume (when disk formatting)	N/A
Recovery progress	Recovering progress of the volume (when disk swapping)	N/A

Table 2: Volume Status Monitoring

Name	Meaning
Vendor	Manufacturer of the disk
Model	Model number of the disk
Capacity	Total capacity of the disk
Firmware	Firmware version of the disk
Serial No.	Serial number of the disk
SMART Support	Enabled/Disabled Note: S.M.A.R.T (self-monitoring analysis and reporting technology) is a disk self-monitoring mechanism, supported by disk manufacturer, which uses several indicators to measure disk reliability.
RAID status	The status of RAID where this disk belongs to

Table 3: Disk Status Monitoring

3. Modify: When a disk is failed and pending to be replaced, RAID 1, 5, and 10 can protect the data from losing with its redundancy information. Different RAID level has different error recovery capability[5].
   If installer is replacing a failing or failed disk, using the「Modify」tab can safely unplug the running HDD. It is similar to「safely remove disk」function, known in Windows software. Its usage is simple:
   (1) Select the failing/failed disk
   (2) Click「Remove」button to remove the selected disk.
   (3) Insert the new disk physically.
4. Delete: This tab is used to delete a selected volume.
5. Format: This tab is used to format the selected volume.

IP Camera/ User Account/ User Prvilege and Permission Setting:
Once all the services and disks are ready, the Config Tab in NuClient is the last stop to configure all the surveillance related data, including IP camera, user account, and user privilege and permission. Some detailed settings (e.g. recording schedule, panoramic viewing…etc) are also available in the config Tab. The information of using config tab in NuClient can be found at「NUUO Crystal User Manual」located at NuClient installation folder.

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[5] http://en.wikipedia.org/wiki/RAID