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Laboratory Environments
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INTRODUCTION

This is a guide for using the virtualized services on laboratory ESXi servers. This guide can be applied to Cisco CCNA/CCNP, SpiderNet and JYVSECTEC laboratory environments. Virtual machines are run on VMware ESXi Hypervisor and can be used via VMware vSphere Client that can be downloaded from VMware internet pages or directly from the aforementioned servers. If one uses these servers from location other than IT-Dynamo Piippukatu, VPN can be used.

Examples depicted on this guide are taken from Spidernet ESXi (sesxi.labranet.jamk.fi) but same principles apply to other environments. Special cases regarding different servers are mentioned at the end of this document.

Connecting to server

VMware vSphere Client is used to connect to the ESXi server. This software is installed in all LabraNet workstations. To download it to your own computer, point your browser to the server (For example https://sesxi.labranet.jamk.fi, note the https!) and click *Download vSphere Client*.

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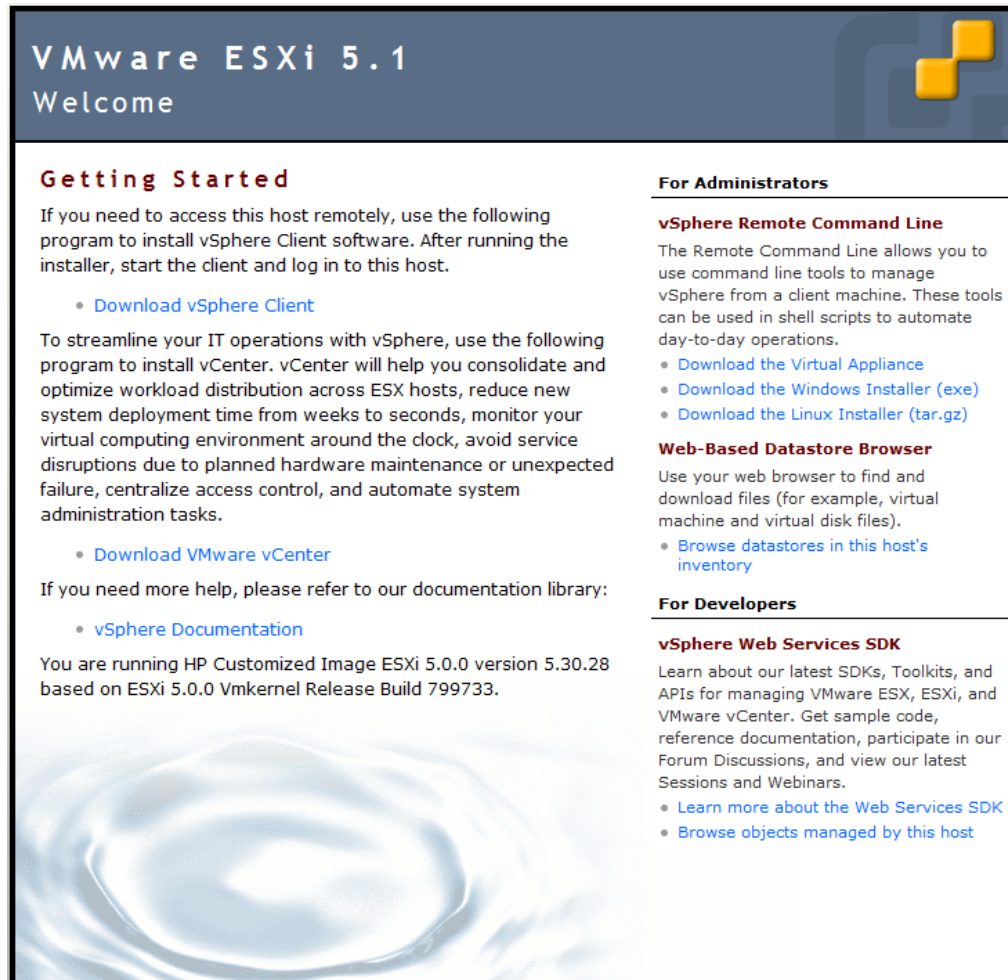### *Virtual Machines guide*

Figure 1. Downloading vSphere Client from the server directly

Start the vSphere Client and provide server address and your credentials to the login screen. For courses ask your instructor for these, for Bachelor theses ask LabraNet administration (Room D325 or http://student.labranet.jamk.fi/contact-the-labranet-helpdesk/) If the client complains about server certificate, it can safely be ignored.

NOTE: You cannot currently change your password using the vSphere Client as there is no such feature available.

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Figure 2. vSphere Client authentication

If you are redirected to the Home page of server, click Inventory, initial view of the server should look somewhat like this:

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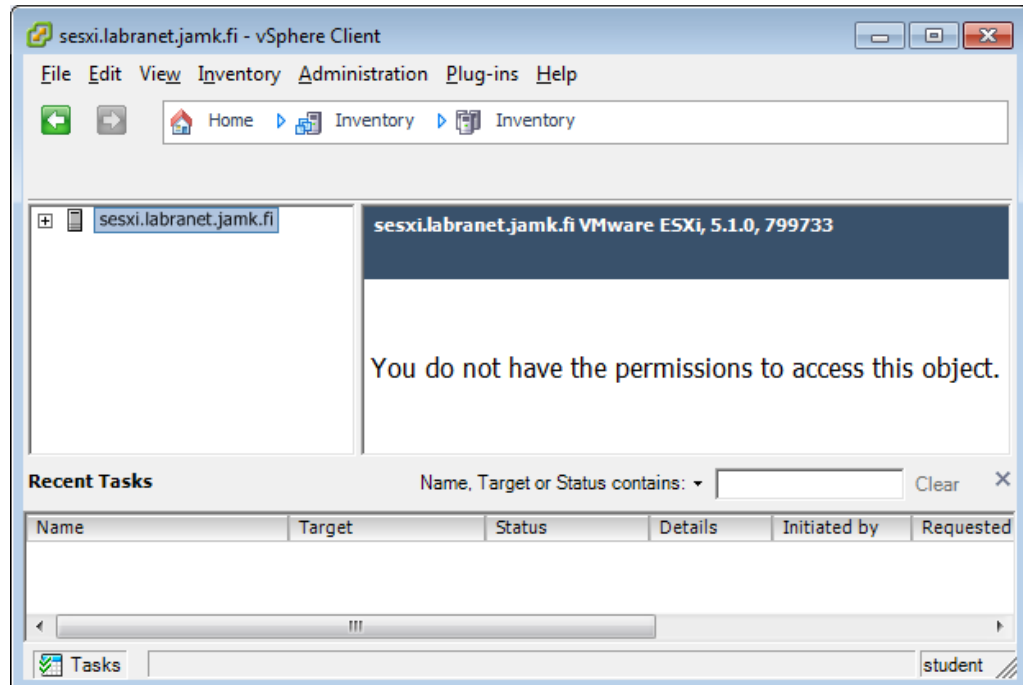*Virtual Machines guide*

Figure 3. vSphere Client Inventory

On the servers, virtual machines are grouped by Resource pools, which limit the virtual machine CPU and memory usage. Expanding the server icon on the left pane will show you those resource pools you can access. For courses, these can be shared machines but for bachelor theses, these are usually dedicated for yourself only.

When you select a virtual machine, the right pane will show information regarding it grouped by tabs. The *Getting started*-tab can be closed with the X mark on the upper right corner. *Summary*-tab will show generic information about the virtual machine and some basic commands for interacting with the machine. *Resource allocation* and *Performance* -tabs will show how much resources are allocated and used by the machine. *Events*-tab will show all events for this virtual machine and the *Console* tab can be used to access the virtual console on the machine. (See *Virtual Console*)

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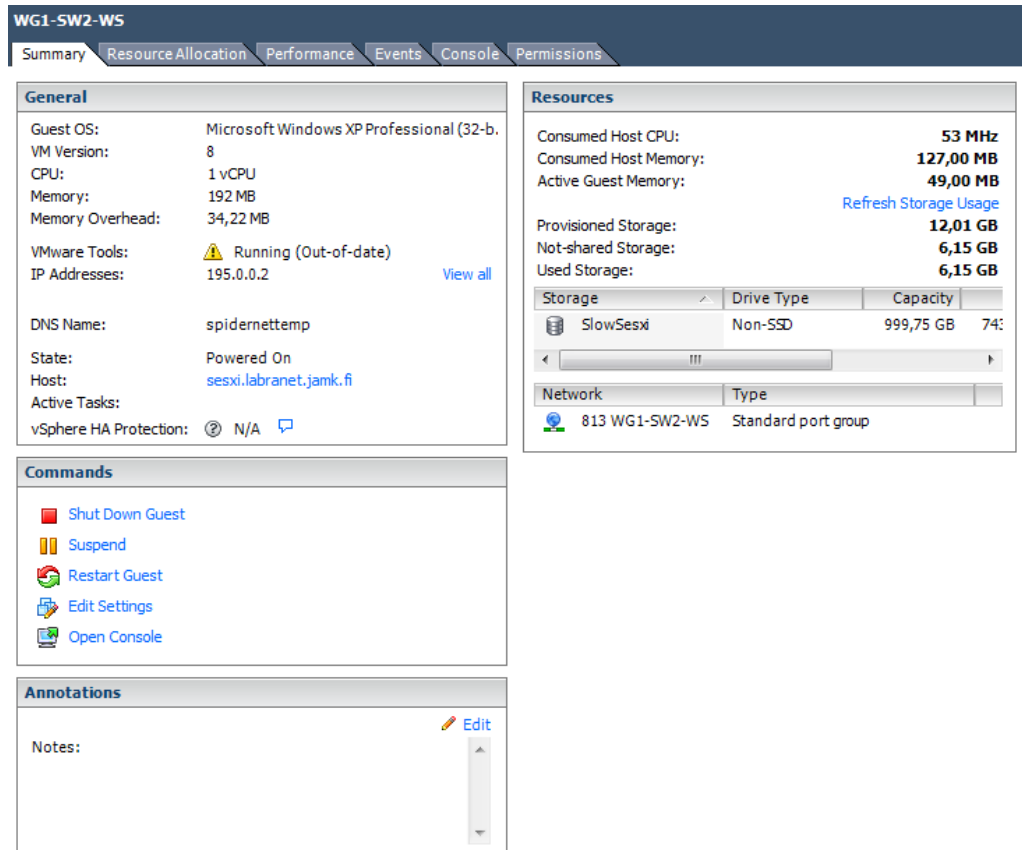*Virtual Machines guide*

Figure 4. Summary tab of a virtual machine

Interacting with virtual machines

Access the context menu for a virtual machine by right clicking it. From this menu, it is possible to power on and off machines, take snapshots, perform guest operations etc. If you have the necessary permissions set, you can also edit settings for the virtual machine, such as memory allocation, hard disks, networks and such.

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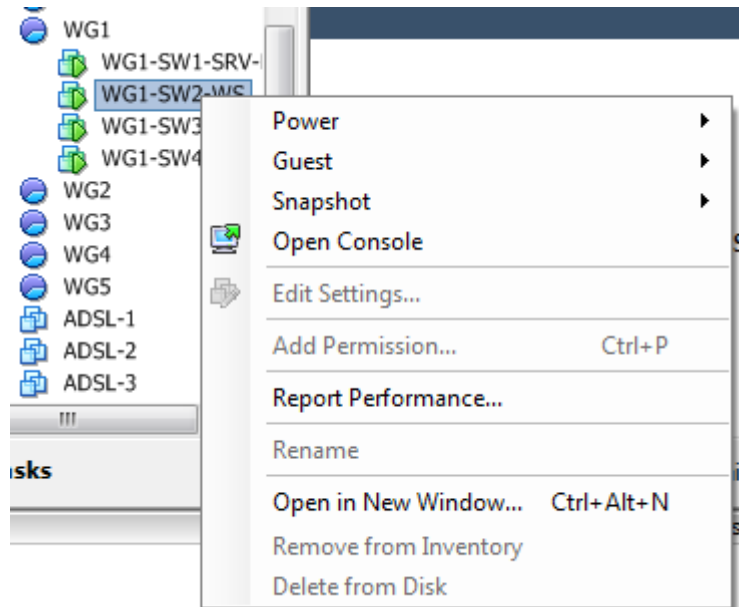*Virtual Machines guide*

Figure 5. Virtual machine context menu

Powering on and off are done from the *Power* menu. *Power off* and *Reset* are hard operations ant they work essentially the same as cutting power and pressing the reset buttons on physical machines. Instead, *Shut Down* and *Restart Guest* are soft operations and require VMware Tools to be installed to the guest machine. Note that VMware does not support ACPI shutdown found on other virtualization environments such as VirtualBox.
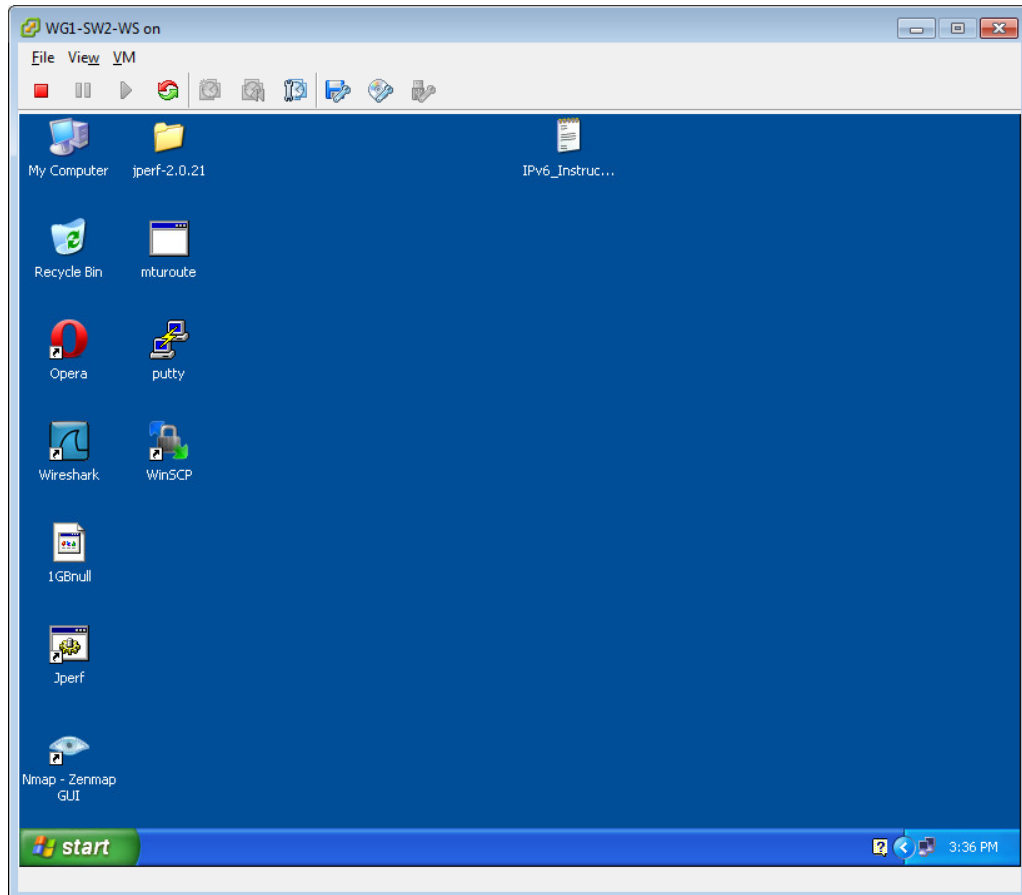
Virtual Console

You can access the virtual machine console by selecting *Open Console* from the context menu or directly from the *Console* tab (not recommended). This will open a new window containing the console access to a virtual machine. Note that this is not a remote desktop connection, but instead represents a physical display and keyboard/mouse combination for the virtual machine.

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Figure 6. Opening console to a virtual machine

On the top of the console window you can find essentially the same power commands and the whole virtual machine context menu is the menu named *VM*.

Connecting external media

The rightmost buttons on the toolbar provide means to connect Floppy disks, CD-ROMs and USB devices, if those devices are available to the virtual machine. The most useful scenario is to connect an .iso –image to the virtual CD-ROM drive. To do this, select the CD-ROM icon, and from the menu, select *CD/DVD drive 1 -> Connect to ISO image on local disk* and provide a path for the image to be used.

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USB devices can also be connected to the virtual machine from the USB menu. The virtual machine must have an USB controller attached. Some USB devices will not work properly, but generic devices such as USB memory sticks and hard disks, web cameras, etc. will probably work fine if the guest operating system has the required drivers.

Copy&Paste

Copy&Paste is possible with the virtual machine console, but only if VMware Tools have been installed and the guest operating system supports copy&paste. For example, Linux command line does not support any clipboard actions, so it is not supported, but both Linux and Windows desktops do support copy&paste. Dragging items to console window is not supported.

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Snapshots

With virtualization it is possible to take snapshots of the machine and later return to the state in the snapshot. This makes it possible to test different configurations and return to known working condition if necessary. Snapshots can be taken on a live machine, however there are some limitations.

Creating a new snapshot is done from the context menu by selecting *Snapshot -> Take Snapshot*. Fill in the name for the snapshot and a description and click OK. A live snapshot can be taken from a running machine by selecting *Snapshot the virtual machine's memory*.
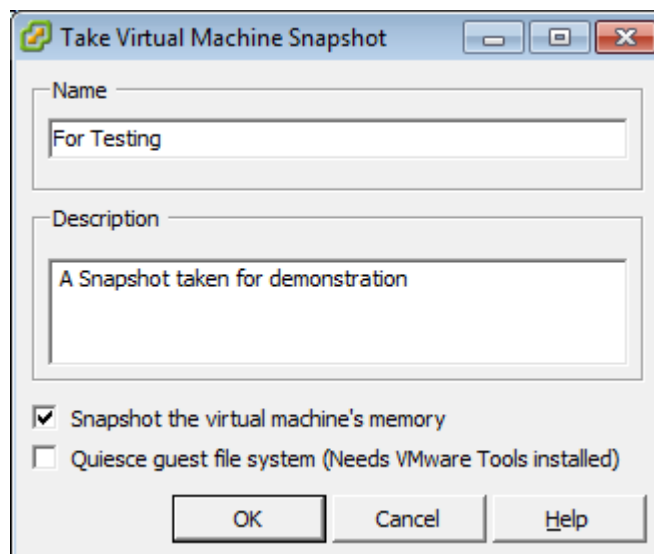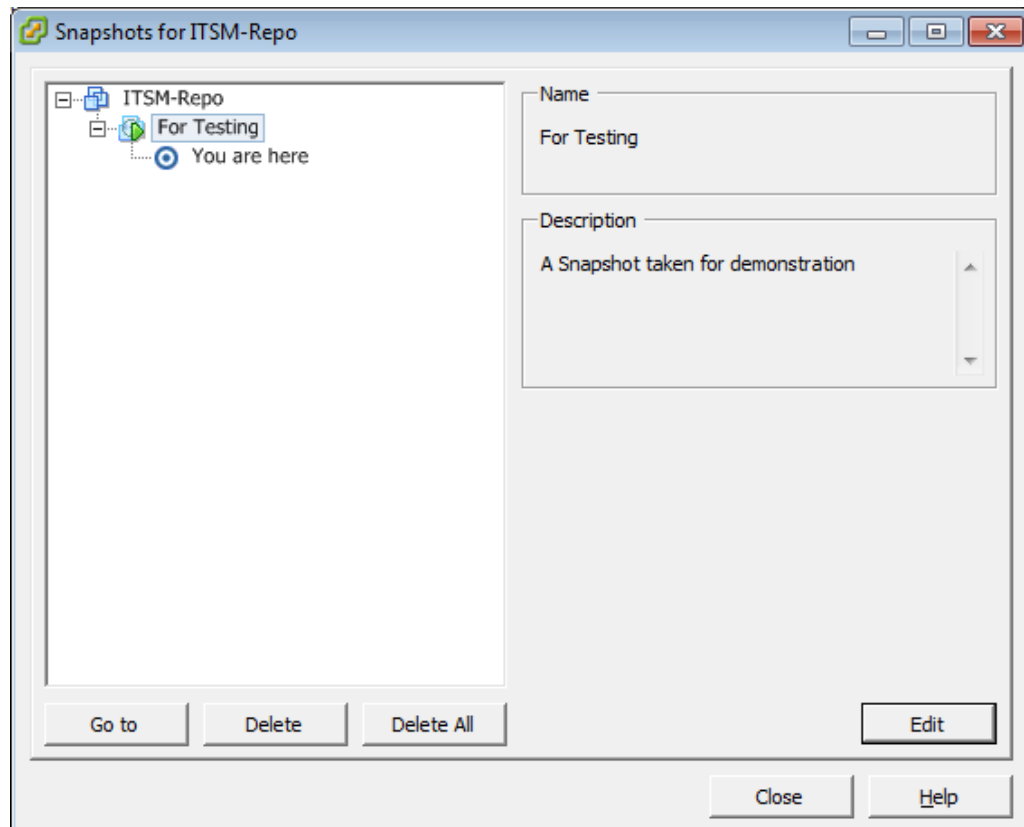
Figure 7. Taking a snapshot

Managing snapshots is done via the Snapshot manager (context menu: *Snapshot -> Snapshot Manager*). Here you can delete old snapshots that are no longer needed and go back to a certain point in time.

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Figure 8. Snapshot manager

ATTENTION! The maximum depth of snapshots is 32, that is, only 32 nested states is possible. However, this will generate a heavy workload for the disks and reduce performance.It is recommended to keep the depth of nested states to a minimum and periodically remove unused snapshots.

Even more care should be taken with live snapshots as these will use a lot of diskspace as every live snapshot will write the memory dump of the virtual machine. So 32 live snapshots from a machine running with 1GB of memory will consume 32GB of additional disk space!

Recommended maximums are 8 nested snapshots and 4 live snapshots. If these are exceeded, performance may suffer.

Non-persistent virtual machines

Some virtual machines, such as the Cisco Pod and Spidernet Workgroup servers and workstations are so-called non-persistent machines. This essentially means that these machines will lose their configuration when they are powered off, so next time it is possible to start configuration from scratch. Rebooting or resetting the VM will not erase changes, but instead a power cycle from the context menu (*Power Off* or *Shut down guest*) will do it.

NOTE: Nonpersistent machines will look exactly the same as ordinary VMs, and usually only specific courses use them.

VMware Tools

It is highly recommended to install VMware Tools on the guest operating system as they contain important drivers and make the system a lot more user-friendly. With VMware Tools, desktop environments work significantly faster, copy&paste works, mouse can be seamlessly grabbed on the console, etc.

NOTE! Before installing VMware Tools, the server must be told what guest operating system the virtual machine is running. This is done via the *Edit Settings* –dialog in the context menu. On the *Options*-tab, select *General Options* and on the right side you can select *Guest Operating System*. The VM must be powered off before changing this value. Please note that selecting correct OS type and architecture (x64/32) is very important or the installation of VMware Tools will fail!

Also, the virtual machine needs to have a virtual CD/DVD drive attached.

Installing VMware Tools can be initiated from the context menu (*Guest -> Install/Upgrade VMware Tools*). VMware Tools installation CD will be inserted to the CD/DVD drive. Depending on the guest OS, the installer will require some manual intervention.

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Windows

Windows will try to autorun the installer from the CD. If this does not happen, go to My Computer/Explorer and open the CD drive. The installer should start. Default values can be applied when installing. When the installer is finished, a reboot is required for the drivers to load.
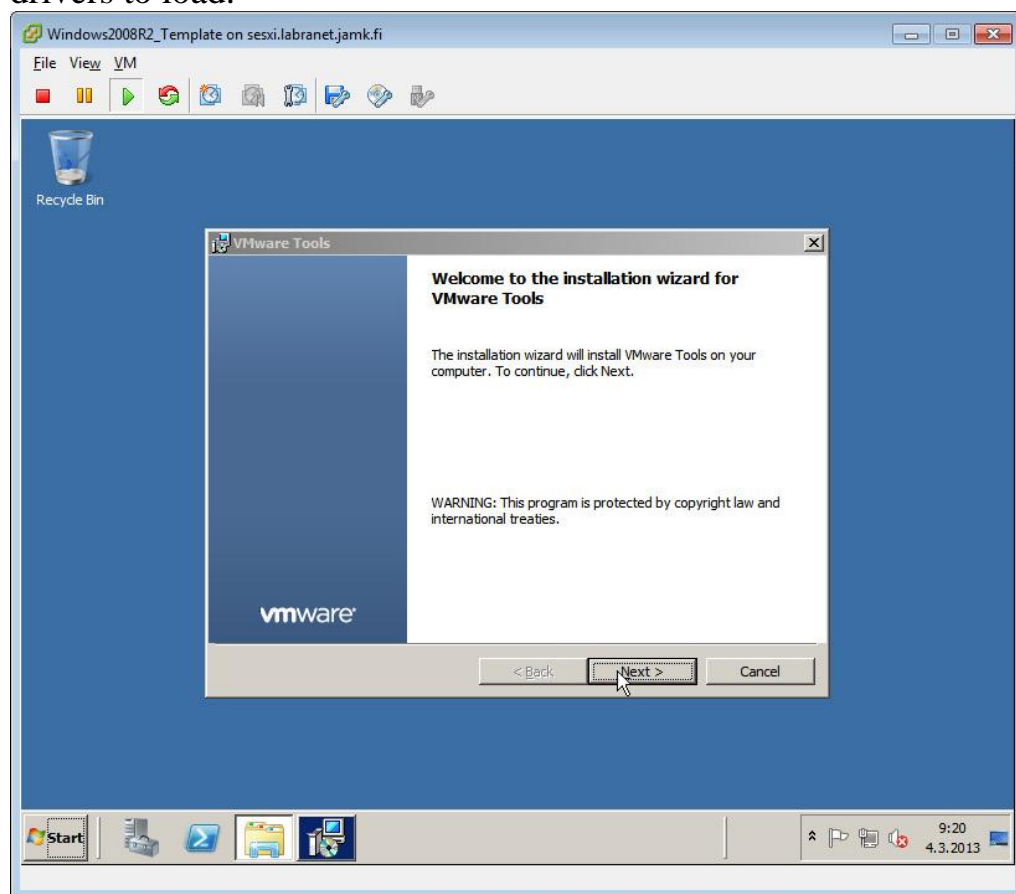

Figure 9. VMware Tools installation on a Windows Server 2008 R2

Redhat-based Linux (RHEL, CentOS, Fedora)

NOTE: Some Red Hat installations don't include Perl by default. You can install it by yum install perl.

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Red Hat –based Linux distributions use static kernel modules, so the only prerequisite packages are gcc, make and linux-headers. Install these with:

yum install gcc make kernel-headers

Installing the tools from command line (Note: Commands may vary and you may need sudo depending on the distribution):

cd /tmp
mkdir cd
mount /dev/cdrom /tmp/cd
cp cd/VMwareTools-version.tar.gz ./
tar –xvf VMwareTools-version.tar.gz
cd vmware-tools-distrib
./vmware-install-tools.pl

The installer will ask options during the installation. Usually defaults will suffice.

NOTE: Currently it is OK to answer yes to the question regarding the automatic kernel modules. This way it is certain that modules will be rebuilt when upgrading kernel.

Reboot is usually required for the VMware-tools modules to load.

Debian-based Linux (Debian, Ubuntu)

Debian-based distributions use dynamic kernel modules and need some prerequisite packages to be installed. These can be installed with:

sudo apt-get install linux-headers-$(uname –r) build-essential libglib2.0-dev

After this, install tools same way as in a Red Hat –based distribution (see above).

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Conversion

Converting machines between VMware products (ESXi / Workstation) and VirtualBox used to be tedious process. The new Open Virtualization Format (OVF) simplifies this, but still some manual intervention is required. Here are depicted some scenarios one may bump into.

Prerequisites

Before converting, make sure the following prerequisites are fulfilled:
- The VM should not have an USB controller or audio device connected. These can be added later on if needed
- Disconnect any floppy or CD-ROM images
- The ESXi does not support SATA AHCI. VirtualBox creates the hard disk as SATA AHCI by default for Linux and Windows machines, which will break the installation. When creating new VMs, set the disk controller manually to *SCSI (LSI Logic)*. For old VMs, conversion is possible (see the following chapters)
- VirtualBox Guest Additions may result in problems, mainly with graphical Linux environments. Refer to VirtualBox documentation on how to remove additions before converting.
- Also, see notes on specific operating systems later on this document.

SATA to SCSI – Windows

As VMware does not support SATA controllers, VMs must have disks connected as IDE, SCSI or SAS. IDE is only partially supported and performance is slow, so SCSI or SAS should be used. For Windows machines, SAS is the recommendation.
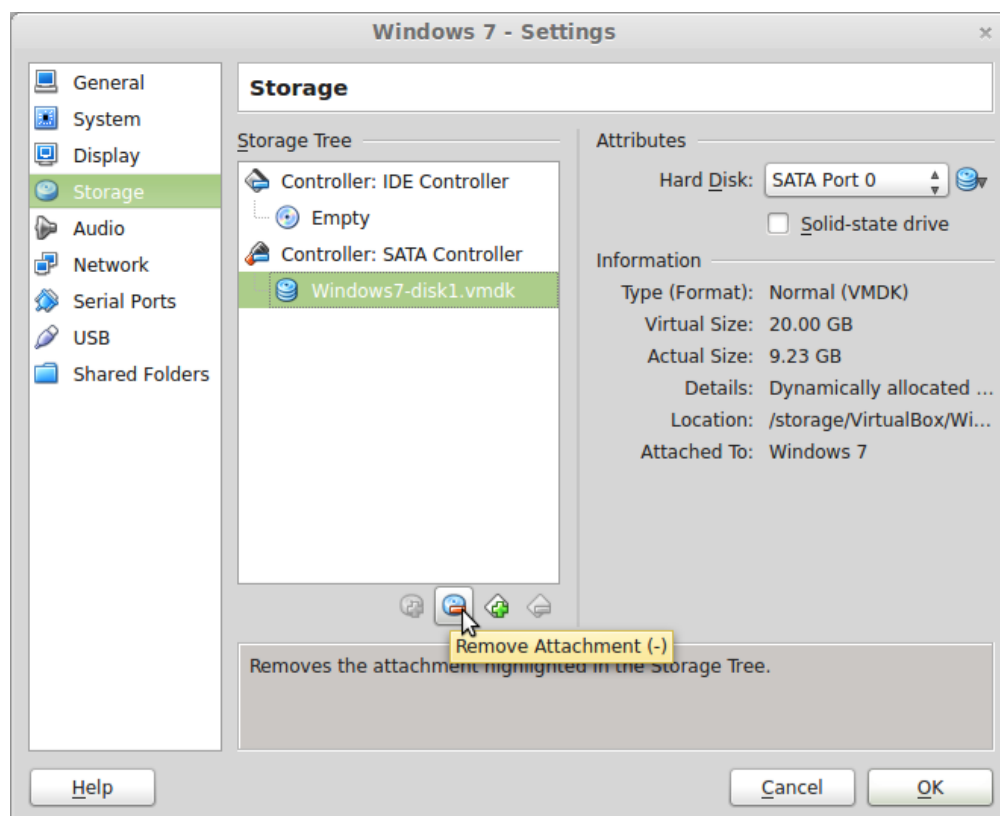
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For Windows machines, SAS controller should be activated before the next step or the Windows installation will not boot. One registry setting needs to be modified on a running VM:

[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\services\ LSI_SAS]
"Start"=dword:00000000

Power off the VM cleanly. Open *VM Settings -> Storage*. Disconnect the hard disk from the SATA controller as shown in the next picture:

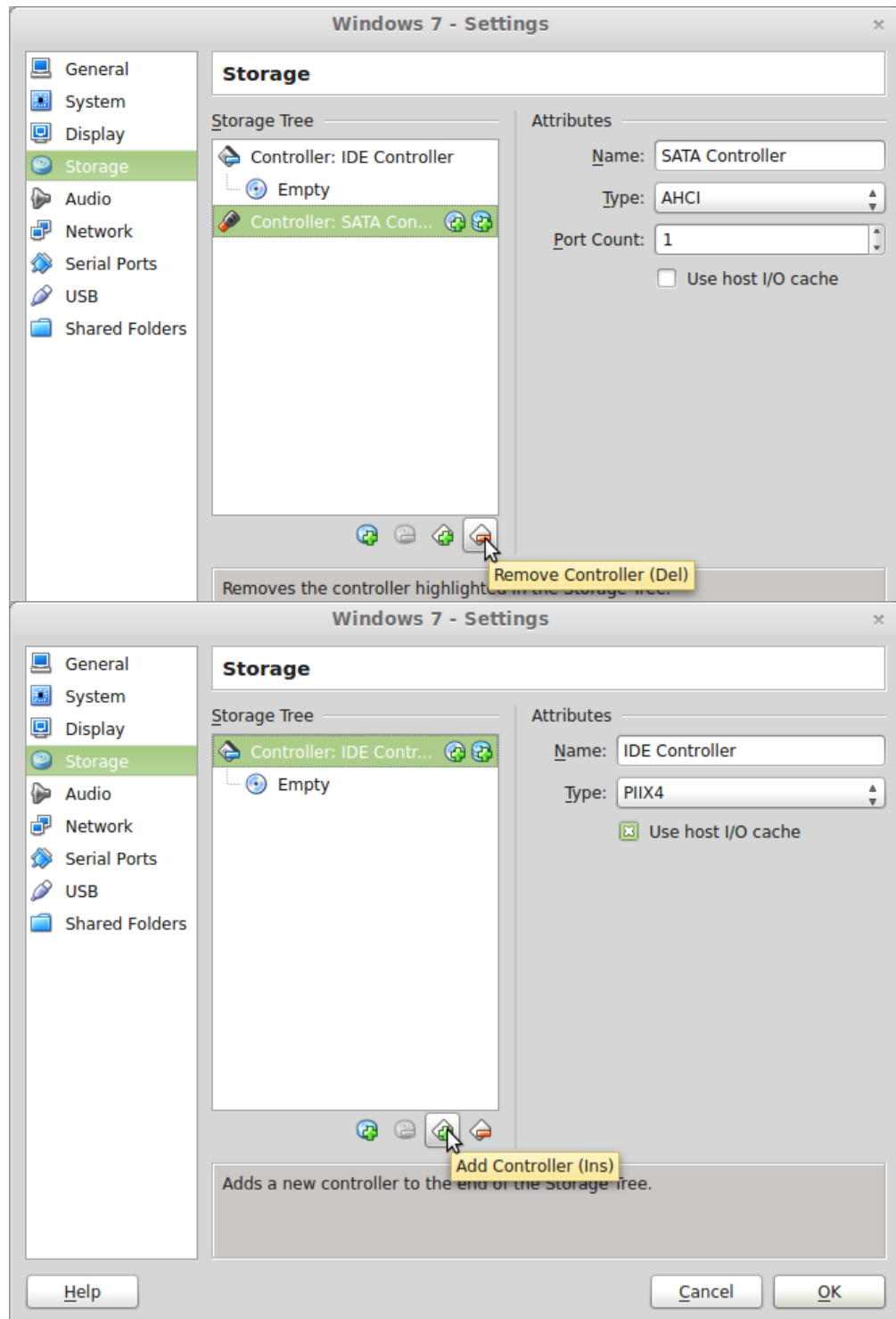**Figure 10. Removing SATA controller**

Now remove the SATA controller altogether and add SAS controller:

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Figure 11. Adding SAS controller

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Now the virtual machine disk can be added back to the SAS controller. Select the controller and select *Add Hard Disk, Choose existing Disk*. On the dialog, navigate to the folder where the VM is located and select the virtual hard disk. The final configuration will look like this:
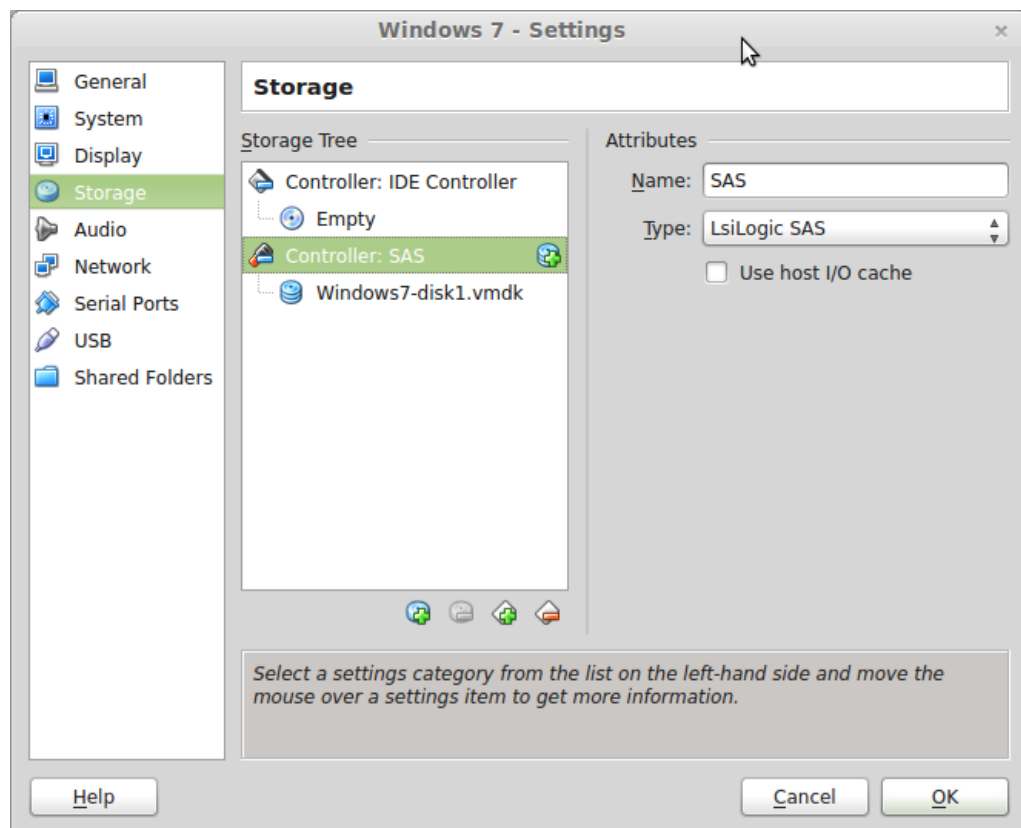

Figure 12. Final configuration.

Click OK and check that the Virtual machine boots correctly. If not, revert back to SATA controller and troubleshoot.

SATA to SCSI – Linux

For Linux machines, no modifications to the OS are required. Perform the same steps as previously mentioned, but use SCSI controller (LSI Logic) instead of SAS as it has better support.

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Exporting OVF

The VM can now be exported from the VirtualBox menu *File –>
Export Appliance*. On the the settings dialog, set the extension to
ovf, so the disk image and ovf file are created separately.

NOTE! After exporting the VM, do not rename the files!

After exporting the VM, ovf file must be edited by hand, as ESXi
expects a different syntax on some configuration items. Open the
file in a text editor and find the line containing:

<vssd:VirtualSystemType>**virtualbox-2.2**</vssd:VirtualSystemTyp
e>

Replace with:

<vssd:VirtualSystemType>**vmx-7**</vssd:VirtualSystemType>

After these changes, the OVF can be deployed to an ESXi server.