# INR + LIA Lab Assignment
# Virtualization

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**Abstract**

Virtual machines (VMs) and virtual networks are a great tool for conducting network experiments. In this lab session you will get familiar with Xen. Xen is a hypervisor which supports both para-virtualization and hardware assisted virtualization . To make installation and configuration easy, you will use precompiled packages provided by the Linux distribution. Before starting fully read this document to get an overview of what's to come. Explain and describe every step you took to solve each task.

## Preparing the environment

*During this lab assignment, you might have to reinstall your server. Backup all data you want to preserve before continuing this lab assignment! If you want to deviate in any way from the suggested setup, you are allowed to do so as long as you first consult with the lab teacher and explain your reason and describe the changes on your wiki. Note that if you are using a non-standard setup you will not receive any help in debugging any problems that might occur! Do this at your own risk! You may not replace Xen for another virtualization stack(KVM, VMware, HyperV).*

**Task 1.** Make sure that Ubuntu 12.04 64bit is installed on server. Use the PXE service to start the installation process if needed. Partition your disks such that you have at least 100GB of unused space.

**Task 2.** *Briefly* explain what you think is the main difference between a 32 bit and a 64 bit operating system.

LVM (Hasenstein [2001]) - *Logical Volume Managment* - allows the grouping of storage resources, called *physical volumes*, in larger pools called *volume groups*. Each group can be then partitioned just as if it would be a single large drive. These partitions are called *logical volumes*. There are a lot of advantages of using LVM over the basic storage approach . LVM can be also combined with raid solutions to provide resilience or to increase performance.

**Task 3.** Install the **lvm2** package and create a physical volume using the free space reserved before. On top of the physical volume create a volume group called `VolumeGroupXen`. Here you will store the virtual machine images. Hints: `pvcreate, vgcreate, pvdisplay`.

## Installing Xen

Before you start using Xen, it is useful to read about its design. A good paper to start with is Barham et al. [2003] and then you can continue with Pratt et al. [2005] . For a more general overview of x86 virtualization, have a look at Adams and Agesen [2006]. You can continue with **virtio**Russel [2008], a proposal for a standard for virtual I/O devices.

A XEN installation includes the XEN hypervisor and a set of tools that allow the administrator to configure and manage virtualization specific aspects of the system. Xen can be configured using multiple tool stacks and `http://wiki.xen.org/wiki/Choice_of_Toolstacks` provides an overview of their features and advantages.

**Task 4.** Install the **xen-hypervisor-4.1-amd64** package and configure the system such that the XEN kernel is booted by default. Also enable the **xl** toolchain in the XEN configuration. Hint: *Like all Debian based systems, Ubuntu stores in /etc/default settings that the user is likely to change*[1]*. Do not forget to run update-grub after changing the bootloader config files.*

You can test that your Xen installation is fully functional by issuing `xl info` and `xl list`.
Have a look at `/etc/xen/xend-config.sxp` to get familiar with the options available.

[1] http://www.debian.org/doc/debian-policy/ch-opersys.html

### Networking

The IPv4 address' to use for your VMs are those in the /28 subnet which is routed to your server. The goal of the next set of tasks is to create an ethernet bridge for all future virtual machines that you will create.

**Task 5.** . Use `brctl` to manually create a bridge named `xenbr0`. Do not add any interfaces to it; we will use routing instead of switching to connect the VMs to the Internet.

**Task 6.** Assign an IPv4 address to the `xenbr0` bridge from your own /28 subnet. Enable IPv4 routing (Hint: `sysctl.conf`) and test the connectivity to your bridge by using ping from your workstation or any other machine connected to the Internet. *Make sure you don't have any firewall filters that prevent forwarding IP traffic.*

**Task 7.** Edit `/etc/network/interfaces` such that `xenbr0` will persist across system reboots. Use the Debian/Ubuntu way![2]

### XEN Virtual Machines

**Task 8.** Apply the patch from `https://bugs.launchpad.net/ubuntu/+source/xen-tools/+bug/997063`

**Task 9.** Using `xen-create-image` create a Debian virtual machine that has the following characteristics:

- Hostname: **Squeeze-01**
- RAM: 1024MB
- Disk size: 10GB
- Swap size: 1024M
- VolumeGroup: VolumeGroupXen
- Distribution: Debian Squeeze
- Filesystem: ext3
- Virtual Cpus: 2
- IP: an IP from your own range

*Hint: You might find useful to inspect the man page of `xen-create-image` and the contents of `/etc/xen-tools`.* Customize `xen-tools.conf` to provide valid network settings so that every newly created virtual machine image will be able to use the bridge that you've created in the previous steps. Also make sure that you can set the root password interactively.

If all goes well, you will find a configuration file called **Squeeze-01.cfg** placed in `/etc/xen`. Have a look at its contents.

**Task 10.** What is `00:16:3E`? Explain why it is used.

**Task 11.** Start the virtual machine and login to its console and test network connectivity *Hint `xl console hostname`*. Exit by hitting `CTRL + ]`

**Task 12.** Use `xl` to find information about the running VM and then stop it and start it again.

**Task 13.** Configure your system such that **Squeeze-01** is auto-started after a reboot. There are different ways to achieve this but can use a simple shell script called by `rc.local`.

**Task 14.** Briefly explain the following terms: DomU, Dom0, PCI pass-through.

**Task 15.** Is **Squeeze-01** a fully or a para virtualized guest? Explain.

**Task 16.** `deboostrap`, `rinse` and `rpmstrap` can be used to aid in the creation of virtual machine images. In fact `xen-create-image` can use all of them under the hood. When would you use one over the others?

**Task 17.** User Mode Linux (Dike et al. [2001]) is another approach to virtualization. Write a short paragraph highlighting at least two differences and two similarities between XEN and UML.

**Task 18.** How do you think that the virtual machine communicates with the outside network in your setup ? Draw a simple network diagram showing at least the network cards, the bridges and any routers that might be present. Don't forget to label everything with IP addresses and names.

[2] `man bridge-utils-interfaces`

## References


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