HAKAP Network virtualization practice

1. How to create/get a VM image?
   - install your own instance
   - Source of ready-to-use virtual machines for open-source operating systems
     - https://www.osboxes.org/
     - VirtualBox and VMware images

2. VirtualBox
   a) Networking
      i) VM Configuration (when VM is not running)
         1) default config: NIC1: NAT
         2) You can add more NICs: e.g. NIC2: Host-only
      ii) To set up host-only networks: File / Host Network Manager
         1) Enable DHCP
   b) Test the nested virtualization feature of VirtualBox (since v6)
      i) Settings / System / Processor: Extended features : “Enable Nested VT-x / AMD-v”
      ii) If it is grayed out then a CPU feature is missing from the host CPU

3. Start the VM in VirtualBox
   - Password: osboxes.org
   - to change screen resolution: Start menu / Preferences / Monitor settings
   - to start a terminal: Start menu / System Tools / LXTerminal

4. Review network settings in **LUbuntu**
   - ifconfig
     - enp0s3: 10.0.2.15 (NIC1: NAT)
     - virbr0, virbr1 : virtual bridges

   - check outbound traffic:
     - ping www.bme.hu

   - how to reach the VM from outside?
     - start a web server for testing:
       - python -m SimpleHTTPServer

     - from a browser in Windows open: 10.0.2.15:8000 ?
     - open a cmd prompt in Windows
       - ? ping 10.0.2.15
       - ipconfig
         - Host-only networks are listed, NAT is not present

A) Set up port forwarding:
VM Settings / Network / NIC1 (NAT) / Advanced / Port forwarding
TCP , Host port: 8888, Guest IP: 10.0.2.15, Guest port: 8000
from a browser in Windows open: localhost:8888/

B) Use Host-only network interface

- ifconfig -a
  - enp0s8 (NIC2) is listed without IP address
- in VBox settings the DHCP is enabled for the Host-only network, to get an IP address use the following command:
  - sudo dhclient enp0s8
- afterward check with "ifconfig" the assigned IP address (192.168.56.101, might be different depending on Host-only network DHCP settings)
- open in Windows browser: http://192.168.56.101:8000/

- check the client IPs in HTTPServer log messages
- Ping also works:
  - from Windows cmd prompt: ping 192.168.56.101
  - from LUbuntu terminal: ping 192.168.56.1 (but Windows Defender Firewall can block it)

5. Hardware assisted virtualization support

- In Windows: VM settings / System / Acceleration: Enable VT-x/AMD-v, also in the right bottom icons of the VM window shows it
- In LUbuntu: "sudo kvm-ok" command
  - Vbox (since v6) is supposed to pass the HW assisted virtualization support to Guest VMs (but e.g. KVM or Hyper-V is capable to pass)
  - If not => Nested VMs inside LUbuntu cannot use HW assisted virtualization

6. Linux VM virtualization with libvirt / virsh / virt-manager (GUI)

- from terminal launch: virt-manager
  - VM settings: double click on the VM, then the "i" (information) icons
  - check network settings (default): NAT and virtio driver
- start up 2 cirros VMs
  - if mouse is locked to VM terminal, release it with Left Ctrl + Left Alt
- check network settings with ifconfig
  - Cirros VM IP address 192.168.122.X
  - virbr0 on LUbuntu: 192.168.122.1
- Test connectivity from cirros nested VM via NAT:
  - internet: ping www.bme.hu
  - the host (LUbuntu): curl 192.168.122.1:8000
  - from the LUbuntu host the cirros nested VMs are also reachable: ping 192.168.122.X

Network settings: Edit / Connection Details / Virtual Networks

Command line tools:
virsh list --all
virsh net-list

7. Change virtual network mode to "host only" in virt-manager
- for cirros images change NICs to "net1" that provides internal and host only networking
- restart cirros VMs
- check networking afterwards:
    - IP addresses from 192.168.100.X, virbr1 on the LUbuntu host
    - no outbound traffic allowed
    - traffic is allowed only between VMs and the LUbuntu host
    - even the default gw is not set (route -n)

8. Change virtual network mode to "bridged" in virt-manager
- for cirros images change NICs to "enp0s8:macvtap" that provides bridged networking
- restart cirros VMs
- check networking afterwards:
    - IP addresses from 192.168.56.X, from the VBox Host-only network
    - cirros guest - LUbuntu host communication is blocked, and outbound traffic also blocked
    - only guest VMs can communicate, the LUbuntu host is excluded from the social event...

To allow host-guest communication use the following commands on the LUbuntu host:

```
brctl addbr br0
brctl addif br0 enp0s8
ip address flush enp0s8 scope global
ifconfig br0 192.168.56.101/24
```

At cirros NIC: Specify shared device name / Bridge name: br0
communication with other host on the subnet e.g. 192.168.56.1 is still blocked

9. Network performance: virtio vs non-virtio driver
Stop cirros VMs, and start up debian VMs
debian7 NIC is set to virtio
debian7-clone is set to e1000
login: root/root

start iperf server on LUbuntu: iperf -s
measure the bandwidth from debian7 and debian7-clone:

```
iperf -c 192.168.122.1
```