

# VLBI SysMon Node

## 1) Used machines

- The used machines are: [Supermicro X7DWT/X7DWT-INF/X7DWT-INF+](#) with two boards in one one-height slot
- [User Manual](#)

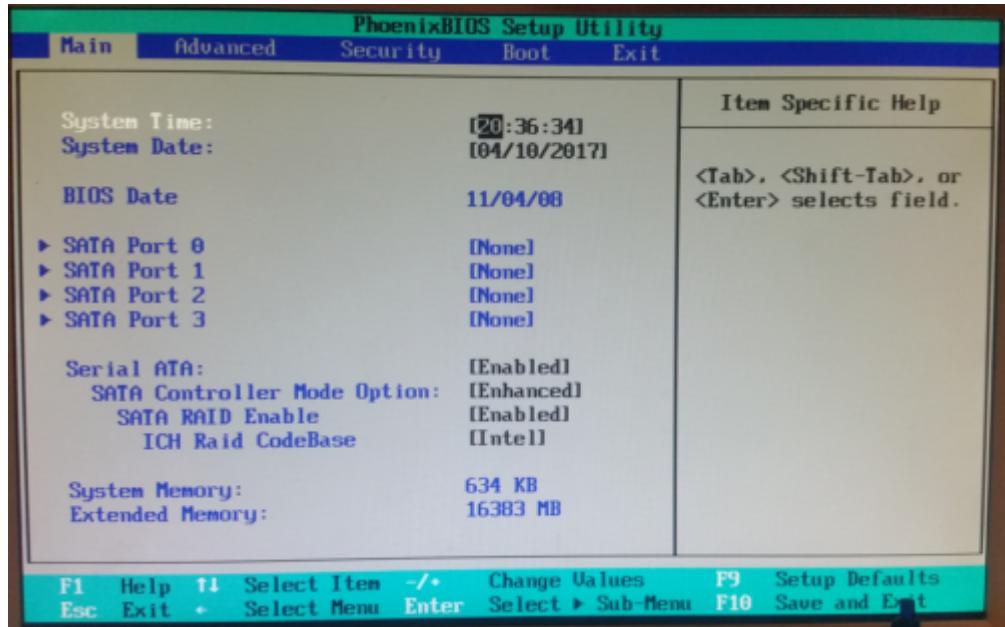


- The completely installed SysMon server looks like this:
- Both computers must be configured in the same way
  - The first is for the internal management (local telescopes)
  - The second is for the external management (other telescopes etc.)

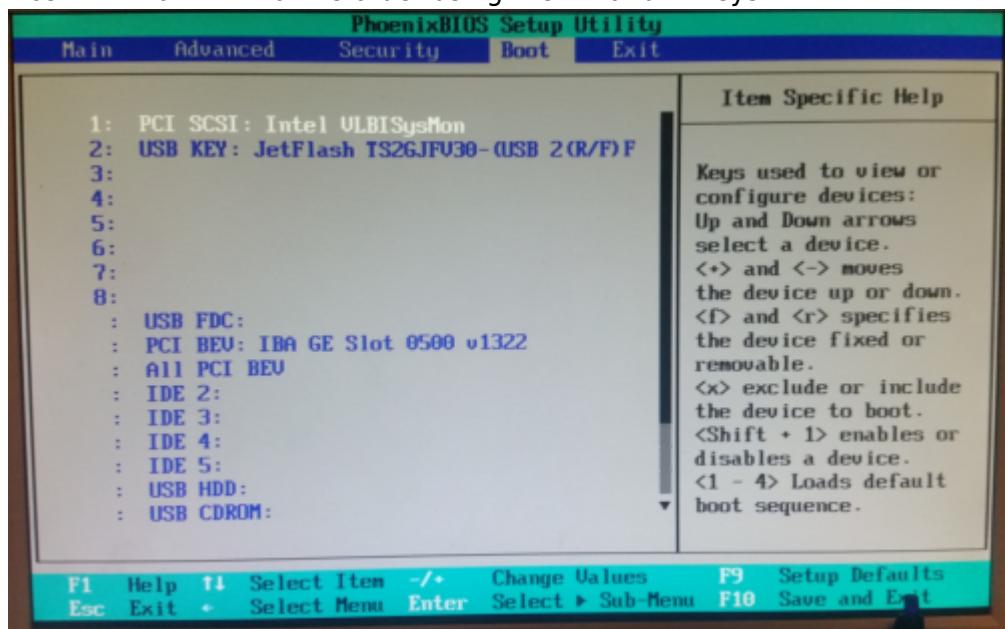


## 2) Setup the BIOS

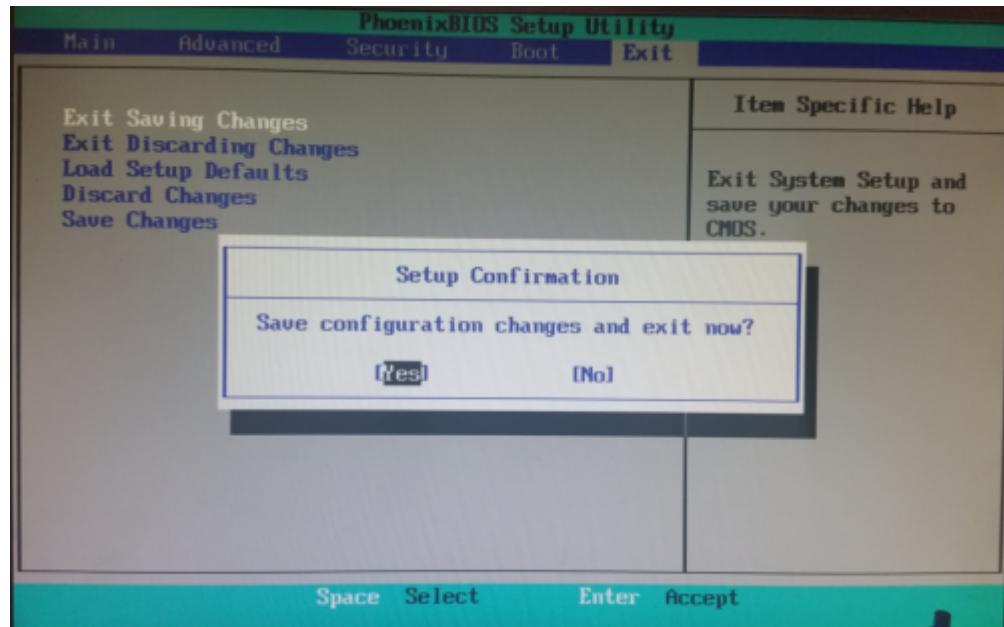
- Open BIOS by pressing “DEL” after startup of the computer
- **Attention: an English keyboard style is used for the following configuration!!!**
- Activate the RAID system in the BIOS
  - See [User manual](#)
  - Enable SATA in the “Main” screen of the BIOS system:
    - “Serial ATA: Enabled”
    - “SATA Controller Mode Option: Enhanced”
    - “SATA RAID Enable: Enabled”
    - “ICH Raid CodeBase: Intel” (we use an Intel ESB2 RAID controller)



- Set the right boot order
  - Change into “Boot” screen of the BIOS system using the arrow keys
  - Push “USB KEY” (maybe also “USB FDC” or other USB devices) and “ PCI SCSI: HostRAID#0 ....” into this order using the '+' and '-' keys

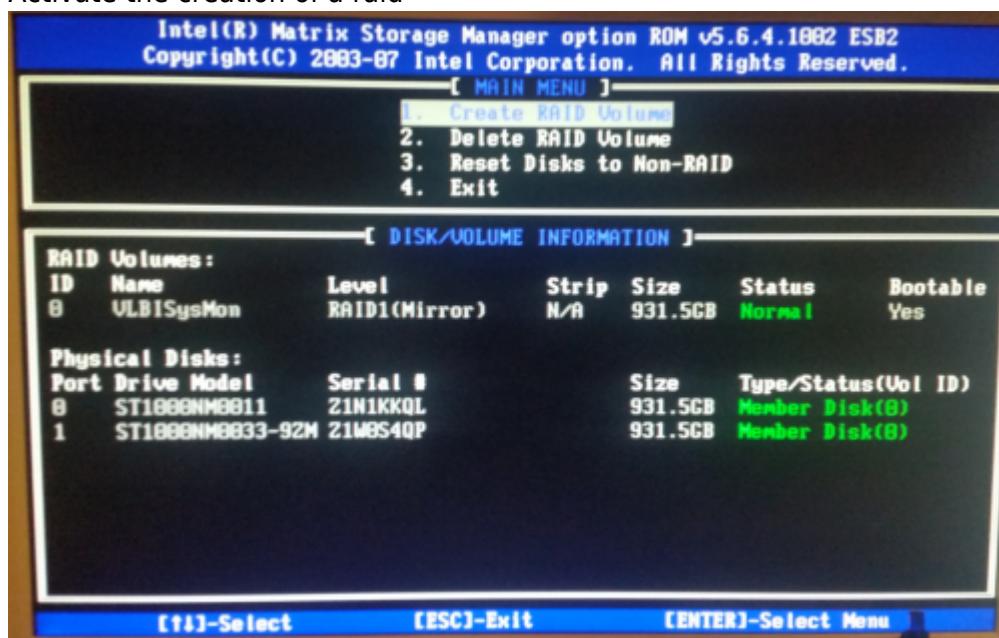


- Exit and save the configuration with all changes using the “Exit” screen



### 3) Configure the RAID 0

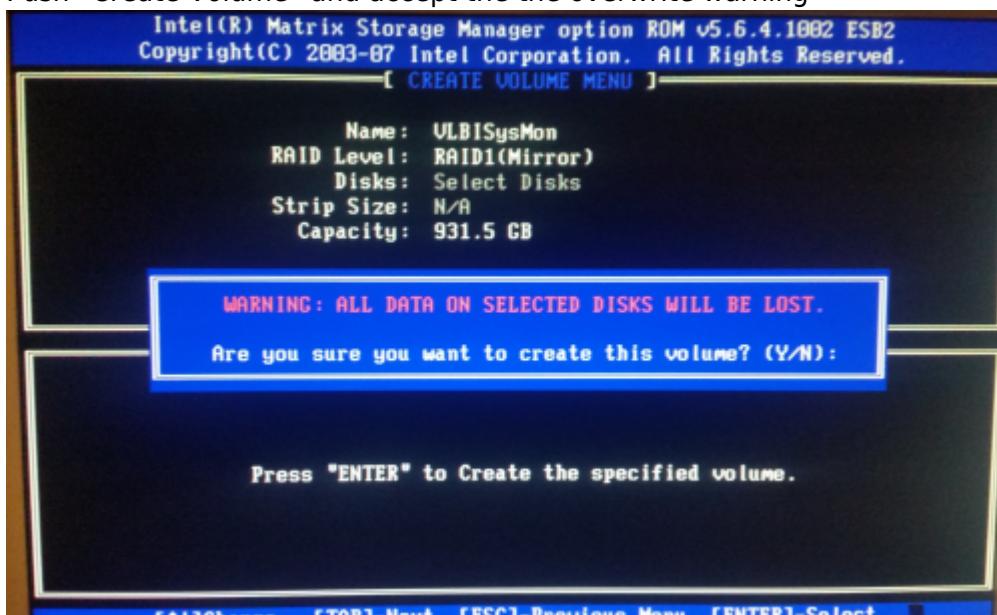
- We use two HDDs with 1TB each as RAID 1 (mirror set) for redundancy on anIntel ESB2 RAID controller.
- Attention: an English keyboard style is used for the following configuration!!!**
- Open the Intel RAID Configuration Utility using **Ctrl+I**
- Activate the creation of a raid



- Create a mirror set (RAID1) with the name "VLBISysMon" on the existing disks



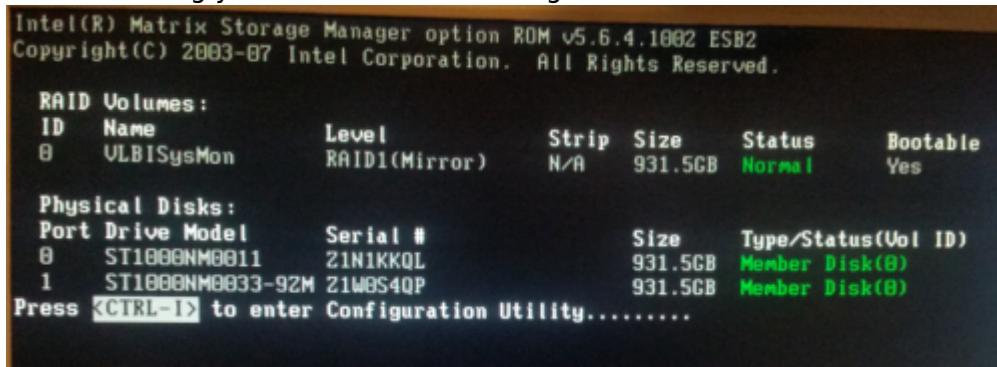
- Push “Create Volume” and accept the the overwrite warning



- Exit the configuration utility



- After rebooting you should see something like this



The screenshot shows the Intel Matrix Storage Manager option ROM interface. It displays RAID Volumes and Physical Disks. A message at the bottom says "Press <CTRL-I> to enter Configuration Utility.....".

RAID Volumes:						
ID	Name	Level	Strip	Size	Status	Bootable
0	ULBISysMon	RAID1(Mirror)	N/A	931.5GB	Normal	Yes

Port	Drive Model	Serial #	Size	Type/Status(Vol ID)
0	ST1000NM0011	Z1N1KKQL	931.5GB	Member Disk(0)
1	ST1000NM0033-92M	Z1WBS4QP	931.5GB	Member Disk(0)

Press <CTRL-I> to enter Configuration Utility.....

## 4) Download Ubuntu and install the ISO on a datastick

### Methode Windows PC and LinuxLive USB Creator

- Download Ubuntu from <https://www.ubuntu.com/download/desktop> on a separate machine, e.g. a Windows PC
- You will get an ISO-image of the installation
- Download “**LinuxLive USB Creator**” from  
<https://www.heise.de/download/product/linuxlive-usb-creator-90060> (do not use UNetbootin because it has some failures with 64-bit Linux/Ubuntu systems; see <http://askubuntu.com/questions/544419/cant-run-a-fresh-install-of-ubuntu-14-10-shows-kernel-p-anick>)
- Install LinuxLive USB Creator by double click on the installer program and follow the installation instructions
- Start the program LinuxLive USB Creator and create a Linux USB-stick (a detailed instruction can be found here:  
<https://www.lidux.de/anleitungen/37-ubuntu-1210-usb-stick-installieren-creator>)
  - Select the USB-stick on which the image should be installed
  - Select the ISO image of the Linux system
  - Select no “PERSISTENZ”
  - Select the formatting of the stick with FAT32
  - Click on the flash sign to start the installation



- The installation is finished after you see:
- 
- Close the program and dismount the USB-stick

### **Methode copying the Ubuntu image on a stick**

Ubuntu CD and DVD images can now be written directly to a USB stick, which is a very easy way to make a bootable USB stick.

- Simply choose a CD or DVD image that will fit on your USB stick and copy it on a stick with no partitions.

```
#sudo cp ubuntu-17.04-desktop-i386.iso /dev/sdc
```

- Further informations:

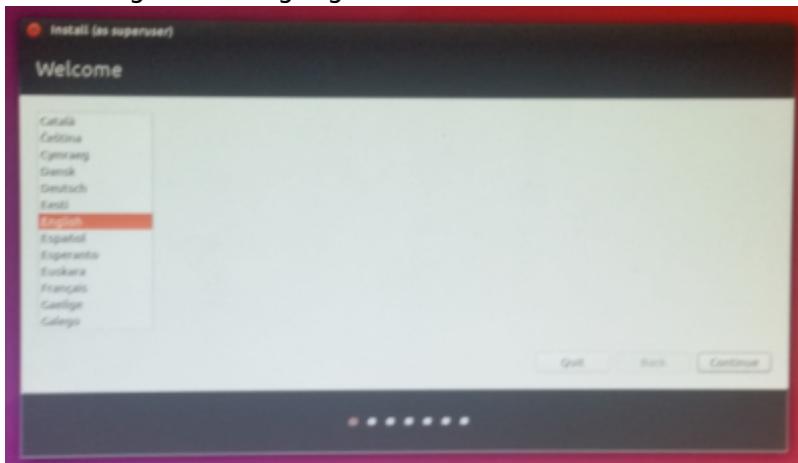
<https://help.ubuntu.com/16.04/installation-guide/amd64/ch04s03.html#usb-copy-isohybrid>

## 5) Install Ubuntu on the SysMon machine

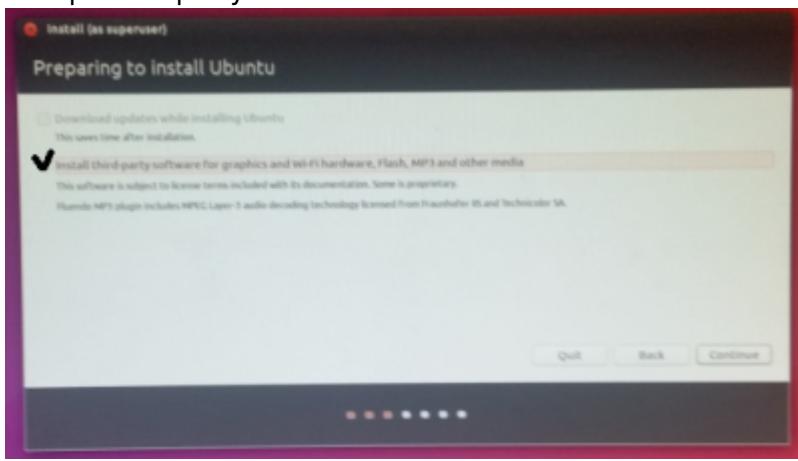
- Insert the stick into a free USB slot
- To connect keyboard and mouse, you need an USB hub, because Supermicro X7DWT just has two USB ports



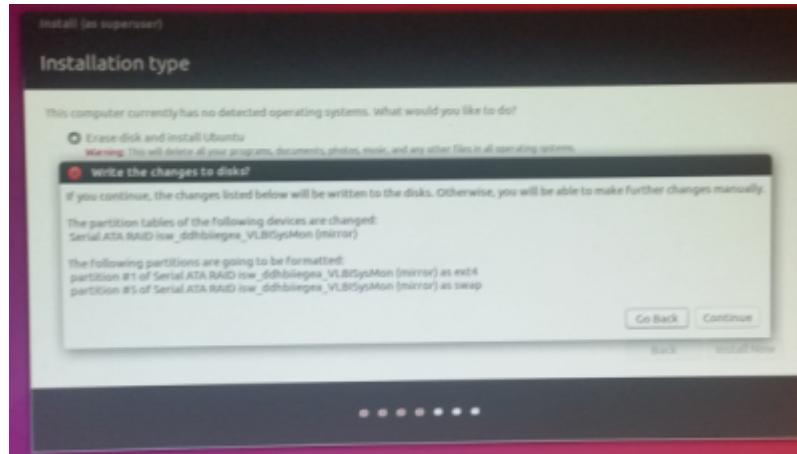
- Start the PC and select “Install Linux” when prompted
- Select English as language



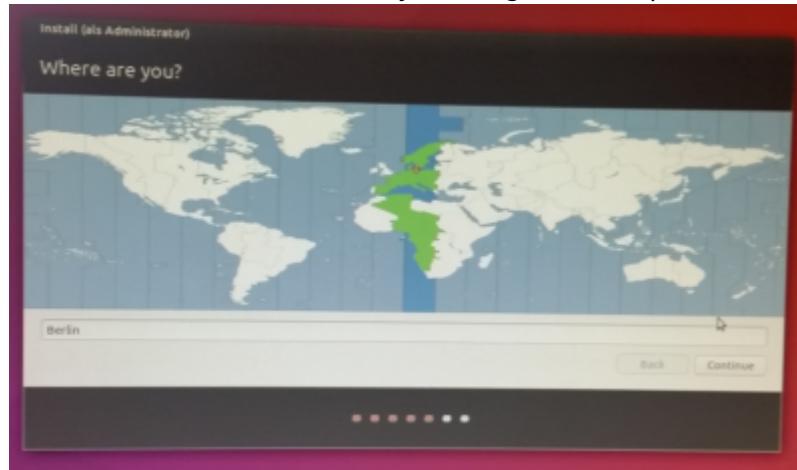
- Accept third-party software



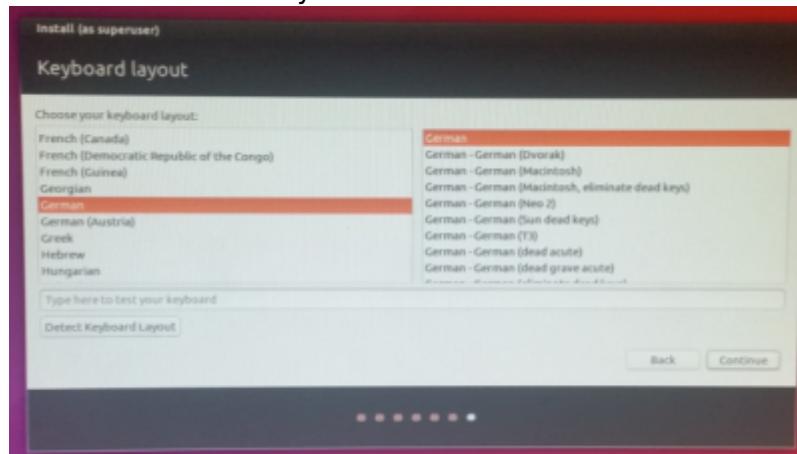
- Select the standard setting “Erase disk and install Ubuntu”. Accept the partitioning request.



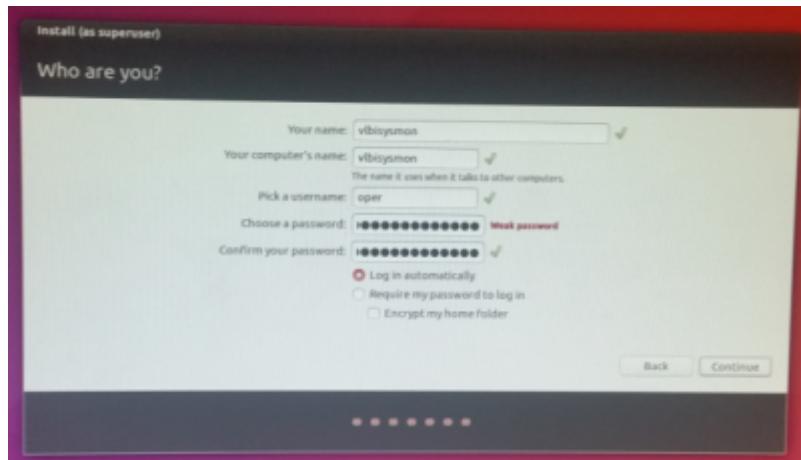
- Select “Berlin” as timezone by clicking onto the position of Berlin on the map



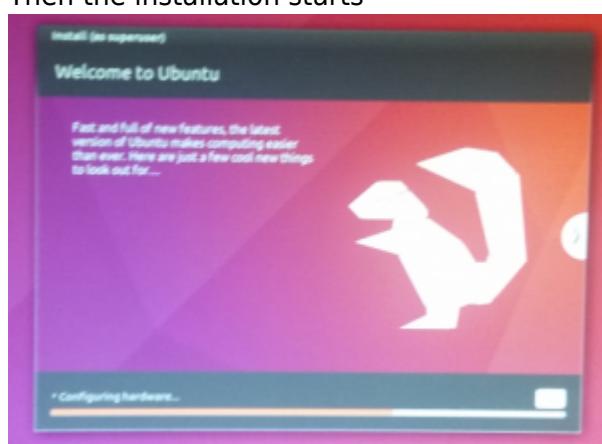
- Select the German keyboard



- Create a the personalization with computer name and your name as “vlbisysmon” and a user “oper” with a dedicated password and select the auto-login.



- Then the installation starts



- Reboot the system and keep the USB-stick in the USB-slot
- Reboot with the live system on the stick (Start Linux from the stick)
- Follow the installation of the GRUB bootloader on the RAID (see [https://wiki.ubuntuusers.de/GRUB\\_2/Reparatur/](https://wiki.ubuntuusers.de/GRUB_2/Reparatur/) (German)) for a standard desktop system
  - Open a terminal (search “term” in the programs)
  - Become root

◦ `sudo su`

- Mount the RAID to /mnt

- `mount /dev/mapper/isw_ciaeibbja_VLBISysMon1 /mnt`  
     (isw stands for Intel Raid Controller; "ciaeibbja" can be a different string)

- You can check the RAID (other checks can be found here:  
<https://www.pilgermaske.org/2013/05/dmraid-mainboard-raid-unter-linux-einrichten/> (German))

- `lsblk`

- Mount the required directories for the GRUB installation

- `sudo mount -o bind /dev /mnt/dev`  
`sudo mount -o bind /sys /mnt/sys`  
`sudo mount -t proc /proc /mnt/proc`  
`cp /proc/mounts /mnt/etc/mtab`

- Change into root environment of the installed system on the RAID

```
• chroot /mnt /bin/bash
```

- Install GRUB (**Attention: the RAID must be used and not a partition on the RAID; this is defined by the device path without an ending number ⇒ not ...\_VLBISysMon1, but ...\_VLBISysMon**)

```
• grub-install /dev/mapper/isw_ciaaeibbja_VLBISysMon
```

```
root@ubuntu:~# grub-install /dev/mapper/isw_dgdgghheaf_VLBISysMon
Installing for i386-pc platform.
• Installation finished. No error reported.
```

- Update GRUB

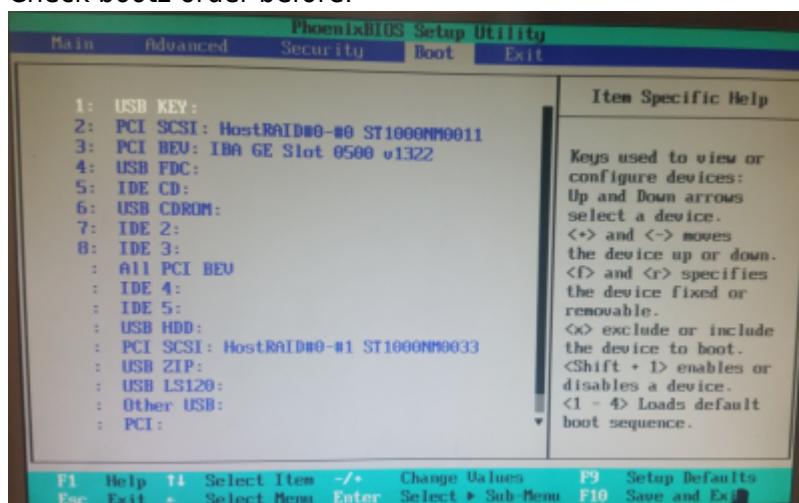
```
• update-grub
```

```
root@ubuntu:~# update-grub
Generating grub configuration file ...
Warning: Setting GRUB_TIMEOUT to a non-zero value when GRUB_HIDDEN_TIMEOUT is set is no longer supported.
Found linux image: /boot/vmlinuz-4.8.0-36-generic
Found initrd image: /boot/initrd.img-4.8.0-36-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
done
```

- Exit the changed root privileges

```
• exit
```

- Reboot the system and extract the USB-stick, so that the system boots from the harddrives. Check bootz order before.



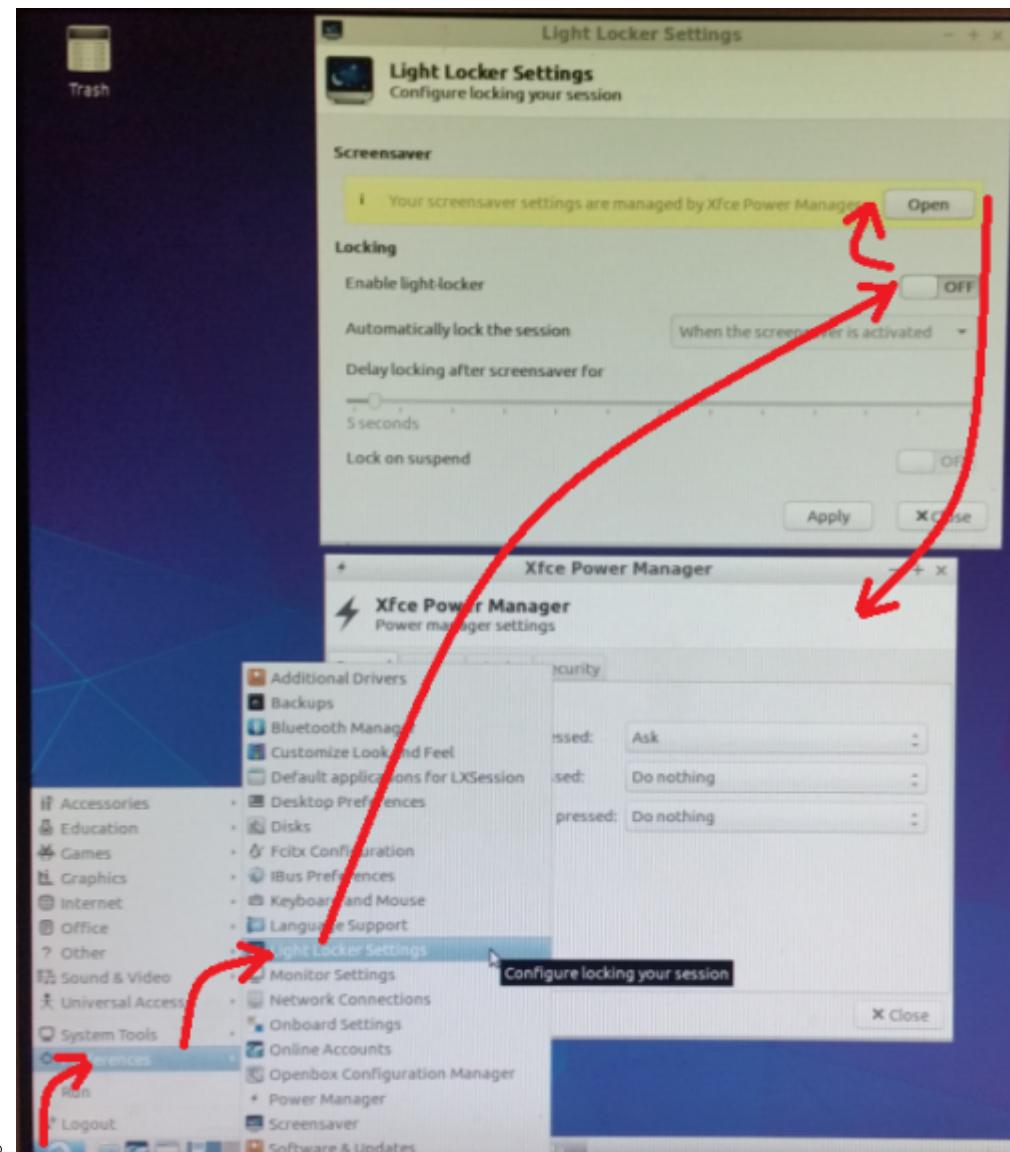
- Open a terminal and become root again

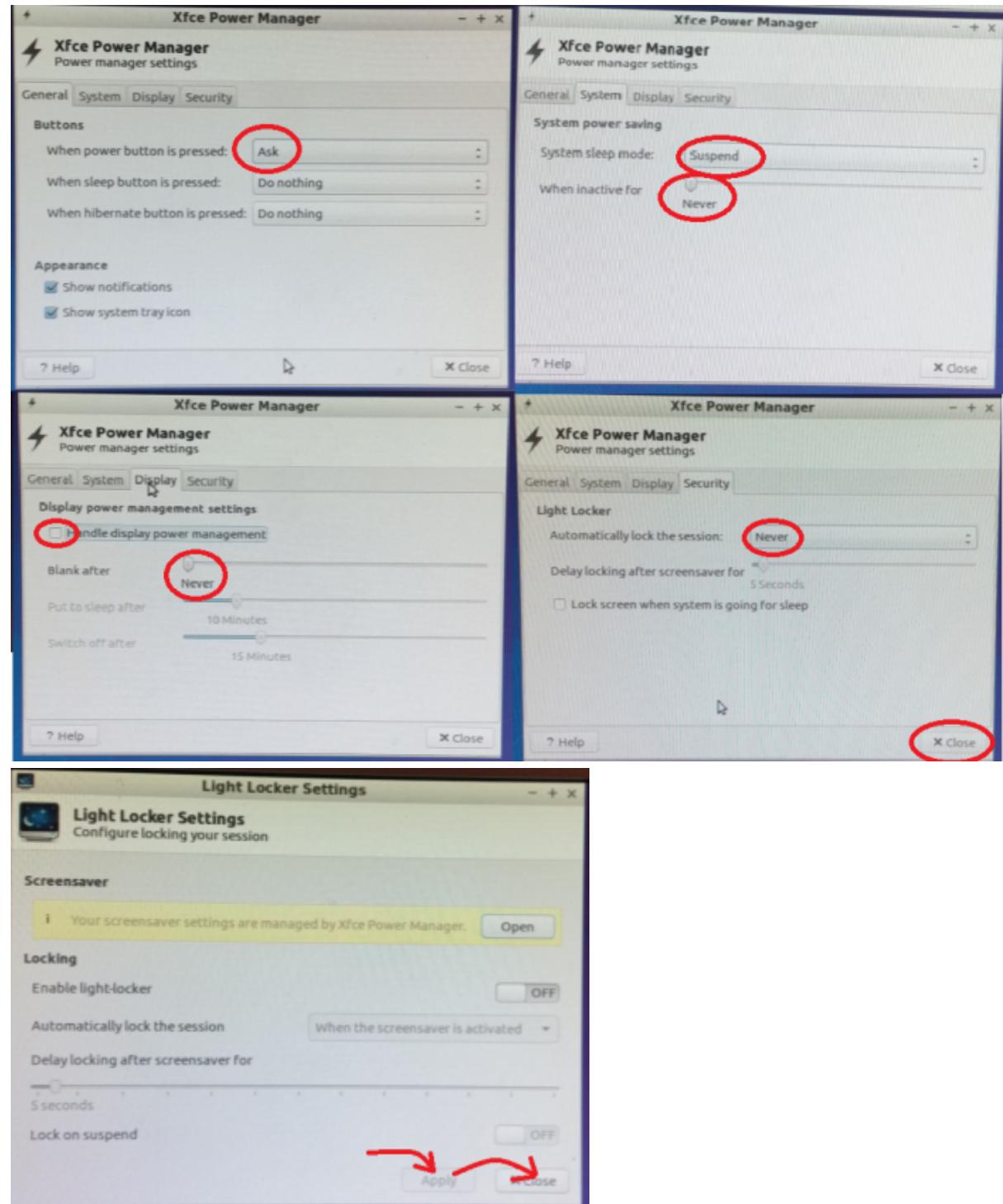
```
• sudo su
```

- If necessary, set a APT-proxy with "cat > /etc/apt/apt.conf", where the following must be entered (finish with "Ctrl+C")

```
• Acquire::http::Proxy "http://gate-w.wettzell.ifag.de:8000";
```

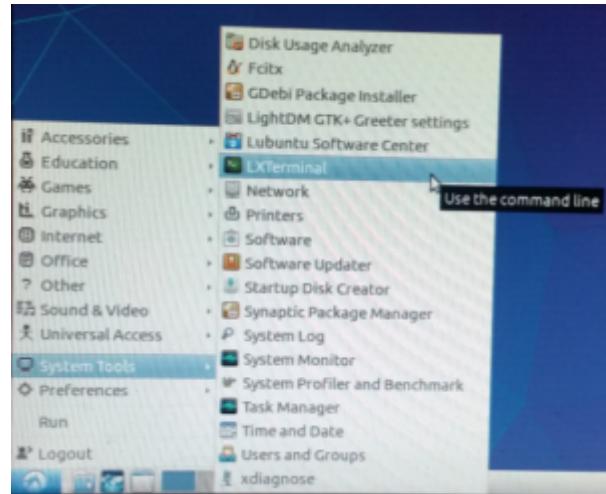
- Update package information
  - `apt-get update`
- **Downgrade the desktop environment from “Unity” to a lightweight one, e.g. “LXDE (Lightweight X11 Desktop Environment)”,** (it is still possible to change the environment after log-out and clicking onto the Ubuntu logo over the user login)
  - with “`sudo apt-get install lubuntu-desktop`”
  - and set it as default environment:
    - check which environments are available with “`ls /usr/share/xsessions/`” and if `Lubuntu.desktop` exists and
    - edit the default settings file with “`vi /usr/share/lightdm/lightdm.conf.d/50-ubuntu.conf`” as root and change it to
    - `[SeatDefaults]`  
`user-session=Lubuntu`
- Reboot
- (Maybe it is necessary to change “update-apt-xapi”-settings, which updates the software database regularly and takes a lot of CPU time)
- **Set all parameters in the screensaver** in the menu **Start menu → Preferences → Light Locker Settings** and follow the instruction in the images below



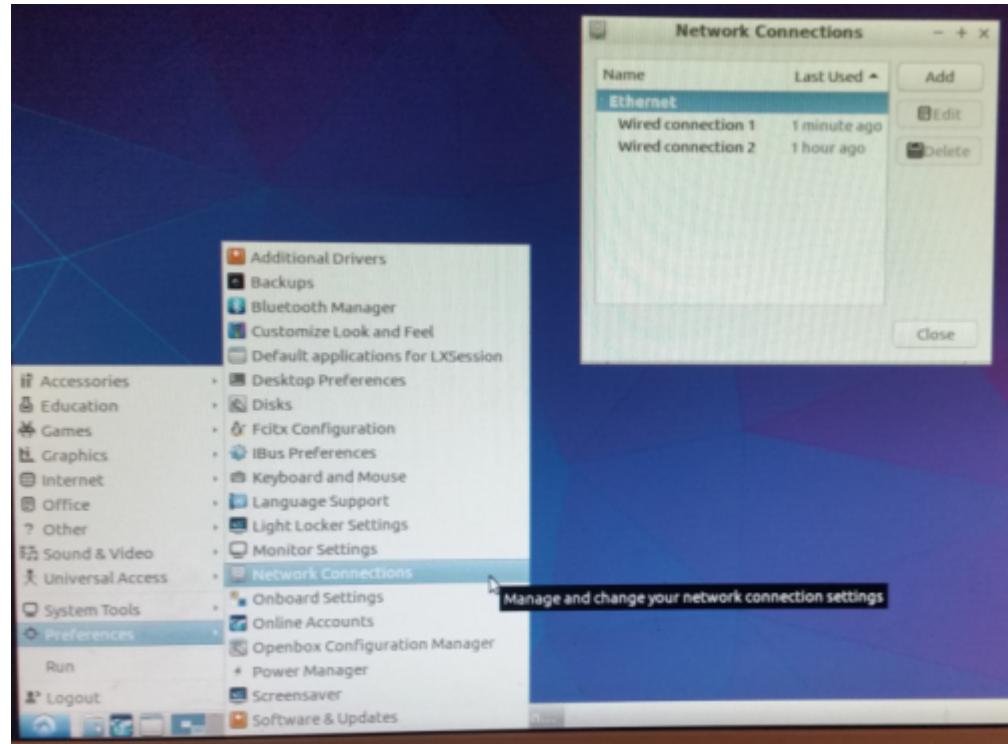


- Set the network

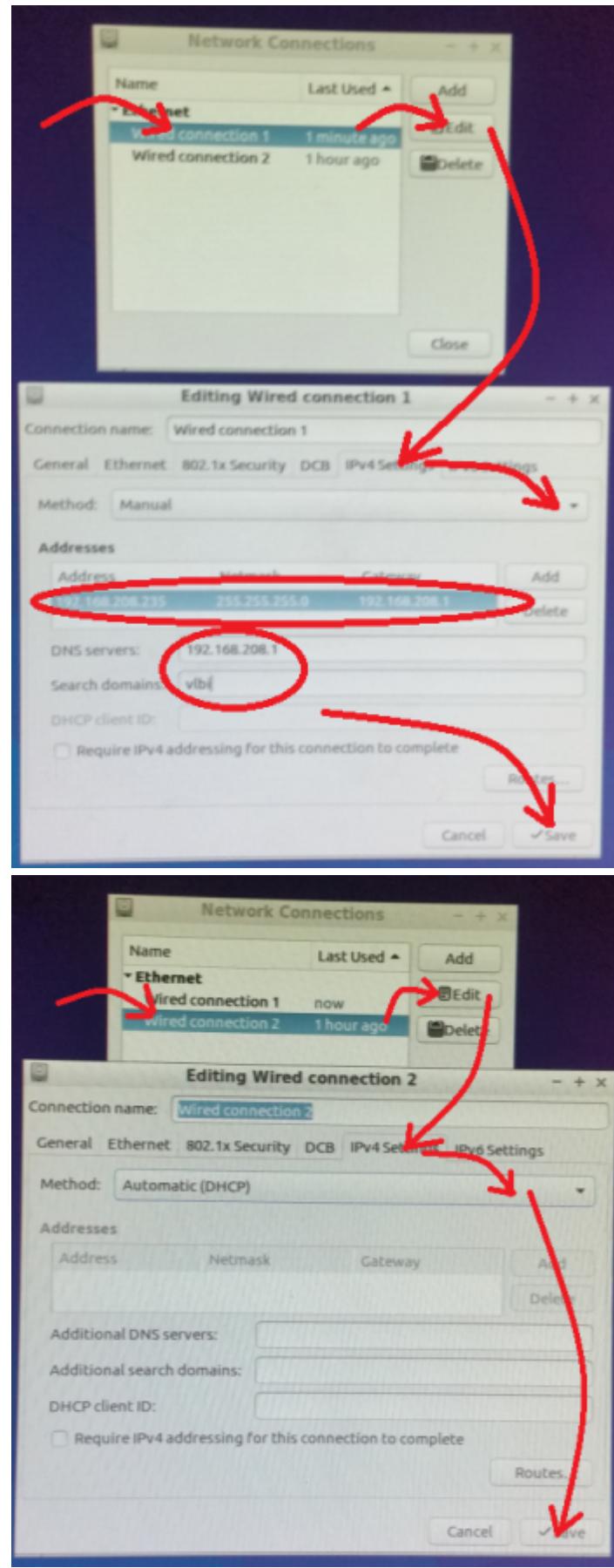
- Open a terminal (“LXTerminal”) using the start menu



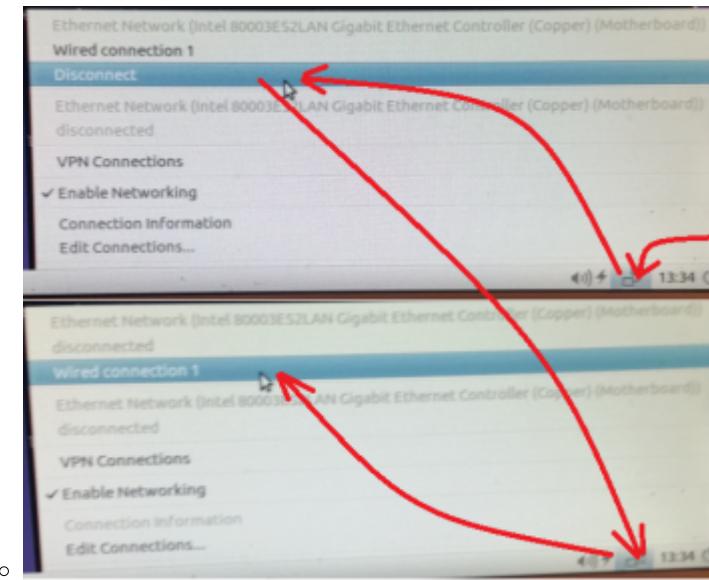
- Become root with “`sudo su`”
- Set hostname if not already correct: “`vi /etc/hostname`” and set it to “`vlbisysmon`”
- Open the “Network Connections” dialog (under the LXDE (Lightweight X11 Desktop Environment) it is in the **Start menu → Preferences → Network Connections**)



- Each server has two network interfaces. The first one gets a static IP setting with an fixed IP from the IP-table (see [IP-addresses of the "vlbi" network](#)) and the second gets a DHCP setting (this can be let as it is in the standard installation)



- Disconnect the wired connection and connect again



- Check the correct settings using "ifconfig" in a terminal

```
root@vlbisysmon: /home/oper
File Edit Tabs Help
TX packets:5949 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1
RX bytes:594678 (594.6 KB) TX bytes:594678 (594.6 KB)

root@vlbisysmon:/home/oper# ifconfig
enp5s0f0 Link encap:Ethernet HWaddr 00:30:48:c6:62:d6
inet addr:192.168.208.235 Bcast:192.168.208.255 Mask:255.255.255.0
inet6 addr: fe80::c9c8:6eb8:204a:1897/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:253278 errors:0 dropped:0 overruns:0 frame:0
TX packets:126280 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:349824597 (349.8 MB) TX bytes:8961190 (8.9 MB)
Interrupt:27 Memory:d80020000-d8040000
```

#### • Set clock to UTC (GMT+0)

- First set the time and timezone in the desktop with **Start menu → System tools → Time and Date**
- Set hardware clock to UTC (as user "root"): "`vi /etc/default/rcS`" and set line "`UTC=yes`"
- Run "`timedatectl set-local-rtc 0`"
- Set localtime to GMT+0: "`rm /etc/localtime`" and "`ln -s /usr/share/zoneinfo/Etc/GMT+0 /etc/localtime`"
- Check it with "`timedatectl`". You should see something like this:

```
root@vlbisysmon:/home/oper# timedatectl
  Local time: Do 2017-04-13 12:04:29 GMT
  Universal time: Do 2017-04-13 12:04:29 UTC
    RTC time: Do 2017-04-13 12:04:29
   Time zone: Etc/GMT+0 (GMT, +0000)
 Network time on: yes
 NTP synchronized: yes
      RTC in local TZ: no
```

#### • Activate NTP

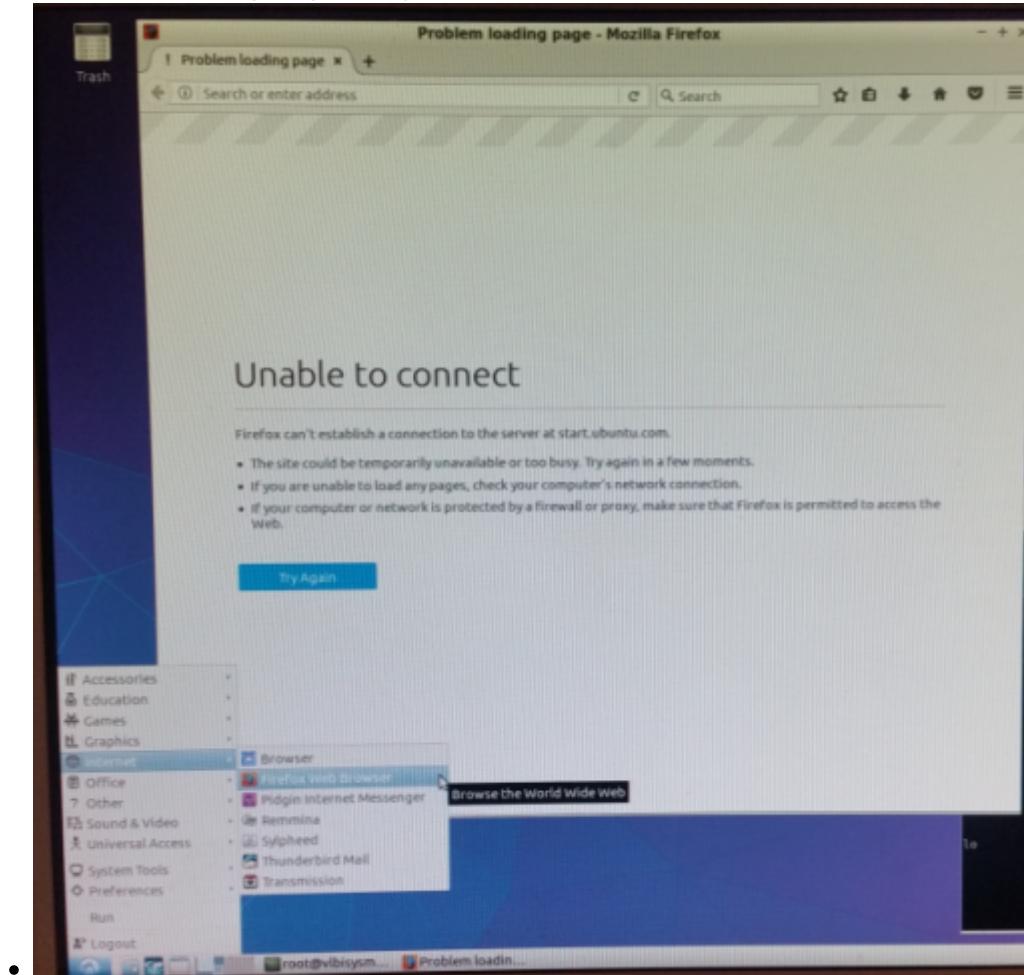
- `"apt-get install ntp"`
- `"apt-get install ntpdate"`
- Set local NTP servers for "`ntpdate`": "`vi /etc/default/ntpdate`"
  - Set line "`NTPSERVERS= "192.168.208.4 192.168.208.5""` (delete the existing `NTPSERVERS` line)
- Set local NTP servers for "`ntpd`": "`vi /etc/ntp.conf`"
  - Set line "`server 192.168.208.4`"
  - Set line "`server 192.168.208.5`"
  - Set all existing server lines as comments (starting '#')
  - Set all existing pool lines as comments (starting '#')
- Set current time once
  - `" /etc/init.d/ntp stop"`

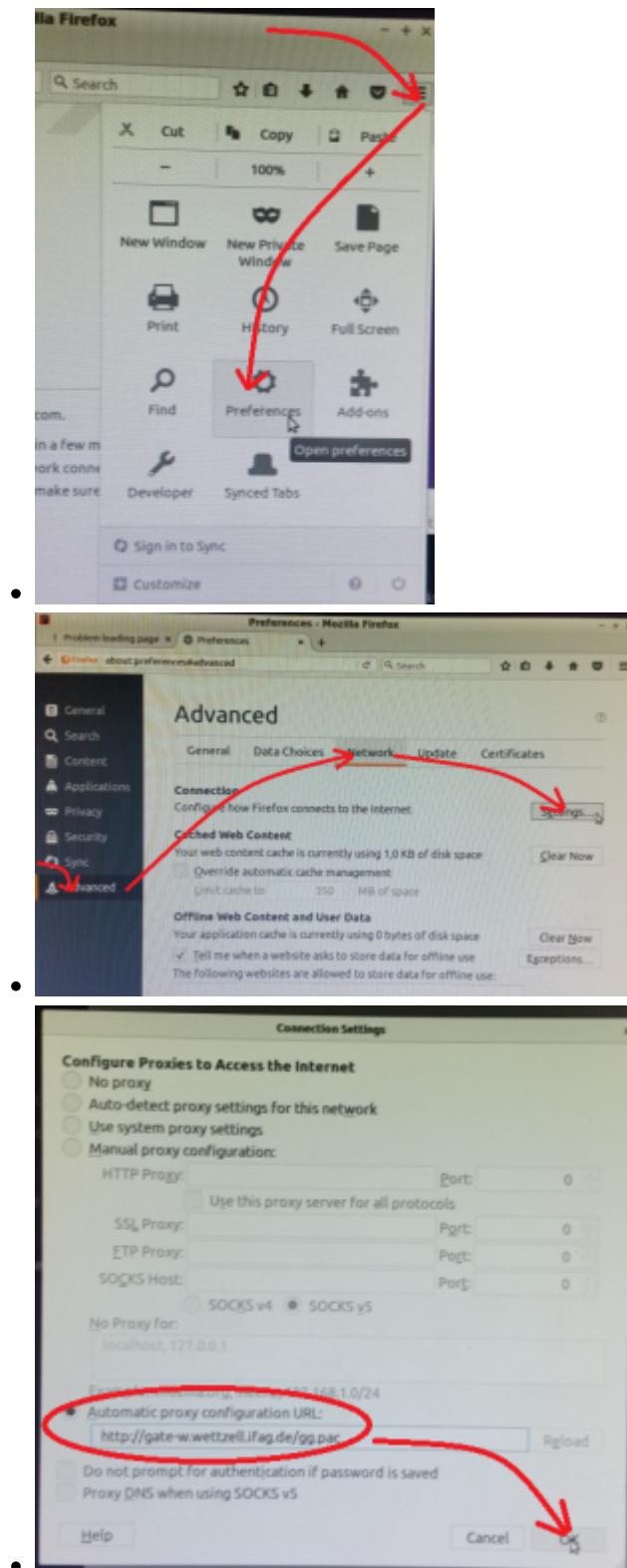
- “`ntpdate -s 192.168.208.4`”
- “`/etc/init.d/ntp start`”
- Check NTP status
  - “`ntpq -p`”

## 6) Customize Linux software for system monitoring

### 6.1) Firefox browser

- Add “Automatic proxy configuration URL” in the Firefox internet browser





- If another browser should also be used, do the same setting there.

## 6.2) SSH server

- Install a SSH server with “`apt-get install ssh`” (or as minimum “`apt-get install openssh-server`”)
- Install “`autossh`” to automatically restart SSH sessions and tunnels with “`apt-get install autossh`”
- Hint: Getting X11 forwarding through ssh working after running su**
  - Run “`xauth list $DISPLAY`” to get the cookie of the SSH connection, e.g.  
“`somehost.somedomain:10 mit-magic-cookie-1 4d22408a71a55b41ccd1657d377923ae`”

- Change user with “*sudo su*”
- Run “*xauth add <<cookie>>*”, e.g. “*xauth add somehost.somedomain:10 mit-magic-cookie-1 4d22408a71a55b41ccd1657d377923ae*” to add the forwarding cookie to the new user
- Create an SSH key for user “oper”, using “*ssh-keygen -b 4096*” and save it to file “*vlbisysmonoper*” (

vlbisysmonoper.zip

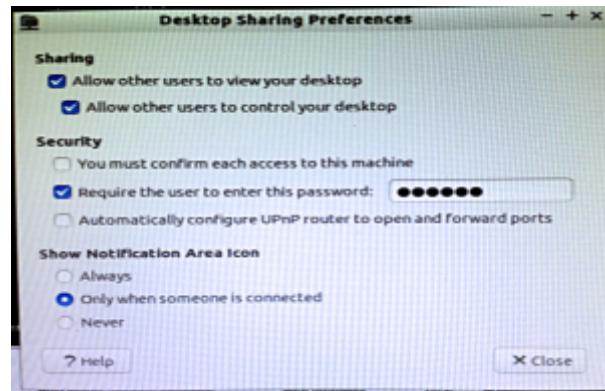
)

```
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa): vlbisysmonroot
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in vlbisysmonroot.
Your public key has been saved in vlbisysmonroot.pub.
The key fingerprint is:
SHA256:q99jHH06xLDpH7PMDZPCdvjr8zCqQV10048ZW/+esiI root@vlbisysmon
The key's randomart image is:
+---[RSA 4096]---+
| . o .
| . .o |
| . *o |
| . + o |
| ... . |
| S . * . |
| . o+.+.. . |
| oo=oXo .. |
| . E=O+@ .. |
| ..oo++X*= |
+---[SHA256]---+
```

- Install the new key file “*ssh-copy-id -i vlbisysmonoper.pub oper@192.168.208.236*”
  - The new key is installed at “*/home/oper/.ssh/authorized\_keys*”
  - Permit password authentication by editing “*/etc/ssh/sshd\_config*” and activate the following line with “no”
- ```
51 # Change to no to disable tunneled clear text passwords
52 PasswordAuthentication no
```
- Restart ssh daemon with “*/etc/init.d/ssh restart*”
  - From now on login is only possible using “*ssh -X -i vlbisysmonoper oper@192.168.208.236*”
  - Note: If you want to use the key with Putty on Windows, you have to use the program “puttygen” to convert the key to a \*.ppk file in the Putty format. Open “puttygen” and follow the menu “File” ⇒ “Load private key” and open the private key generated before. It converts the key. Save the new key by pushing on the button “Save private key” and store it as “*vlbisysmonoper.ppk*”. Then open Putty and create a new connection. Open the menu “SSH” ⇒ “Auth” and add the new private key in \*.ppk format.

### 6.3) Vino VNC server

- Configure the “Desktop Sharing Preferences” by calling “*vino-preferences*” as user “oper” (define a VNC password: here “+oper!”)



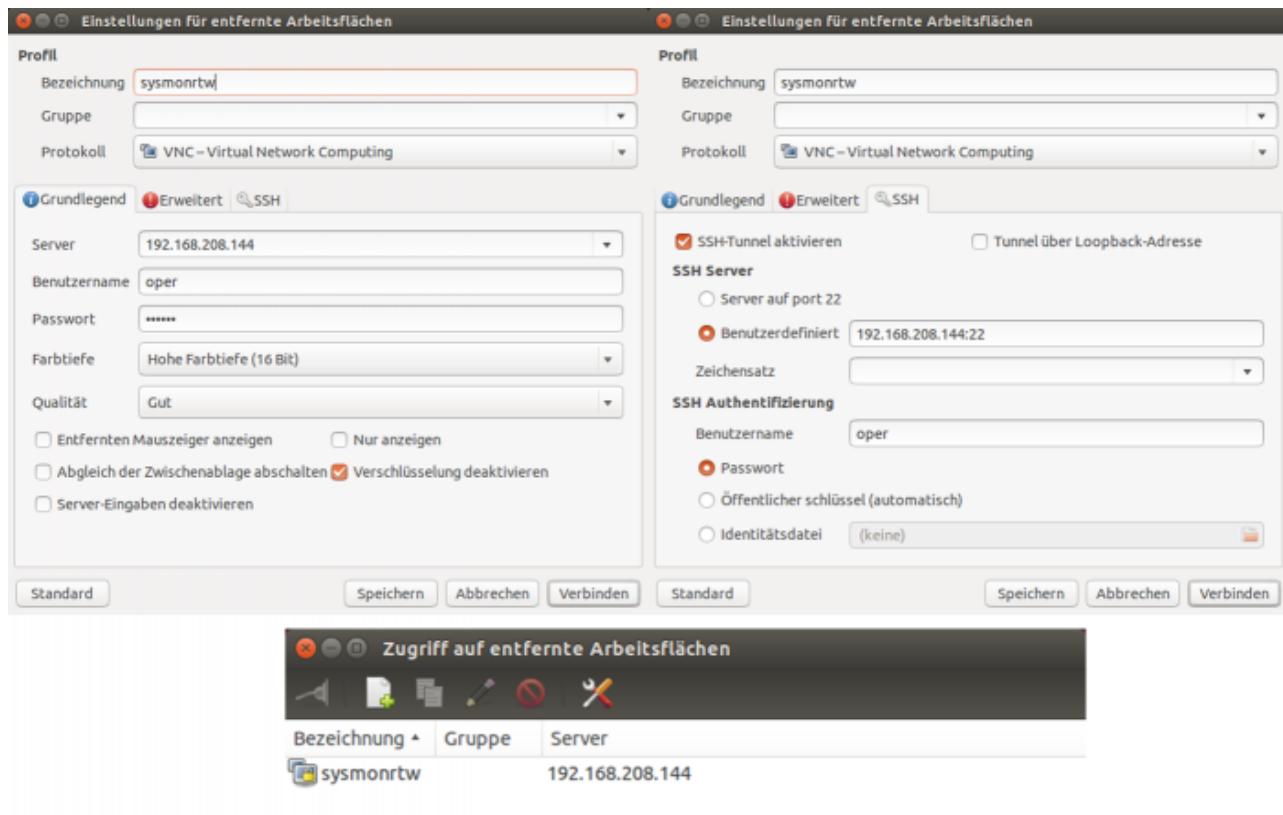
- Disable encryption, to easily allow the access with all VNC clients, with “`gsettings set org.gnome.Vino require-encryption false`”
- Create a new directory (if not yet available) as user “oper”: “`mkdir /home/oper/Software` ” and “`mkdir /home/oper/Software/vino_vnc` ”
- Change into the new directory with “`cd /home/oper/Software/vino_vnc` ”
- Create a start script “`vinovnc.sh`” with an editor in the new folder and add the following content:

```
• #!/bin/bash
  /usr/lib/vino/vino-server > /dev/null 2> /dev/null &
```

- Change the access rights of the new script with “`chmod 744 ./vinovnc.sh` ”
- Create a desktop starter file with “`vi /home/oper/.config/autostart/vinovnc.desktop` ” and add the following context (it can also be created with the program “lxshortcut”):

```
• [Desktop Entry]
  Type=Application
  Name=Vino VNC server
  Comment=Automatic start of the VINO VNC server
  Exec=/home/oper/Software/vino_vnc/vinovnc.sh
  Terminal=false
```

- Test the automatic start: log-out and -on again, which should start the application (test it with “`ps ax | grep vino`”)
- The VNC Ports are: **5800** and **5900**
- An example configuration of a remote VNC client can look like the following setup for the Ubuntu “Remmina Remote Desktop Client” (similar settings can also be used for other VNC clients, like “Real VNC” under windows or xvnc4viewer under Linux; just if a tunneling is required, it must be set manually, using a separate SSH client)



## 6.4) Editor geany

- Install geany using the command “`apt-get install geany`”

## 6.5) GNU g++ compiler

- Install g++ using the command “`apt-get install g++`”

## 6.6) Subversion

- Install Subvserion as root with “`apt-get install subversion`”

## 6.7) PostgreSQL 9.5

- “`apt-get install postgresql-9.5`”
- The PostgreSQL database is then at “`/var/lib/postgresql/9.5/main`”
- The PostgreSQL configuration is then at “`/etc/postgresql/9.5/main/postgresql.conf`” (to find the current location of the configuration file use “`ps ax | grep postgres`”, which prints the complete calling arguments of the server including the “config\_file” parameter, e.g. “`/usr/lib/postgresql/9.5/bin/postgres -D /var/lib/postgresql/9.5/main -c config_file=/etc/postgresql/9.5/main/postgresql.conf`”)
- Enable remote access
  - “`vi /etc/postgresql/9.5/main/postgresql.conf`” and enable “`listen_addresses = 'localhost'` and “`port = 5432`”
  - “`vi /etc/postgresql/9.5/main/pg_hba.conf`” and enable “`host all all 127.0.0.1/32 trust`”

```

    o  # Database administrative login by UNIX sockets
      local  all      postgres          trust
      # TYPE  DATABASE   USER      CIDR-ADDRESS      METHOD
      # "local" is for Unix domain socket connections only
      local  all      all               trust
      # IPv4 local connections:
      host   all      all      127.0.0.1/32       trust
      # IPv6 local connections:
      host   all      all      ::1/128           trust
      # Zabbix database access
      local  zabbix  zabbix          md5

```

- Restart PostgreSQL with “`/etc/init.d/postgresql stop`” and “`/etc/init.d/postgresql start`” (“`/etc/init.d/postgresql-8.4 restart`” my not work correctly)
- Test the connectivity with “`psql -h 127.0.0.1 -p 5432 postgres postgres`” (quit with Ctrl-D)
- For the programming [simple\\_psqlquery](#) can be used
- Further documentation can be found on <http://www.postgresql.org/docs/9.5/static/index.html>
- Install the PostgreSQL library for the compiler using “`apt-get install libpq-dev`”

## 6.8) Wettzell System Monitoring Software (SysMon)

- The software can be found on the Wettzell Subversion repository  
<http://xsamba.wtz/svn/vlbi/trunk/code/vlbisysmon/>
- Create a directory “Software” in the home directory of the user oper with “`mkdir /home/oper/Software`”
- Change into the new directory and fetch the SysMon source with the Subversion command “`svn co http://xsamba.wtz/svn/vlbi/trunk/code/vlbisysmon/`”
- Connect to PostgreSQL using “`psql -h 127.0.0.1 -p 5432 postgres postgres`” (quit with Ctrl-D)
- Create role and database:
  - “`CREATE ROLE sysmon ENCRYPTED PASSWORD '+sysmon!' SUPERUSER NOCREATEDB NOCREATEROLE NOINHERIT LOGIN CONNECTION LIMIT 100;`”
  - “`CREATE DATABASE sysmon WITH OWNER=sysmon;`”
- Test the connectivity to the new database with “`psql -h 127.0.0.1 -p 5432 sysmon sysmon`” (quit with Ctrl-D)
- Change into directory of Wettzell SysMon software and build the individual components which you want to use
  - ```
cd /home/oper/Software/vlbisysmon/main/sysmon_sender/make
make build
cd /home/oper/Software/vlbisysmon/main/sysmon_backup/make
make build
```

## 6.8) Apache web server

- Install Apache2 as root with “`apt-get install apache2`”

## 6.9) PHP

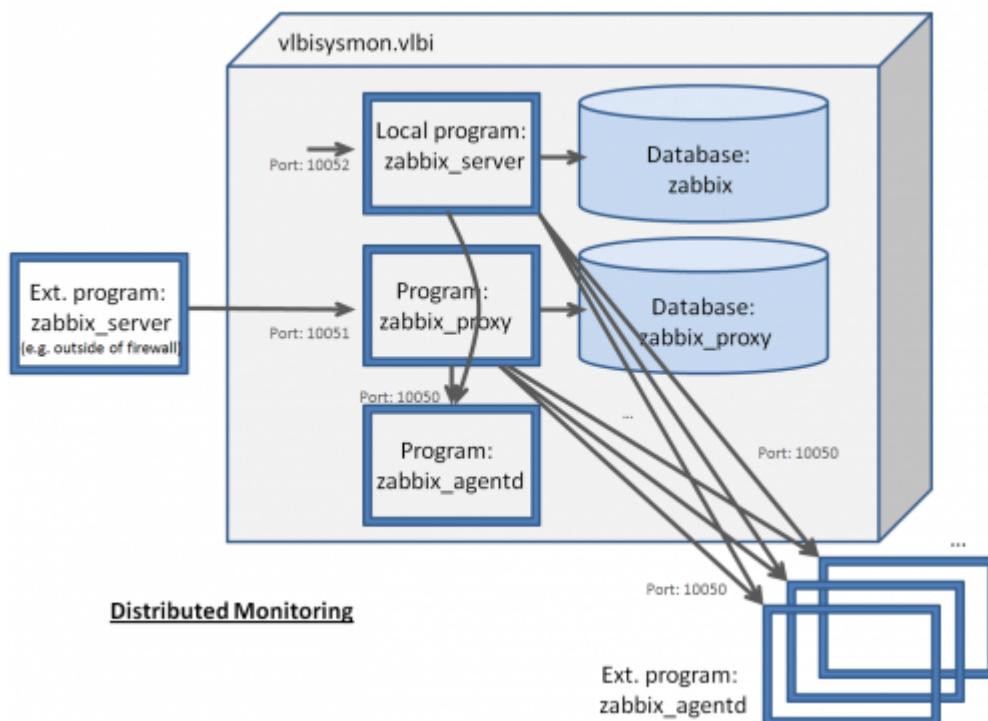
- “`apt-get install php libapache2-mod-php php-mcrypt`”

## 6.10) automake

- “`apt-get install automake`”

## 6.11) Zabbix

- Idea of a distributed monitoring concept (the map as Powerpoint file )



- A basic manual can be found here: <https://www.zabbix.com/documentation/2.2/manual>
- Install the Zabbix software using
  - “`apt-get install zabbix-server-pgsql`”
  - “`apt-get install zabbix-agent`”
  - “`apt-get install zabbix-frontend-php`”
- Create log file folders
  - “`mkdir /var/log/zabbix-server`”
  - “`mkdir /var/log/zabbix-agent`”
  - “`mkdir /var/log/zabbix-proxy`”
  - “`chown zabbix:zabbix /var/log/zabbix-server`”
  - “`chown zabbix:zabbix /var/log/zabbix-agent`”
  - “`chown zabbix:zabbix /var/log/zabbix-proxy`”
- Add “zabbix” user to “oper” group
  - `adduser zabbix oper`
- Configure the server with “`geany /etc/zabbix/zabbix_server.conf`”

- ListenPort=10052  
DBHost=localhost  
DBName=zabbix  
DBUser=zabbix  
DBPassword=zabbix  
LogFile=/var/log/zabbix-server/zabbix\_server.log  
ExternalScripts=/home/oper/Software/vlbisysmon/bin/

- Create the zabbix database after connecting with " psql -h 127.0.0.1 -p 5432 postgres postgres" (quit with Ctrl-D)

- CREATE USER zabbix WITH PASSWORD 'zabbix';  
CREATE DATABASE zabbix OWNER zabbix;

- Create the zabbix proxy database after connecting with " psql -h 127.0.0.1 -p 5432 postgres postgres" (quit with Ctrl-D)

- CREATE USER zabbix\_proxy WITH PASSWORD 'zabbix\_proxy';  
CREATE DATABASE zabbix\_proxy OWNER zabbix\_proxy;

- Download the Zabbix sources which fit to the Zabbix installation of the operating system: e.g. for Ubuntu 16.04. LTS it is Zabbix 2.4.7 (to check, start "zabbix\_server" with "DebugLevel=3" in the configuration file "/etc/zabbix/zabbix\_server.conf" and read the log file at "/var/log/zabbix-server/zabbix\_server.log", which is also defined in the configuration file of the server):

- zabbix\_3.2.4.orig.tar.gz
- or download from <http://www.zabbix.com/download.php> to the directory /home/oper/Software/ and extract the package with "tar -zxvf zabbix\_3.2.4.orig.tar.gz"

The screenshot shows the Zabbix website's download page for version 3.2. On the left, there's a sidebar with links for Product, Solutions, Services, Training, Partners, Download, Community, and About Us. The 'Download' link is currently selected. Below the sidebar, there's a 'Download' button and three links: 'Download Old Releases', 'Release Notes', and 'Templates, Modules and More'. The main content area is titled 'Zabbix Packages' and displays a table with columns: Package, Distribution, Version, Architecture, Download, and Documentation. The table shows packages for Red Hat Enterprise Linux, CentOS, Oracle Linux, Debian, and Ubuntu. The 'Ubuntu' row is highlighted with a red box. The table data is as follows:

Package	Distribution	Version	Architecture	Download	Documentation
Zabbix 3.2	Red Hat Enterprise Linux CentOS Oracle Linux	7	x86_64	<a href="#">Download</a>	
		6	i386	<a href="#">Download</a>	
		5	x86_64	<a href="#">Download</a>	
Debian	7 (Wheezy), 8 (Jessie)	i386	<a href="#">Download</a>		
		amd64	<a href="#">Download</a>		
Ubuntu	14.04 LTS (Trusty), 16.04 (Xenial Xerus)	i386 amd64	<a href="#">Download</a>		

- Change into folder /home/oper/Software/zabbix-3.2.4/database/postgresql and run (see [https://www.zabbix.com/documentation/3.2/manual/appendix/install/db\\_scripts](https://www.zabbix.com/documentation/3.2/manual/appendix/install/db_scripts)) for the server

- psql -h 127.0.0.1 -p 5432 -U zabbix zabbix < schema.sql  
# stop here if you are creating database for Zabbix proxy  
psql -h 127.0.0.1 -p 5432 -U zabbix zabbix < images.sql  
psql -h 127.0.0.1 -p 5432 -U zabbix zabbix < data.sql

- and for the proxy

- ```
psql -h 127.0.0.1 -p 5432 -U zabbix_proxy zabbix_proxy < schema.sql
```

- Restart Zabbix server process
  - “`/etc/init.d/zabbix-server stop`”
  - “`/etc/init.d/zabbix-server start`”
- Configure PHP with “`geany /etc/php/7.0/apache2/php.ini`” and restart the Apache2 server with “`/etc/init.d/apache2 stop`” and “`/etc/init.d/apache2 start`”

- ```
[Date]
; Defines the default timezone used by the date functions
date.timezone = Europe/Berlin
max_execution_time = 600
post_max_size = 32M
memory_limit = 256M
mbstring.func_overload = 0
upload_max_filesize = 16M
max_input_time = 600
```

- Create Web front-end as root
  - “`cd /var/www`”
  - “`mv /var/www/html/ /var/www/html_original`”
  - “`chown -R www-data:www-data /var/www/html_original`”
  - “`mkdir html`”
  - “`cp -R /home/oper/Software/zabbix-3.2.4/frontends/php/* ./html/.`”
  - “`chown -R www-data:www-data /var/www/html`”
  - Restart the Apache2 server with “`/etc/init.d/apache2 stop`” and “`/etc/init.d/apache2 start`”
  - Open a browser and connect to “<http://127.0.0.1>” and follow the instructions (if the configuration file cannot be saved automatically, then download it and save it at `/var/www/html/conf/`.)



**ZABBIX**

### Check of pre-requisites

	Current value	Required
PHP version	7.0.15-Ubuntu0.16.04.4	5.4.0 OK
PHP option "memory_limit"	256M	128M OK
PHP option "post_max_size"	32M	16M OK
PHP option "upload_max_filesize"	16M	2M OK
PHP option "max_execution_time"	600	300 OK
PHP option "max_input_time"	600	300 OK
PHP option "date.timezone"	Europe/Berlin	OK
PHP databases support	PostgreSQL	OK
PHP bcmath	on	OK
PHP mbstring	on	OK
PHP option "mbstring.func_overload"	off	off OK

[Back](#) [Next step](#)

Licensed under [GPL v2](#)

Zabbix 3.2.4. © 2001–2017, Zabbix SIA

**ZABBIX**

### Configure DB connection

Please create database manually, and set the configuration parameters for connection to this database. Press "Next step" button when done.

Database type	<input type="button" value="PostgreSQL ▾"/>
Database host	<input type="text" value="localhost"/>
Database port	<input type="text" value="0"/> 0 - use default port
Database name	<input type="text" value="zabbix"/>
User	<input type="text" value="zabbix"/>
Password	<input type="password" value="zabbix"/>

[Back](#) [Next step](#)

Licensed under [GPL v2](#)

Zabbix 3.2.4. © 2001–2017, Zabbix SIA

**ZABBIX**

### Zabbix server details

Please enter the host name or host IP address and port number of the Zabbix server, as well as the name of the installation (optional).

Welcome  
Check of pre-requisites  
Configure DB connection  
Zabbix server details  
Pre-installation summary  
Install

Host:

Port:

Name:

[Back](#) [Next step](#)

Licensed under [GPL v2](#)

Zabbix 3.2.4, © 2001–2017, Zabbix SIA

**ZABBIX**

### Pre-installation summary

Please check configuration parameters. If all is correct, press "Next step" button, or "Back" button to change configuration parameters.

Welcome  
Check of pre-requisites  
Configure DB connection  
Zabbix server details  
Pre-installation summary  
Install

Database type	PostgreSQL
Database server	localhost
Database port	default
Database name	zabbix
Database user	zabbix
Database password	*****
Database schema	
Zabbix server	localhost
Zabbix server port	10051
Zabbix server name	

[Back](#) [Next step](#)

Licensed under [GPL v2](#)

Zabbix 3.2.4, © 2001–2017, Zabbix SIA

ZABBIX Install

Welcome  
Check of pre-requisites  
Configure DB connection  
Zabbix server details  
Pre-installation summary  
Install

Congratulations! You have successfully installed Zabbix frontend.  
Configuration file "/var/www/html/config/zabbix.conf.php" created.

Back Finish

Licensed under GPL v2

Zabbix 3.2.4. © 2001–2017, Zabbix SIA

ZABBIX

Username

Password

Remember me for 30 days

or sign in as guest

Help • Support

© 2001–2017, Zabbix SIA

**Favourite graphs**

No graphs added.

**Favourite screens**

No screens added.

**Favourite maps**

No maps added.

**Status of Zabbix**

Parameter	Value	Details
Zabbix server is running	No	localhost:10051
Number of hosts (enabled/disabled/templates)	39	0 / 1 / 38
Number of items (enabled/disabled/not supported)	0	0 / 0 / 0
Number of triggers (enabled/disabled [problem/ok])	0	0 / 0 [0 / 0]
Number of users (online)	2	1
Required server performance, new values per second	0	

Updated: 18:35:52

**System status**

Host group	Disaster	High	Average	Warning	Information	Not classified
No data found.						

Updated: 18:35:52

**Host status**

Host group	Without problems	With problems	Total
No data found.			

Updated: 18:35:52

**Last 20 issues**

Host	Issue	Last change	Age	Info	Ack	Actions
No data found.						

0 of 0 issues are shown Updated: 18:35:52

**Web monitoring**

Host group	Ok	Failed	Unknown
No data found.			

Updated: 18:35:52

- Prepare manual Zabbix installation

- `sudo apt-get install libsnmp-dev`

- Update the “zabbix\_server” and “zabbix\_agent” to the latest version

- Change into directory “`/home/oper/Software/zabbix-3.2.4/`”
  - Run a configuration

- `./configure --enable-server --enable-agent --enable-proxy --with-postgresql --with-net-snmp`

- Build the server and agent

- `make`

- Copy server, agent and proxy to `/usr/sbin`

- `mv /usr/sbin/zabbix_server /usr/sbin/zabbix_server_2.4.7`  
`cp /home/oper/Software/zabbix-3.2.4/src/zabbix_server/zabbix_server`  
`/usr/sbin/zabbix_server`  
`mv /usr/sbin/zabbix_agentd /usr/sbin/zabbix_agentd_2.4.7`  
`cp /home/oper/Software/zabbix-3.2.4/src/zabbix_agent/zabbix_agentd`

```
/usr/sbin/zabbix_agentd
    cp /home/oper/Software/zabbix-3.2.4/src/zabbix_proxy/zabbix_proxy
/usr/sbin/zabbix_proxy
```

- Create a new configuration file for the proxy

- cp /home/oper/Software/zabbix-3.2.4/conf/zabbix\_proxy.conf  
/etc/zabbix/.

- and edit it with “geany /etc/zabbix/zabbix\_proxy.conf”

- DBHost=localhost  
DBName=zabbix\_proxy  
DBUser=zabbix\_proxy  
DBPassword=zabbix\_proxy  
ProxyMode=1 # Passive => Server fetches data  
LogFile=/var/log/zabbix-proxy/zabbix\_proxy.log

- Create a soft-link to the original configuration files

- ln -s /etc/zabbix/zabbix\_server.conf  
/usr/local/etc/zabbix\_server.conf  
ln -s /etc/zabbix/zabbix\_agentd.conf  
/usr/local/etc/zabbix\_agentd.conf  
ln -s /etc/zabbix/zabbix\_proxy.conf  
/usr/local/etc/zabbix\_proxy.conf

- Create a shell script to test startup of server using “geany /usr/sbin/zabbix\_server.sh ” and change the mode to allow the execution of the script

- #!/bin/bash  
  
/usr/sbin/zabbix\_server -c /etc/zabbix/zabbix\_server.conf  
  
◦ “mode 755 /usr/sbin/zabbix\_server.sh ”

- Create a shell script to test startup of proxy using “geany /usr/sbin/zabbix\_proxy.sh ” and change the mode to allow the execution of the script

- #!/bin/bash  
  
/usr/sbin/zabbix\_proxy -c /etc/zabbix/zabbix\_proxy.conf  
  
◦ “mode 755 /usr/sbin/zabbix\_proxy.sh ”

- Stop agent and server

- /etc/init.d/zabbix-server stop  
/etc/init.d/zabbix-server start  
/etc/init.d/zabbix-agent stop  
/etc/init.d/zabbix-agent start

- Change server name using “`geany /etc/zabbix/zabbix_agentd.conf`”
  - `Hostname=vlbisysmon.vlbi`

- Change hostname to “`vlbisysmon.vlbi`” also in the Web interface

The screenshot shows the Zabbix Web interface with the 'Hosts' tab selected in the top navigation bar. Below the navigation bar is a search bar with 'Name' and 'DNS' fields and an 'Apply' button. The main area displays a table of hosts. One host, 'vlbisysmon.vlbi', is selected and highlighted with a blue border. At the bottom of the host table is an 'Edit' button. The bottom half of the screen shows a detailed configuration form for the selected host. The form includes fields for 'Host name' (set to 'vlbisysmon.vlbi'), 'Visible name' (empty), 'Groups' (with 'In groups' set to 'Zabbix servers' and 'Other groups' containing 'Discovered hosts', 'Hypervisors', 'Linux servers', 'Templates', and 'Virtual machines'), and 'Agent interfaces' (IP address set to '127.0.0.1', connect to 'IP', port '10050', and 'Default' radio button selected). There are also sections for 'SNMP interfaces', 'JMX interfaces', and 'IPMI interfaces', each with an 'Add' button. A 'Description' text area is present, along with 'Monitored by proxy' (set to '(no proxy)'), 'Enabled' (checkbox checked), and a row of buttons: 'Update', 'Clone', 'Full clone', 'Delete', and 'Cancel'.

- Change password of user “Admin”

The screenshot shows the Zabbix Administration - Users page. At the top, there is a navigation bar with links: Monitoring, Inventory, Reports, Configuration, Administration, General, Proxies, Authentication, User groups, Users, Media types, Scripts, and Queue. A red arrow points from the 'Administration' link in the top navigation to the 'Administration' tab in the main header. The main content area is titled 'Users' and contains a table with two rows. The columns are: Alias, Name, Surname, User type, Groups, Is online?, Login, Frontend access, Debug mode, and Status. The first row has an alias 'Admin', name 'Zabbix', surname 'Administrator', user type 'Zabbix Super Admin', group 'Zabbix administrators', status 'Yes (2018-02-07 16:07:15)', login 'Ok', frontend access 'System default', debug mode 'Disabled', and status 'Enabled'. The second row has an alias 'guest', name 'Zabbix', surname 'User', user type 'Guests', group 'Guests', status 'No', login 'Ok', frontend access 'System default', debug mode 'Disabled', and status 'Enabled'. Below the table, it says 'Displaying 2 of 2 found'. At the bottom, there are buttons for '0 selected', 'Unblock', and 'Delete'.

The screenshot shows the Zabbix Administration - Users page with the 'User' tab selected. It displays the configuration for the 'Admin' user. The fields are: Alias (Admin), Name (Zabbix), Surname (Administrator), and Groups (Zabbix administrators). Below these, there is a 'Permissions' section with a 'Change password' button highlighted by a red arrow. Other settings include Language (English (en\_GB)), Theme (System default), Auto-login (checked), Auto-logout (min 90 seconds set to 900), Refresh (in seconds) set to 30, Rows per page set to 50, and URL (after login) empty. At the bottom, there are buttons for 'Update', 'Delete', and 'Cancel'.

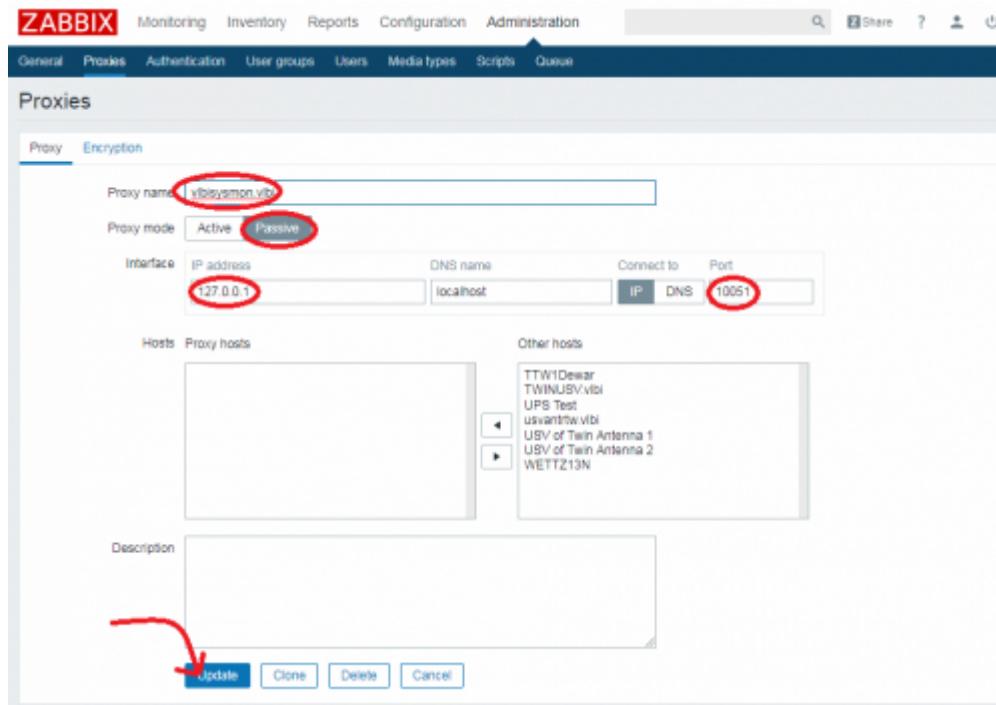
The screenshot shows the 'Users' configuration page under 'Administration'. A red arrow points from the 'User' tab to the 'Alias' field, which contains 'Admin'. Another red arrow points from the 'Media' tab to the 'Name' field, which contains 'Zabbix'. A third red arrow points from the 'Permissions' tab to the 'Groups' dropdown, which lists 'Zabbix administrators'. Other visible fields include 'Surname' (Administrator), 'Password' (circled in red), 'Password (once again)' (circled in red), 'Language' (English en\_GB), 'Theme' (System default), 'Auto-login' (checkbox checked), 'Auto-logout (min 90 seconds)' (checkbox unchecked), 'Refresh (in seconds)' (30), 'Rows per page' (50), and 'URL (after login)' (empty). Buttons at the bottom include 'Update' (blue), 'Delete', and 'Cancel'.

- Disable “guest”

The screenshot shows the 'User groups' configuration page under 'Administration'. A red arrow points from the 'User groups' tab to the 'Enabled' checkbox for the 'Guests' group, which is checked. Another red arrow points from the 'Administration' tab to the 'Enabled' checkbox. The table lists five user groups: 'Disabled', 'Enabled debug mode', 'Guests' (highlighted in yellow), 'No access to the frontend', and 'Zabbix administrators'. The 'Guests' row shows 1 member named 'guest'. Buttons at the bottom include 'Create user group', 'Apply', 'Reset', 'Enable' (disabled), and 'Disable' (blue).

- Create the proxy for the localhost in the Web interface

The screenshot shows the 'Proxies' configuration page under 'Administration'. A red arrow points from the 'Proxies' tab to the 'Create proxy' button, which is highlighted in blue.



- This proxy **must** now be used to access agents etc., because it is also used by other external Zabbix servers to forward data in distributed systems. **Attention: All data items which are just collected by a local Zabbix server and not by the proxy cannot be forwarded to external Zabbix servers outside of firewalls!!!**

#### **Possible error situations**

- Error log: *zabbix\_agentd [8394]: Can't recreate Zabbix semaphores for IPC key 0x7a028449 Semaphore ID 196608. Operation not permitted.*
  - Remove the semaphore manually *ipcrm -S 0x7a028449*
- Error log: *zabbix\_server [56363]: cannot attach to existing shared memory: [13] Permission denied*
  - The program was started before using another user ⇒ always start programs with same user; maybe reboot to solve this problem
- Data do not arrive at the *zabbix\_server*
  - Stop the *zabbix\_server*, *zabbix\_proxy* and *zabbix\_agentd*; start the *zabbix\_proxy*; start the *zabbix\_server*; start the *zabbix\_agentd*

## 7) Create an HTTP file archive

- Create a directory in the web space of the already existing Apache server to store historic monitoring data there as files

```
• mkdir /var/www/html/monitoring_archive
  chown -R www-data:www-data /var/www/html/monitoring_archive
  chmod -R 777 /var/www/html/monitoring_archive
```

- The structure of the archive can be individual but suggested is a folder structure in the following way: monitoring control point ID, year, month, individual day file, e.g.

```
• TTW1Dewar
  | -> 2017
    |   | -> 01
```

```

|   |   | -> 20170101TTW1Dewar.txt
|   |   | -> 20170102TTW1Dewar.txt
|   |   | -> 20170103TTW1Dewar.txt
|   |   | -> 20170104TTW1Dewar.txt
|   |   | -> ...
|   |   | -> 02
|   |   | -> 03
|   |   | -> 04
|   |   | -> ...
| -> 2018
| -> 2019
| -> ...
Meteo
...

```

- Each program for the individual monitoring control point must take care on the individual structure itself.

## 8) Change HTTP to HTTPS

- See: [http://lab4.org/wiki/Zabbix\\_Webftontend\\_%C3%BCber\\_HTTPS\\_verschluesseln](http://lab4.org/wiki/Zabbix_Webftontend_%C3%BCber_HTTPS_verschluesseln)
- **Create an SSL certificate (or buy one)**

- Create a new directory for the new certificates and change to this

```

◦ mkdir -p /etc/ssl/certs/zabbix-server
cd /etc/ssl/certs/zabbix-server

```

- Create private key (you have to enter a pass phrase) and delete password

```

◦ openssl genrsa -des3 -out server.key 2048
openssl rsa -in server.key -out server_nopw.key

```

- Sign certificate

```

◦ openssl req -new -key server_nopw.key -out server.csr

```

- You are about to be asked to enter information that will be incorporated into your certificate request.

What you are about to enter is what is called a Distinguished Name or a DN.

There are quite a few fields but you can leave some blank  
For some fields there will be a default value,  
If you enter '.', the field will be left blank.

-----

Country Name (2 letter code) [AU]:DE

State or Province Name (full name) [Some-State]:Bayern

Locality Name (eg, city) []:Bad Koetzing

Organization Name (eg, company) [Internet Widgits Pty Ltd]:TUM

Organizational Unit Name (eg, section) []:FESG

Common Name (e.g. server FQDN or YOUR name) []:192.168.208.236

(future IP or alias)

Email Address []:alexander.neidhardt@mytum.de

Please enter the following 'extra' attributes  
to be sent with your certificate request

A challenge password []:

An optional company name []:

- Create self-signed certificate

- ```
openssl x509 -req -days 999 -in server.csr -signkey
server_nopw.key -out server.crt
```

- **Activate SSL in Apache**

- Activate SSL module

- ```
a2enmod ssl
```

- Activate port 443 in the Apache configuration */etc/apache2/ports.conf* and add

- ```
<IfModule mod_ssl.c>
    Listen 443
</IfModule>
```

- Change to directory */etc/apache2/site-enabled*

- ```
cd /etc/apache2/site-enabled
```

- Create symbolic link

- ```
ln -s ../site-available/default-ssl.conf default-ssl.conf
```

- Create a virtual host by editing */etc/apache2/sites-available/default-ssl.conf*; add something like this:

- ```
<IfModule mod_ssl.c>
<VirtualHost _default_:443>
    ServerAdmin webmaster@localhost
    ServerName zabbix.example.com
    SSLEngine On
    SSLCertificateFile /etc/ssl/certs/zabbix-server/server.crt
    SSLCertificateKeyFile /etc/ssl/certs/zabbix-
server/server_nopw.key
    DocumentRoot /var/www/zabbix/
</VirtualHost>
</IfModule>
```

- Deactivate HTTP

- ```
a2dissite 000-default
```

- Change listen ports to avoid port 80 in */etc/apache2/ports.conf*

- #Listen 80
- Restart Apache server
- /etc/init.d/apache2 restart

- **Install curl for web page monitoring**

- apt-get install curl

## 9) Specific setup for the Wettzell vlbisysmon-PCs

- Wettzell VLBI-systems use the complete Wettzell suite of SysMon. It is available here: <http://xsamba.wtz/svn/vlbi/trunk/code/vlbisysmon/>
- All standard installation folders and files of Zabbix are deleted, because everything is contained in “/home/oper/Software/vlbisysmon”
- It contains the folders:
  - “**bin**”: all executable binaries and script files after compilation and building
  - “**control**”: all configuration files
  - “**main**”: all main programs of the Wettzell SysMon suite
  - “**make**”: a general Makefile to build and install the central vlbisysmon-PC with Zabbix-server, -proxy, and -agentd
  - “**scripts**”: the central start script and all other scripts (usually as externals to the VLBI script folder)
  - “**sensor\_hardware**”: all code parts running on a separate sensor hardware
  - “**sensor\_proxies**”: all clients connecting to sensor servers to get data and copying them to SysMon
  - “**sensor\_servers**”: all sensor servers connecting to a hardware, reading data and offering them usually with an RPC interface
  - “**sensors**”: all interface code files to communicate to the sensor hardware (client side); usually used by sensor servers to read data
  - “**ssh\_draft**”: SSH files, like private keys to automatically connect to other servers
  - “**zabbix**”: Zabbix releases which are used on the system
- To build and install the VLBI SysMon system do the following steps
  - Create a folder “*Software*” in the home directory of user “*oper*”
  - Change into this folder
  - svn co http://xsamba.wtz/svn/vlbi/trunk/code/vlbisysmon/
  - cd ./vlbisysmon/make
  - Build and install the code
    - make
    - make install
  - Now everything is prepared for a start
- To start all servers run

- /etc/init.d/vlbisysmon\_server start

- To check if all servers are run enter

- /etc/init.d/vlbisysmon\_server check

- You should see something like this:

```
CHECK PROCESS
/home/oper/Software/Vlbisysmon/bin/zabbix_server -c /home/oper/Software/vlbisysmon/control/zabbix_server.conf is running!
CHECK PROCESS
/home/oper/Software/Vlbisysmon/bin/zabbix_proxy -c /home/oper/Software/vlbisysmon/control/zabbix_proxy.conf is running!
CHECK PROCESS
/home/oper/Software/Vlbisysmon/bin/zabbix_agentd -c /home/oper/Software/vlbisysmon/control/zabbix_agentd.conf is running!
CHECK PROCESS
/home/oper/Software/vlbisysmon/bin/autossh run.sh /root/.ssh/oper_vlbisysmon -R10049:127.0.0.1:10051 -R22222:127.0.0.1:22 vlbisysmon.vlbi.wettzell.de is running!
```

- To stop all servers enter

- /etc/init.d/vlbisysmon\_server stop

## 10) Create ZABBIX users for different purposes

- The following users are created on the centralized system monitoring machine
  - Admin (Zabbix Super User: administrator)
  - oper (Zabbix User: Wettzell operator)
  - JIVE (Zabbix User: Jumping JIVE EVN network manager)
  - maybe different other users one per site (Zabbix User: site operator)
- Before a user can be created, it is necessary to create a suitable user group with defined access rights (a user group and therefore a user has no rights at all after pure creation)
- A group can be created like this

User groups

| User group                                                                                                        |                                      | Permissions                         |
|-------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------|
| Group name                                                                                                        | JIVE                                 |                                     |
| Users                                                                                                             | In group                             | Other groups                        |
|                                                                                                                   | JIVE (Joint Institute for VLBI ERIC) | All                                 |
|                                                                                                                   | <input type="button" value="&lt;"/>  | <input type="button" value="&gt;"/> |
| Frontend access                                                                                                   | System default                       |                                     |
| Enabled                                                                                                           | <input checked="" type="checkbox"/>  |                                     |
| Debug mode                                                                                                        | <input type="checkbox"/>             |                                     |
| <input type="button" value="Update"/> <input type="button" value="Delete"/> <input type="button" value="Cancel"/> |                                      |                                     |

User groups

| User group          | Host group          | Permissions               |
|---------------------|---------------------|---------------------------|
| All groups          | All groups          | None                      |
| Linux servers       | Linux servers       | Read-write Read Deny None |
| Mark6               | Mark6               | Read-write Read Deny None |
| NASA Field Systems  | NASA Field Systems  | Read-write Read Deny None |
| TTW1                | TTW1                | Read-write Read Deny None |
| TTW1Dewar Host      | TTW1Dewar Host      | Read-write Read Deny None |
| TTW1Receiver        | TTW1Receiver        | Read-write Read Deny None |
| TTW2                | TTW2                | Read-write Read Deny None |
| TTW2Mark6           | TTW2Mark6           | Read-write Read Deny None |
| WETT2138Meteo Host  | WETT2138Meteo Host  | Read-write Read Deny None |
| WETT2138_Meteo Host | WETT2138_Meteo Host | Read-write Read Deny None |
| Zabbix servers      | Zabbix servers      | Read-write Read Deny None |

type here to search      Select      Read-write      Read      Deny      None

Add      Update      Delete      Cancel

Host groups

- Name
- Discovered hosts
- Hypervisors
- Linux servers
- Mark6
- NASA Field Systems
- Templates\_imported
- Templates\_ZabbixExamples
- TTW1
- TTW1Dewar Host
- TTW1Receiver
- TTW2
- TTW2Mark6
- Virtual machines
- WETT2138Meteo Host
- Zabbix servers

Select      WETT2138\_Meteo Host      Select

- A user can then be created doing the following steps (defining a name, the group membership, password, etc.)

Configuration      Administration

General Proxies Authentication User groups **Users** Media types Scripts Queue

Users

User group All      Create user

Alias JIVE

Name Joint Institute for VLBI ERIC

Surname

Groups JIVE      Add

Delete selected

Password Change password

Language English (en\_GB) You are not able to choose some of the languages, because locales for them are not installed on the web server.

Theme System default

Auto-login

Auto-logout (min 90 seconds) 900

Refresh (in seconds) 30

Rows per page 50

URL (after login)

Update      Delete      Cancel

## 11) Install additional images

- The monitoring center uses additional background images:



- 
- [world\\_sw\\_4000\\_2000.png](#)
- [world\\_sw\\_2000\\_1000.png](#)
- [world\\_sw\\_1000\\_500.png](#)



- 
- [stationmap\\_wettzell\\_2800\\_2100.png](#)
- [stationmap\\_wettzell\\_1400\\_1050.png](#)

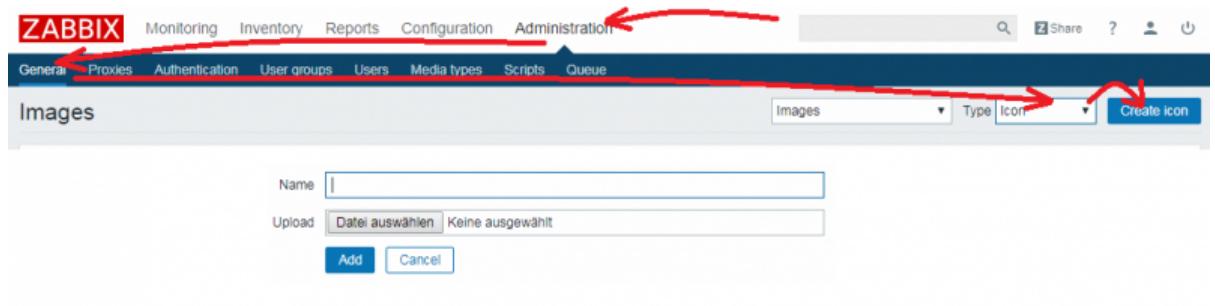
- Background images can be installed with:

The screenshot shows the Zabbix Administration interface. At the top, there's a navigation bar with 'Monitoring', 'Inventory', 'Reports', 'Configuration', 'Administration' (highlighted by a red arrow), and other items like 'Share', '?', and a user icon. Below this is a sub-navigation bar with tabs: 'General' (highlighted by a red arrow), 'Proxies' (highlighted by a red arrow), 'Authentication', 'User groups', 'Users', 'Media types', 'Scripts', and 'Queue'. Under the 'Proxies' tab, there's a sub-section titled 'Images'. It has fields for 'Name' (with an input field and a 'Upload' button) and 'Type' (set to 'Background'). A 'Create background' button is also visible. There are 'Add' and 'Cancel' buttons at the bottom.

- 
- The monitoring center uses additional icon images (icons always require the sizes 24, 48, 64, 96, 128 pixels):

- 24 48 64 96 128

- Icon images can be installed with:



From:

[http://wiki.wtz/ - Geodetic Observatory - Wiki](http://wiki.wtz/)

Permanent link:

[http://wiki.wtz/doku.php?id=vlbi:sysmon:000\\_vlbi\\_sysmon\\_node](http://wiki.wtz/doku.php?id=vlbi:sysmon:000_vlbi_sysmon_node)

Last update: **2018/04/20 23:36**