

DATA2410-1 22V Datanettverk og Skytjenester
GROUP Portfolio Assignment 2 - Docker and Zabbix Real Use-Case

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1. Introduction

1.1. Our project directory

For ease of use, all project-files are separated into the following sub-folders based on their functionality. configs: files pertaining docs: files pertaining to documentation and explanation of our project

1.2. Virtual Machines with VirtualBox

Originally, we attempted to use docker containers on the intel1-server to implement our solution. However, the server ran out of storage space, so we created virtual machines through VirtualBox as a substitute.

The first thing we needed was a VM running Ubuntu Focal Fossa. Cloning this VM would let us create the 3 virtual machines needed for the assignment, each with 4GB of RAM and 10GB of disk space. We started by downloading the image for Ubuntu Focal Fossa (20.04) from: <https://releases.ubuntu.com/20.04/ubuntu-20.04.4-desktop-amd64.iso> and creating VM1.

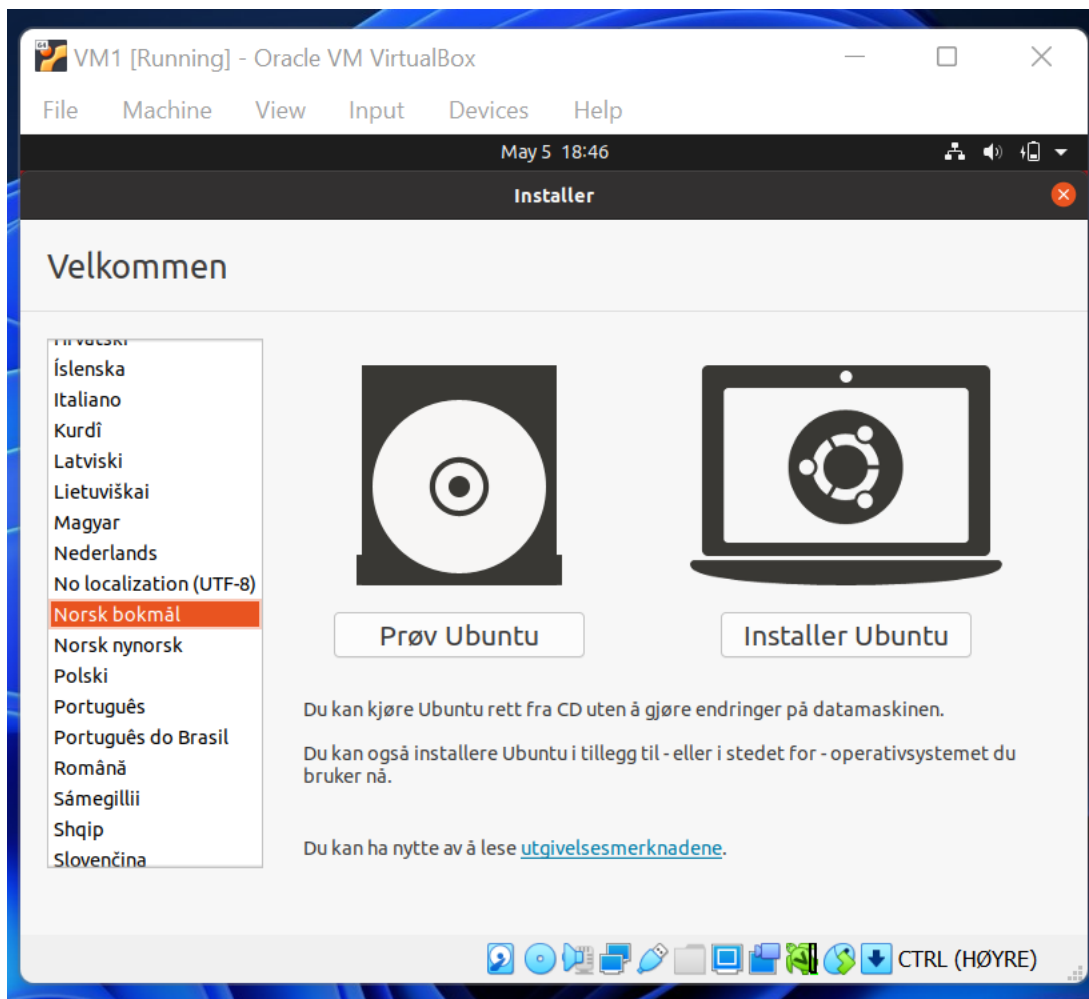


Figure 1: Ubuntu installation screen

We started by setting up VM1 on a bridged network. The reason we started with VM1 was to make sure that it was working. We created VM2 by cloning VM1 and changing the mac address. We cloned VM1 one more time to create VM3. By changing the mac addresses we ensured that each VM had their own local IP on the bridged network. By doing it this way, we made sure that all three VMs could communicate with each other, whilst also being able to communicate with the host machine.

The architecture diagram in the assignment description can be interpreted to mean that we should use an internal

network for all of the VMs whilst giving VM2 a second bridged network adapter. This would ensure that only the nginx proxy could reach the outside of the internal VM network. Since the assignment didn't specify what network method to use for the VMs, we decided against this, because this would make our assignment more complicated than necessary.

2. VM1: Docker containers setup - Quad Container Setup

After setting up the three VMs, we used the file `docker-compose.yml`, to set up the four docker containers with the required config instructions for the assignment within VM1. This file can be found in the `configs` folder in our project directory. The first step in setting up the docker containers was to install docker on VM1.

We used the following command to install docker.

```
sudo apt-get install -y docker-compose
```

When setting up the docker containers, we mostly used the auto generated docker files, but we made some minor adjustments by setting the environment variables for these files before they were generated. The environment variables were created outside the `docker-compose.yml` file, and later referenced in the `docker-compose.yml` file. We created volume links as external volumes, to make it possible to edit the files outside the docker containers via the docker volume functionality, since these volume files are synchronized with the volume files we mapped them to. The `docs` volume was used to get the `.sql` file to create the server. Setting up volumes for outside access made debugging easier while working on the project. For example we utilized this setup to look at the `zabbix_server.conf` config file to see if the environment variables in the `docker-compose.yml` file was correctly written in the config file.

The following block of code describes how we set up the volumes according to the description above.

```
sudo docker volume create mysql-server-data
sudo docker volume create zabbix-server-config
sudo docker volume create zabbix-web-config
sudo docker volume create zabbix-agent-config
sudo docker volume create docs
```

In the block below, we display our docker compose file `configs/docker-compose.yml` from the `configs` folder in our project directory. This file was run with the `docker-compose up` command on VM1 to start the docker containers.

```
# Docker Container setup for VM 1
version: "3.0"
services:
  # mysql container setup
  mysql-server:
    image: haakco/mysql80
    ports:
      - 3306
    hostname: mysql-server
    restart: unless-stopped
    volumes:
      - mysql-server-data:/var/lib/mysql
    environment:
      - MYSQL_ROOT_PASSWORD=123
      - MYSQL_DATABASE=zabbix
      - MYSQL_USER=zabbix
      - MYSQL_PASSWORD=123
    cap_add:
      - SYS_NICE
    networks:
      zabbix-net:
        ipv4_address: 172.200.1.1
        # not really supposed to have two commands put putting it on one line broke things and this seems to work
        # tried this, but it did not work:
        # command: bash -c "--default-authentication-plugin=mysql_native_password && --datadir=/var/lib/mysql/c
    command: --default-authentication-plugin=mysql_native_password
    command: --datadir=/var/lib/mysql/data

  # zabbix server setup
  zabbix-server:
```

```

image: zabbix/zabbix-server-mysql
ports:
  - 10051:10051
hostname: zabbix-server
restart: unless-stopped
volumes:
  - zabbix-server-config:/etc/zabbix
  - docs:/usr/share/doc/
environment:
  - DB_SERVER_HOST=mysql-server
  - MYSQL_DATABASE=zabbix
  - MYSQL_USER=zabbix
  - MYSQL_PASSWORD=123
depends_on:
  - mysql-server
networks:
  zabbix-net:
    ipv4_address: 172.200.1.2

# zabbix web container
zabbix-web:
  image: zabbix/zabbix-web-nginx-mysql
  ports:
    - 80:8080
  hostname: zabbix-web
  restart: unless-stopped
  volumes:
    - zabbix-web-config:/etc/zabbix
  environment:
    - DB_SERVER_HOST=mysql-server
    - MYSQL_DATABASE=zabbix
    - MYSQL_USER=zabbix
    - MYSQL_PASSWORD=123
    - ZBX_SERVER_HOST=zabbix-server
  depends_on:
    - mysql-server
    - zabbix-server
  networks:
    zabbix-net:
      ipv4_address: 172.200.1.3

# zabbix agent container
zabbix-agent:
  image: zabbix/zabbix-agent
  ports:
    - 10050:10050
  hostname: zabbix-agent
  restart: unless-stopped
  volumes:
    - zabbix-agent-config:/etc/zabbix
  environment:
    - ZBX_SERVER_HOST=zabbix-server
  depends_on:
    - zabbix-server
  networks:
    zabbix-net:

```

```

    ipv4_address: 172.200.1.4

# custom network for the containers
networks:
  zabbix-net:
    driver: bridge
    ipam:
      config:
        - subnet: 172.200.1.0/16

# volumes for the containers
volumes:
  mysql-server-data:
    external: true
  zabbix-server-config:
    external: true
  zabbix-web-config:
    external: true
  zabbix-agent-config:
    external: true
  docs:
    external: true

```

After the docker containers were up and running, we decided to set up host profiles for active and passive checks between the zabbix agent and server in the docker stack. This was to ensure that everything connected properly. The web frontend is hosted on VM1 port 80 as per the assignment description, so to reach it, we simply typed the address in a web browser. In later steps of the assignment, we set up an nginx proxy that allowed us to reach the frontend through the localhost-address.

zabbix-agent	Items 66	Triggers 34	Graphs 13	Discovery 3	Web	
zabbix_server	Items 67	Triggers 34	Graphs 13	Discovery 3	Web	172.200.1.4:10050

Linux by Zabbix agent active	Enabled		None
Linux by Zabbix agent	Enabled	ZBX	None

Figure 2: Image showing that the zabbix-agent and zabbix-server is working

Here is a screengrab of our docker compose log, showing that all the checks except for one is working between the agent and server. Our thoughts was that this one check from the template probably wasn't suited for being run in a docker environment as some things can be different there.

So this should fully explain how we did the first part of this assignment, how we installed docker, how we configured our docker-compose stack and made our docker bridge network inside of VM1, while also going a little further by using the frontend to set up the hosts there.

```

zabbix-web_1 | 192.168.50.247 - - [12/May/2022:11:10:04 +0000] "POST /zabbix.php?action=noti
fications.get&sid=b6bbe17608fd0db2&output=ajax HTTP/1.0" 200 424 "http://192.168.50.247:8080/zab
bix.php?action=host.list" "Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:100.0) Gecko/20100101 Fi
refox/100.0" "192.168.50.206"
zabbix-agent_1 | 78:20220512:111009.996 active check "system.sw.packages" is not supported
: Cannot obtain package information.
zabbix-web_1 | 192.168.50.247 - - [12/May/2022:11:10:11 +0000] "POST /jsrpc.php?output=json-
rpc HTTP/1.0" 200 63 "http://192.168.50.247:8080/zabbix.php?action=host.list" "Mozilla/5.0 (Wind
ows NT 10.0; Win64; x64; rv:100.0) Gecko/20100101 Firefox/100.0" "192.168.50.206"
zabbix-server_1 | 188:20220512:111014.632 item "zabbix-agent:system.sw.packages" became not
supported: Cannot obtain package information.
zabbix-web_1 | 192.168.50.247 - - [12/May/2022:11:10:21 +0000] "POST /jsrpc.php?output=json-
rpc HTTP/1.0" 200 63 "http://192.168.50.247:8080/zabbix.php?action=host.list" "Mozilla/5.0 (Wind
ows NT 10.0; Win64; x64; rv:100.0) Gecko/20100101 Firefox/100.0" "192.168.50.206"

```

Figure 3: Logs from docker compose after setting up hosts on frontend

3. VM2 and VM3: Install zabbix-agent and zabbix-proxy

3.1. VM2

We followed this guide to complete task 1 in part III of the assignment description: <https://bestmonitoringtools.com/install-zabbix-proxy-on-ubuntu/> There were a few things we did differently from the guide. These will be described below.

3.1.1. Installing Zabbix Proxy

We started by installing Zabbix Proxy on VM2 with the following commands:

NB: These links are not the same given in the tasks as using the release packages gave a lot of problems with wrong versions, sometimes we would get version 4 or 5, and sometimes a 6.2 beta version, whilst all we needed was the 6.0.x versions as these were the ones that the docker compose stack received. We got our downloads from this zabbix repo:

```

apt-get install wget

wget https://repo.zabbix.com/zabbix/6.0/ubuntu/pool/main/z/zabbix-release/zabbix-release_6.0-1%2Bubuntu20.04_all.deb

dpkg -i zabbix-release_6.0-1+ubuntu20.04_all.deb

# needed this as well since we got the wrong version of the proxy by just having the release package
wget https://repo.zabbix.com/zabbix/6.0/ubuntu/pool/main/z/zabbix/zabbix-proxy-mysql_6.0.1-1%2Bubuntu20.04_amd64.deb

dpkg -i zabbix-proxy-mysql_6.0.1-1+ubuntu20.04_amd64.deb

apt-get install -f

apt-get install zabbix-proxy-mysql

apt-get install zabbix-sql-scripts

```

The only notable difference between the guide and what we did in this part of the task, is that we used Zabbix-proxy version 6.0.1 instead of Zabbix-proxy version 6.1, because the assignment descriptions asks us to use version 6.1.1

3.1.2. Configuring MariaDB database for the proxy to use

After we finished installing Zabbix Proxy, we installed and configured the database, using MariaDB, according to both the guide mentioned above, and the assignment description.

The following block of code describes the installation of MariaDB on VM2:


```

sudo apt install software-properties-common -y

curl -LsS -O https://downloads.mariadb.com/MariaDB/mariadb_repo_setup

sudo bash mariadb_repo_setup --mariadb-server-version=10.6

sudo apt update

sudo apt -y install mariadb-common mariadb-server-10.6 mariadb-client-10.6

```

After installing MariaDB we began configuring the database by running the following commands to start and enable MariaDB, and configure it to start on boot:

```

sudo systemctl start mariadb

sudo systemctl enable mariadb

```

The next step in the configuration of the database was to reset the password. We did that with the commands in the following code block: The following code blocks set the password for new **root password** = 123.

```

sudo mysql_secure_installation

Enter current password for root (enter for none): Press Enter

Switch to unix_socket authentication [Y/n] y

Change the root password? [Y/n] y

New password: <Enter root DB password>

Re-enter new password: <Repeat root DB password>

Remove anonymous users? [Y/n] y

Disallow root login remotely? [Y/n] y

Remove test database and access to it? [Y/n] y

Reload privilege tables now? [Y/n] y

```

The only notable difference between the guide and what we did was that we set the root password to '123', in stead of 'rootDBpass'.

After we set the root password, it was time to create the database by running the commands in the following block of code:

```

sudo mysql -uroot -p'123' -e "create database zabbix_proxy character set utf8mb4 collate utf8mb4_bin;"

sudo mysql -uroot -p'123' -e "grant all privileges on *.* to zabbix@localhost identified by 'zabbixDBpass';"

```

The last step in the configuration of the database was to import the initial schema and data with the following command:

```

sudo cat /usr/share/doc/zabbix-sql-scripts/mysql/proxy.sql | mysql -uzabbix -p'zabbixDBpass' zabbix_proxy

```

In the installation and configuration of the database, we followed the guide quite exactly. Therefore, there are very few differences between what we did to install and configure the database, and what is stated in the installation guide.

3.1.3. Configuring Zabbix Proxy

Once the installation and configuration of the database was complete, it was time to configure the Zabbix Proxy. The first step when configuring the Zabbix Proxy was to open the config file with the following command:

```
sudo gedit /etc/zabbix/zabbix_proxy.conf
```

In the file we changed the following values:

```
DBPassword=zabbixDBpass
ConfigFrequency=100
Server=192.168.50.95
Hostname=Zabbix Proxy
DBName=zabbix_proxy
DBUser=zabbix
```

After editing the necessary values, we saved and exited the file. We set the `ConfigFrequency` to be 100 seconds. This parameter determines how often the proxy retrieves data from the configuration file, and is useful to cut down on the waiting time between updates on the status of the Zabbix Proxy. The notable differences between our config file, and the config file in the guide is that we have a different IP address for the server, and a different hostname for the proxy itself.

3.1.4. Starting and enabling the Zabbix Proxy

Next, we started the Zabbix Proxy and enabled it to boot on startup with the following commands:

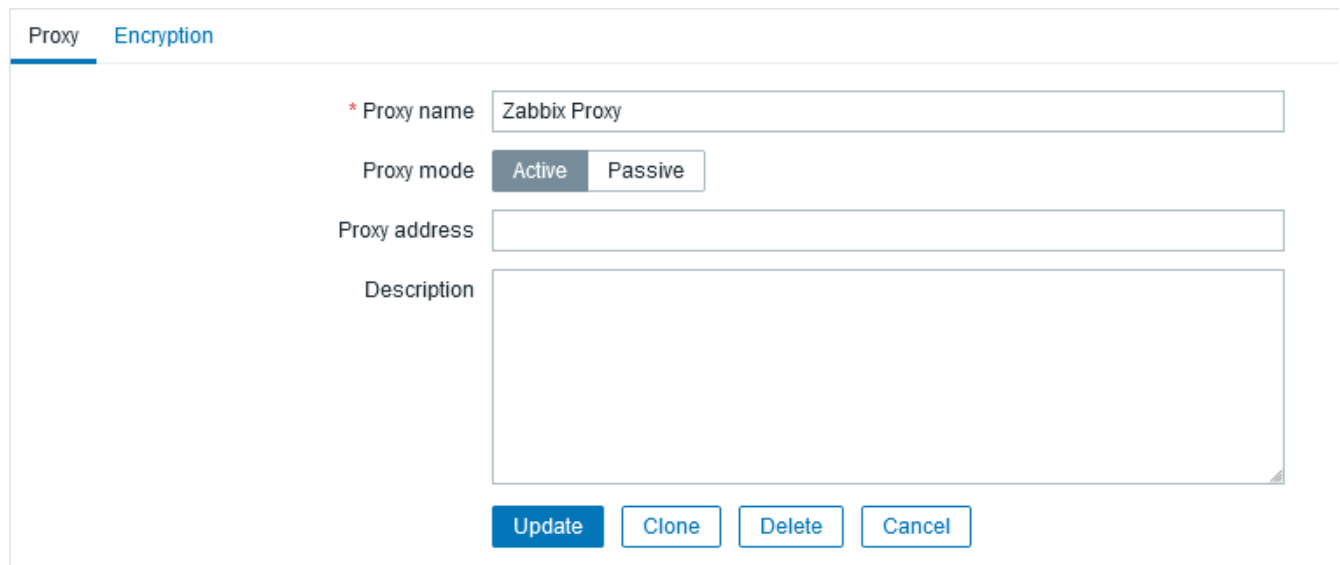
```
# makes the proxy start by default
sudo systemctl enable zabbix-proxy

# not really needed but I like to do this just in case
sudo systemctl start zabbix-proxy
```

It is important to take note of the `Hostname` in the `zabbix-proxy` config file. We need it in order to connect the proxy to the server using the web frontend. While in the `zabbix-proxy` config file, it is also important to make sure that the `DBPassword` is set to the correct value.

3.1.5. Registering Zabbix Proxy in the Zabbix frontend

Quickly documenting how we did the frontend setup of the proxy after, doing the config on VM2, and also an image verifying that it was connected



The screenshot shows the Zabbix Proxy configuration page in the Zabbix web interface. The 'Proxy' tab is active. The form contains the following fields and controls:

- Proxy name:** A text input field containing 'Zabbix Proxy'.
- Proxy mode:** Two radio buttons, 'Active' (selected) and 'Passive'.
- Proxy address:** An empty text input field.
- Description:** A large empty text area.
- Buttons:** At the bottom, there are four buttons: 'Update' (highlighted in blue), 'Clone', 'Delete', and 'Cancel'.

Name ▲	Mode	Encryption	Compression	Last seen (age)	Host count	Item count
Zabbix Proxy	Active	None PSK	On	3s	1	73

Figure 4: Image showing that the zabbix-proxy is connected

3.2. VM 3. Zabbix Agent installation and setup

The following code block must be run as root on VM3 to install the Zabbix-agent.

```
wget https://repo.zabbix.com/zabbix/6.0/ubuntu/pool/main/z/zabbix-release/
zabbix-release_6.0-1%2Bubuntu20.04_all.deb

sudo dpkg -i zabbix-release_6.0-1+ubuntu20.04_all.deb

#had to use this one for right version
wget https://repo.zabbix.com/zabbix/6.0/ubuntu/pool/main/z/zabbix/
zabbix-agent_6.0.1-1%2Bubuntu20.04_amd64.deb

sudo dpkg -i zabbix-agent_6.0-1+ubuntu20.04_amd64.deb

sudo apt-get install -f

sudo apt-get install zabbix-agent
```

The following code block creates the psk encryption key.

```
openssl rand -hex 32 > zabbix_agent.psk

cat zabbix_agent.psk
e8126679667a8594bc8d3d76121b6ba2a5fb4b6d41bea2cd62190c163fbc6c6b
```

The following code block moves the psk encryption key to /opt/zabbix folder.

```
sudo mkdir /opt/zabbix

sudo chmod 777 /opt/zabbix

sudo mv zabbix_agent.psk /opt/zabbix/
```

Used these commands to edit the zabbix-agent.conf file

```
sudo vim /etc/zabbix/zabbix_agentd.conf
```

The following code block contains the lines we changed in the zabbix-agent.conf file; to enable psk encryption.

```
TLSConnect=psk
TLSAccept=psk
TLSPSKIdentity=cbt_psk_01,
TLSPSKFile=/opt/zabbix_agent.psk
# the local ip of our bridged networked VM2
Server=192.168.50.247
```

See point/heading 5 to see how we configured this in the front end.

4. VM2: Nginx proxy

We started by installing nginx with the following commands.

```
sudo apt-get update

sudo apt-get install nginx
```

Once nginx was installed, we disabled the default virtual host by unlinking it, using the following command.

```
sudo unlink /etc/nginx/sites-enabled/default
```

To add the new configurations to the proxy, we moved to the `sites-available` directory to create our new file.

```
cd /etc/nginx/sites-available/
nano reverse-proxy.conf
```

Here we created a new configuration file for the nginx-proxy. These configurations makes sure that the nginx-proxy listens on port 8080, and redirects all incoming traffic from that port to the Zabbix-server using `proxy_pass` followed by the Zabbix-server's IP address and port number.

```
server {
    listen 8080;
    server_name localhost;

    location / {
        proxy_pass http://192.168.50.95:80;
        proxy_set_header Host $http_host;
        proxy_set_header X-Real-IP $remote_addr;
        proxy_set_header X-Forwarded-For $proxy_add_x_forwarded_for;
        proxy_set_header X-Forwarded-Proto $scheme;
    }
}
```

To complete the proxy, we activate the directives by linking to `/sites-enabled/` using the following command.

```
sudo ln -s /etc/nginx/sites-available/reverse-proxy.conf /etc/nginx/sites-enabled/reverse-proxy.conf
```

Lastly, to see if it worked, we ran an nginx configuration test and restarted the service.

```
sudo service nginx configtest
* Testing nginx configuration [ OK ]

sudo service nginx restart
* Restarting nginx nginx [ OK ]
```

This verifies that nginx works as intended.

Image of nginx-proxy being accessed from host machine via VM2 local IP in bridged network on port 8080.

Hostnames on all VMs where ubuntu1 because vm2 and vm3 where created by cloning vm1.

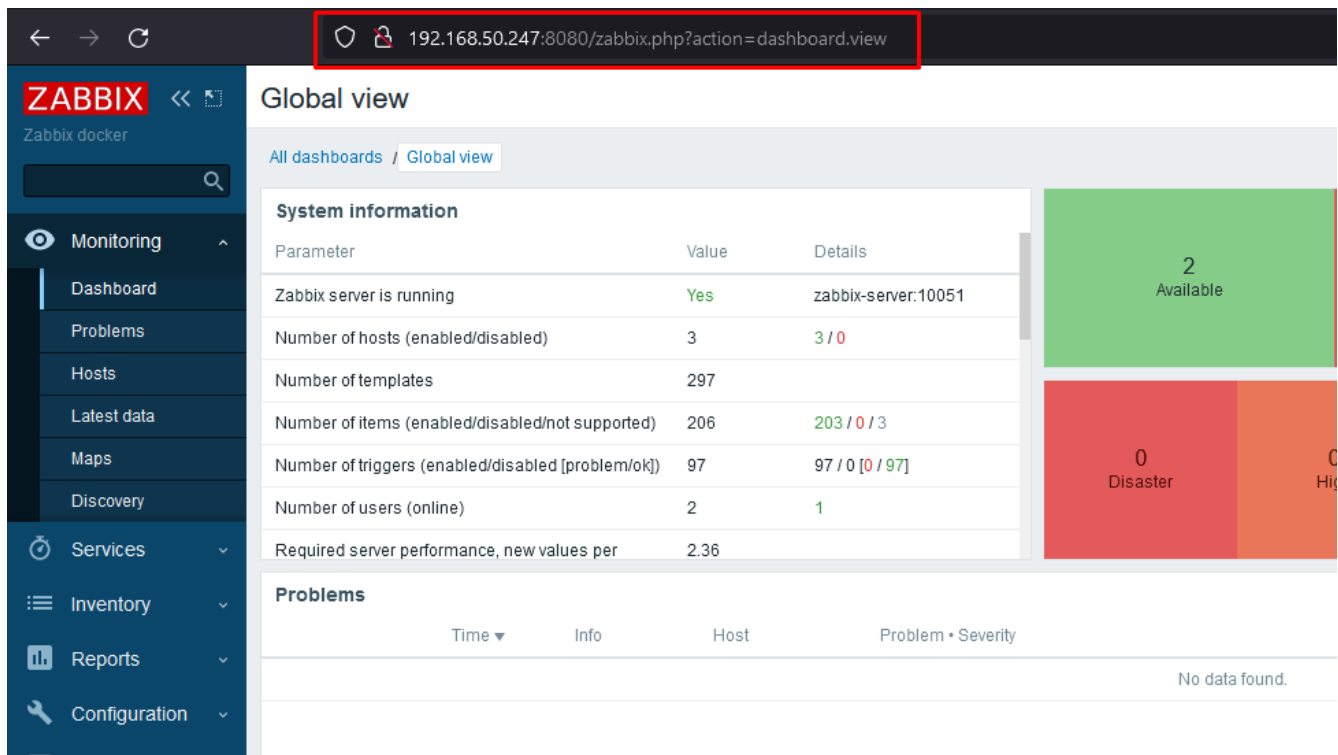


Figure 5: Image showing zabbix frontend from nginx proxy

```

valid_lft forever preferred_lft forever
ubuntu1@ubuntu1-VirtualBox:~$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noque
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 15
    link/ether 08:00:27:2a:01:1a brd ff:ff:ff:ff:ff:ff
    inet 192.168.50.247/24 brd 192.168.50.255 scope
        valid_lft 70486sec preferred_lft 70486sec

```

Figure 6: Image showing local ip of vm2

5. VM1: Zabbix frontend

To access the Zabbix frontend, we connected to the nginx-proxy on VM2 via its local IP and port 8080 as specified. This redirected us to the VM1 zabbix-web docker container. Once logged in to the Zabbix frontend, we added the host according to the descriptions, made the items as per point a) and b) and lastly the triggers as per point c) and d)

Name ▲	Items	Triggers	Graphs	Discovery	Web	Interface
zabbix-agent	Items 66	Triggers 34	Graphs 13	Discovery 3	Web	
zabbix_server	Items 67	Triggers 34	Graphs 13	Discovery 3	Web	172.200.1.4:10050
zabbix_server_agent_vm3	Items 73	Triggers 29	Graphs 14	Discovery 3	Web	192.168.50.151:10050

Proxy	Templates	Status	Availability	Agent encryption
	Linux by Zabbix agent active	Enabled		None
	Linux by Zabbix agent	Enabled	ZBX	None
Zabbix Proxy	Linux by Zabbix agent	Enabled	ZBX	PSK None PSK CERT

Figure 7: Image of our host setup with VM3 agent, split in two for easier viewing on paper

We created a new template named zabbix-monitoring in the zabbix-monitoring host group:

TemplatesTagsMacrosValue mapping

* Template name

zabbix-monitoring

Visible name

zabbix-monitoring

Templates

type here to search

Select

* Groups

zabbix-monitoring x

type here to search

Select

Description

AddCancel

5.1. Items

We created the item for total disk space usage in the directory `/var` with interval of 1 hour:

```
fsv.fs.size[/var,used]
```

We created an that will monitor the docker process usage with interval of 1 minute:

```
proc.cpu.util[dockerd]
```

<input type="checkbox"/>	Name ▲	Triggers	Key	Interval	History
<input type="checkbox"/>	... Docker process usage		proc.cpu.util[dockerd]	1m	90d
<input type="checkbox"/>	... Total Used Disk Space		vfs.fs.size[/var,used]	60m	90d

Figure 8: Image showing that the items are created

5.2. Triggers

We created a trigger that triggers when uptime is longer than 240 days:

```
last(/zabbix_server_agent_vm3/system.uptime)>240d
```

All hosts / zabbix_server_agent_vm3 Enabled ZBX Items 73 Triggers 28 Graphs 14 Discovery rules 3 Web scenarios

Trigger Tags Dependencies

* Name uptime over 240 days

Event name uptime over 240 days

Operational data

Severity Not classified Information Warning Average High Disaster

* Expression last(/zabbix_server_agent_vm3/system.uptime)>240d Add

Expression constructor

OK event generation Expression Recovery expression None

PROBLEM event generation mode Single Multiple

OK event closes All problems All problems if tag values match

Figure 9: Image showing trigger uptime creation dialog

We created a trigger that triggers when disk I/O is higher than 20% average for 5 minutes:

```
avg(/zabbix_server_agent_vm3/system.cpu.util[,iowait],5m)>20
```

After making those triggers we made sure that the triggers where correctly created:

Triggers

All hosts / zabbix_server_agent_vm3 Enabled ZBX Items 73 Triggers 29 Graphs 14 Discovery rules 3 Web scenarios

Trigger Tags Dependencies

* Name

Event name

Operational data

Severity

* Expression

[Expression constructor](#)

OK event generation

PROBLEM event generation mode

OK event closes

Figure 10: Image showing trigger disk io creation dialog

<input type="checkbox"/>	Information	OK	Linux by Zabbix agent: System name has changed	<code>last(/zabbix_server_agent_vm3/system.hostname,#1)<>last(/zabbix_server_agent_vm3/system_hostname)</code>
<input type="checkbox"/>	Warning	OK	Linux by Zabbix agent: System time is out of sync	<code>fuzzysync(/zabbix_server_agent_vm3/system.localtime,(\$SYSTEM.FUZZYTIME.MAX))=0</code>
<input type="checkbox"/>	Not classified	OK	uptime over 240 days	<code>last(/zabbix_server_agent_vm3/system.uptime)>240d</code>
<input type="checkbox"/>	Average	OK	Linux by Zabbix agent: Zabbix agent is not available	<code>max(/zabbix_server_agent_vm3/zabbix(host.agent.available),(\$AGENT.TIMEOUT))=0</code>

Figure 11: Image showing the uptime trigger is created

<input type="checkbox"/>	Not classified	OK	Disk i/o is overloaded	<code>avg(/zabbix_server_agent_vm3/system.cpu.util[,iowait],5m)>20</code>
<input type="checkbox"/>	Warning	OK	Linux by Zabbix agent: Getting closer to process limit	<code>last(/zabbix_server_agent_vm3/proc.num)/last(/zabbix_server_agent_vm3/kern)</code>
<input type="checkbox"/>	Warning	OK	Linux by Zabbix agent: has been restarted	<code>last(/zabbix_server_agent_vm3/system.uptime)<10m</code>
<input type="checkbox"/>	Warning	OK	Linux by Zabbix agent: High CPU utilization Depends on: zabbix_server_agent_vm3: Load average is too high	<code>min(/zabbix_server_agent_vm3/system.cpu.util,5m)>(\$CPU.UTIL.CRIT)</code>

Figure 12: Image showing the disk io trigger is created

6. References

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