
THIRTYSOMETHING

DIY-NAS

About my DIY-NAS

ThirtySomething

21.05.2022

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Change history

Version	Date	Description	Name
1.0.0	02.04.2022	<ul style="list-style-type: none"> Start with description 	ThirtySomething
1.0.1	16.04.2022	<ul style="list-style-type: none"> Rename section WOL to Autosutdown Fill section Autosutdown with content 	ThirtySomething
1.0.2	16.04.2022	<ul style="list-style-type: none"> Split file DIY-NAS-Content into separate files 	ThirtySomething
1.0.3	21.04.2022	<ul style="list-style-type: none"> Update to latest template version Add section about used ports Add svnExport.sh as appendix 	ThirtySomething
1.0.4	23.04.2022	<ul style="list-style-type: none"> Add documentation about Syncing docker container 	ThirtySomething
1.0.5	25.04.2022	<ul style="list-style-type: none"> Split section OMV plugins into files Add description of PhotoPrism 	ThirtySomething
1.0.6	28.04.2022	<ul style="list-style-type: none"> Add list of containers from old document 	ThirtySomething
1.0.7	30.04.2022	<ul style="list-style-type: none"> Use latest template version Add section about Pi-hole 	ThirtySomething
1.0.8	11.05.2022	<ul style="list-style-type: none"> Use latest template version Add copyright hint to the images 	ThirtySomething
1.0.9	19.05.2022	<ul style="list-style-type: none"> Add description of Watchtower 	ThirtySomething
1.0.10	21.05.2022	<ul style="list-style-type: none"> Add description of MariaDB and phpMyAdmin Switch SCM-Manager from manual to docker-compose.yaml Switch syncthing from manual to docker-compose.yaml Add description of Mosquitto 	ThirtySomething

Table 1: Change history

1 Initial situation

In 2010 I bought my first [NAS](#). It was a [Synology DS411slim](#). The device is running up to now. For a few years now, it is only supplied with security updates. That is quite remarkable for the fact that it has already 12 years on the hump.

Now I've run out of space - I have 4*2TB running there in [RAID 10](#), which results in about 3.7TB. In addition, the performance is, well, not quite up to date.

2 Search for alternatives

2.1 Use a mini PC in front of the NAS

Realizing this situation I was searching for alternatives. The first idea was to use a [mini PC](#) in front of the [NAS](#). This failed for some reasons.

- Using the [NAS](#) directly for [Docker](#) volumes
- The CPU of the mini PC does not support [Intel VT](#)
- The network as bottleneck for [Docker](#) containers

2.2 Hardware alternatives

Then I decided to by a new [NAS](#) system. But which kind of [NAS](#) will it be? I've spent a long time to search the internet for possible soultions. I didn't know about the possibility to pimp a [TerraMaster NAS](#) with a different [OS](#). This is also possible for [Western Digital NAS](#) as described [here](#) and [here](#). Also the variant with a mini PC and separated storage case was interesting. The idea is to get the most out of money, so the ranking here is done by price/performance ratio and the DIY [NAS](#) wins the comparison.

- DIY [NAS](#) system on PC base
- DIY [NAS](#) system with separated storage case and mini PC
- Commercial [NAS](#) system
- Commercial [NAS](#) with custom OS

2.3 The planned hardware

When comparing the different hardware solutions, I also made a comparison between an Intel and an AMD based [NAS](#). The AMD variant won the price/power chapter, so I decided to buy:

- 32GB G.Skill RipJaws V black DDR4-3200 DIMM Dual Kit
- 250GB Samsung 970 Evo Plus M.2 2280
- 400 Watt be quiet! Pure Power 11 CM Modular 80+ Gold

- Black Fractal Design Node 304 cube without power supply
- 4x 4000GB WD Red Plus WD40EFZX 128MB 3.5"
- ASRock Fatal1ty B450 Gaming-ITX/AC AMD B450
- AMD Athlon 3000G with Radeon Vega Graphics 3.5GHz
- Noctua NH-L9a-AM4 topblow cooler

2.4 The bought hardware

„Life is what happens to you while you're busy making other plans.“

Figure 1: A quote from John Lennon

This means that the availability of chips and other events affect the market and make it difficult to realize these plans. For example, motherboards in mini-ITX format with AM4 socket are really hard to get. That's why I revised my decision on the components:

- 32GB G.Skill RipJaws V black DDR4-3200 DIMM Dual Kit
- 250GB Samsung 970 Evo Plus M.2 2280
- 400 Watt be quiet! Pure Power 11 CM Modular 80+ Gold
- Black Fractal Design Node 304 cube without power supply
- 4x 4000GB WD Red Plus WD40EFZX 128MB 3.5"
- ASRock H610M-ITX/AC mITX Intel H610 DDR4 S1700
- Intel Core i3-12100 tray
- Noctua NH-L9i-17xx topblow cooler

The difference is that the CPU is a latest generation [Intel i3](#) processor. The corresponding [motherboard](#) is also brand new. Both were only launched in Q4/2021. This has some consequences: [OMV](#) 5 does not support the network chip of the motherboard. So I decided to install the [OMV](#) 6 beta on my [DIY NAS](#). I also tried [TrueNAS](#) – it looks much more professional than [OMV](#), but it is also a bit more complicated to understand and configure. It also doesn't have native support for [Docker](#).

3 The hardware build

Although I build up my last PC more than 25 years ago assembling the hardware was a breeze. The only surprise was the mounting position of the power supply. As I understand how to do this everything was fine.

4 The software installation

4.1 The operating system

The basic installation of [OMV](#) works without any problems. This is known from debian. Additional [Volker Theile](#), the founder of the [OMV](#) project, and his team have done a very good job. Thank you guys!

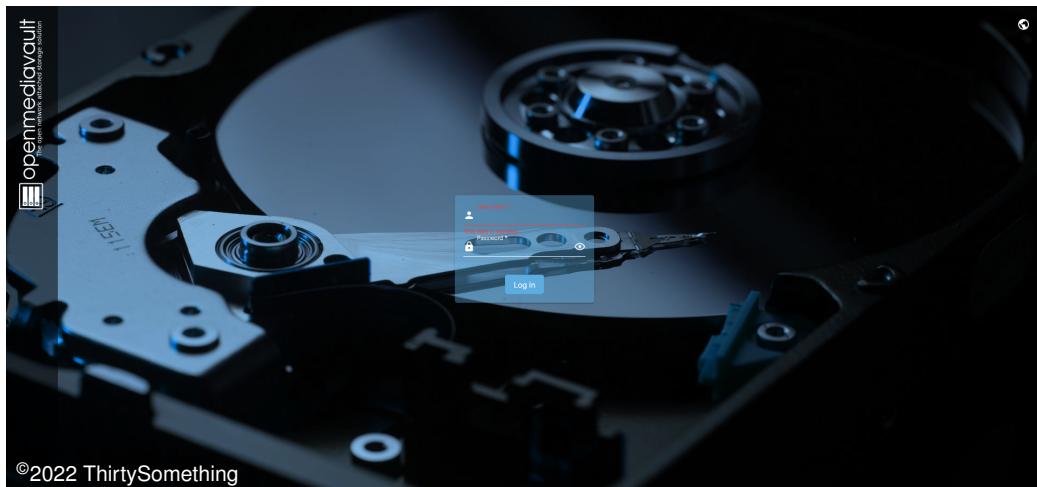


Figure 2: The OMV login page

4.2 The disks

All attached disks are working. The system disk is a NVME SSD with a 250 GB capacity. All others are 4 TB WD RED disks.

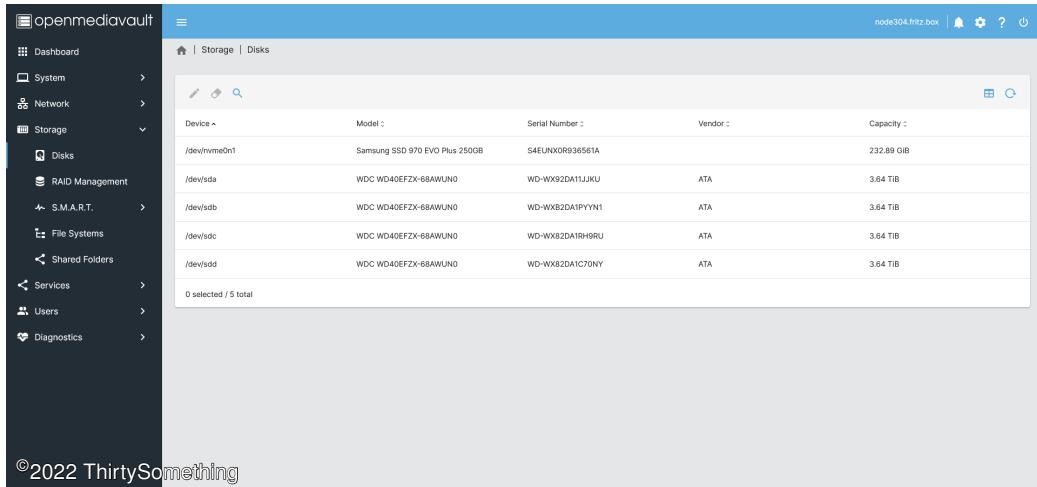


Figure 3: The OMV disks

4.3 The RAID storage

Configuring the [RAID](#) was also less problematic. But there is an important point: As long as the RAID system is created, do not use the RAID! During the RAID build I was playing around with [OMV plugins](#) to see the diskstats – and damaged the RAID build. After a reboot the system hangs on the filesystem check. I was shocked - also about the large amount of blocks the fsck found and tried to repair. It took a while to understand what happens. Then I've startet from scratch and everything was okay. The creation of the file system at the end went without problems. A filesystem check found nothing to do.

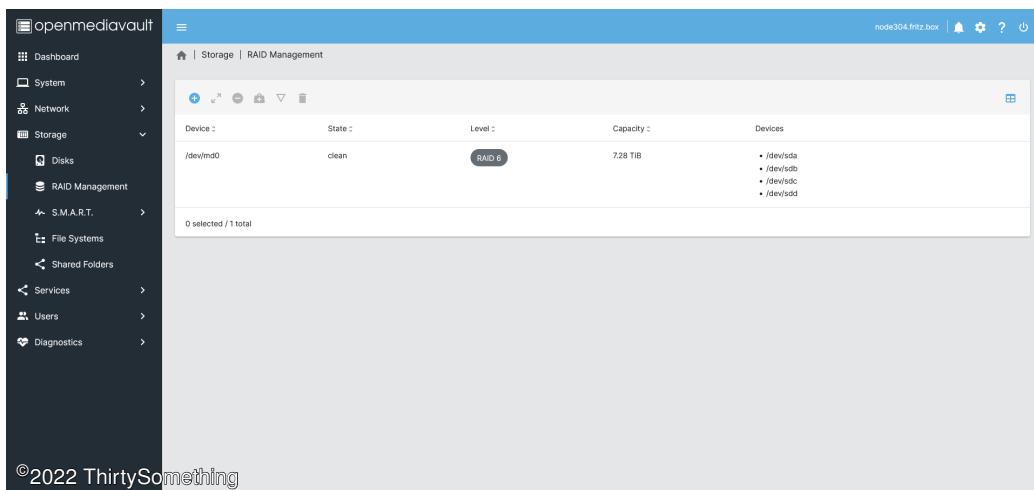


Figure 4: The OMV RAID

4.4 The file system

This was a simple step – just create a filesystem on the previously created RAID volume.

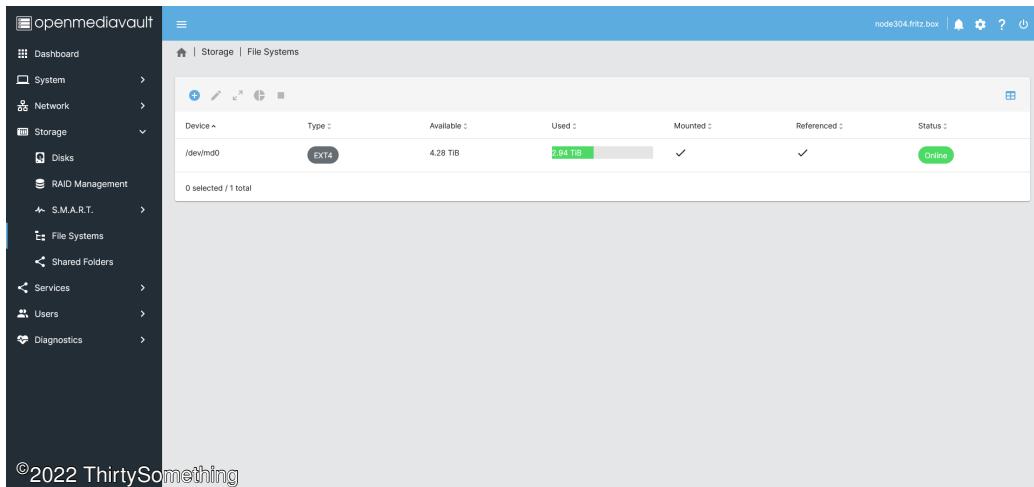


Figure 5: The OMV filesystem on the RAID

4.5 Shared folders

Some common folders should be defined before anything else is done:

- The folder `docker` for the use of [Docker](#).

- The folder `homes` as base folder for the users home directories.
- The folder `music` for the miniDLNA plugin.
- The folder `quarantine` for the use of [ClamAV](#).
- The folder `video` also for the miniDLNA plugin.

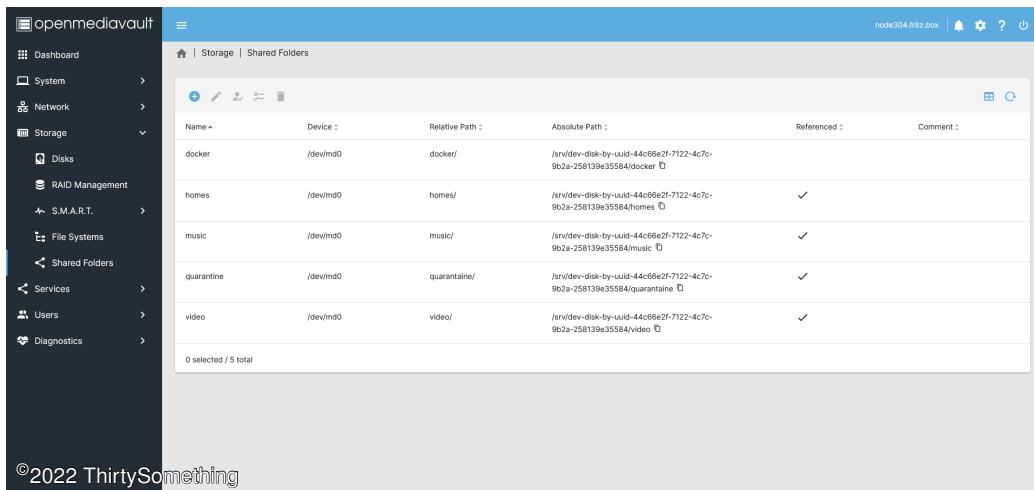


Figure 6: The OMV shared folders

This „shared folders“ are defined as container to be used inside of [OMV](#). To make them accessible from the network you have to enable services for them.

4.6 Users

In the settings the option `User home directory` is enabled and points to the previously created `homes` folder. Then I created the users.

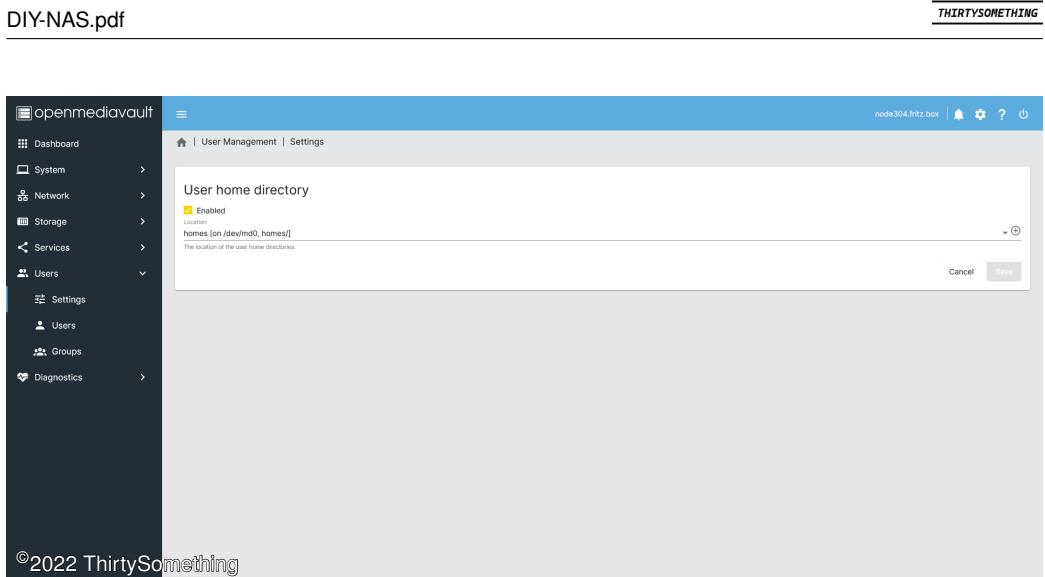


Figure 7: The OMV users home directory

4.7 CIFS shares

Simple - enable the SMB/CIFS service, enable the home directories and then create shares for the previously defined shared folders. Allow read/write access for the administrator of the shares (me), the others got read access to them.

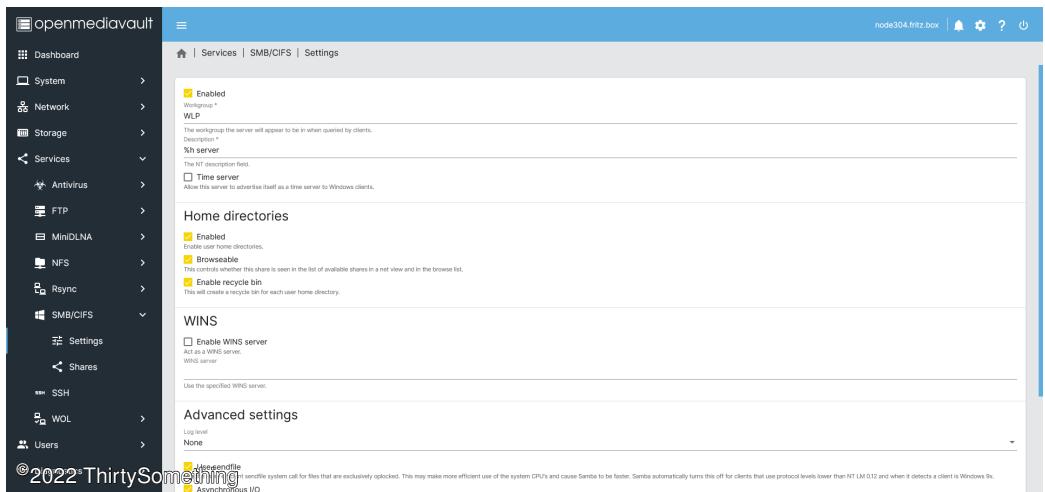
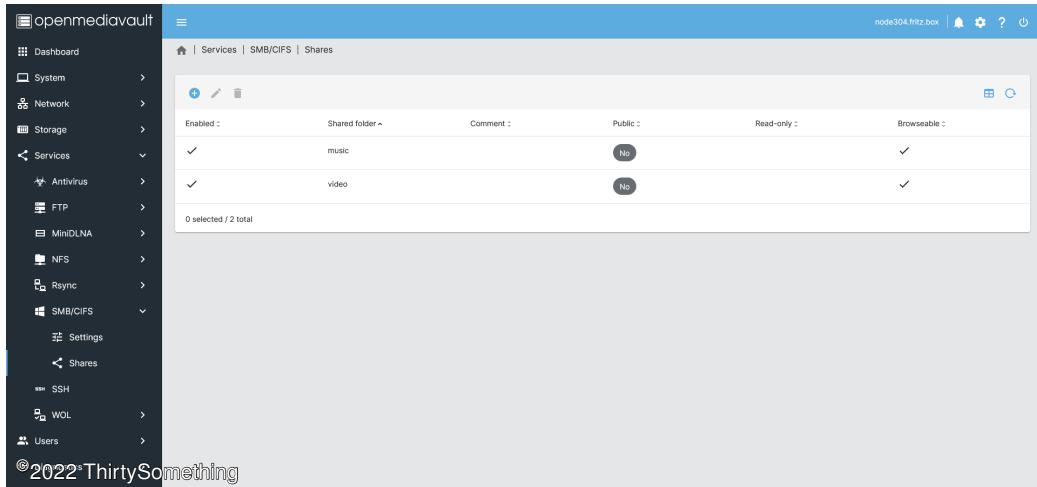


Figure 8: The OMV CIFS settings

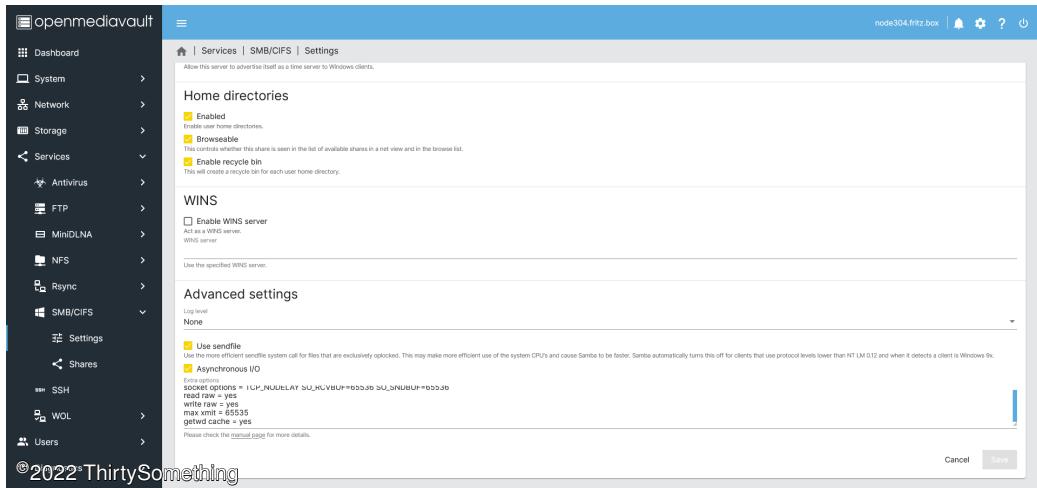
**Figure 9:** The OMV CIFS shares

As you can see there is actually no public access to these shares. This means that only privileged users can access them.

4.8 Tuning

4.8.1 SMB/CIFS

Transferring data from the old **NAS** to the new one takes a lot of time. To speed up the process I searched for some tuning and found this [here](#):

**Figure 10:** The OMV advanced CIFS settings

5 OMV plugins

5.1 ClamAV

To protect the data I want to use an antivirus program. As open source solution there is [ClamAV](#) available – and also as plugin for [OMV](#).

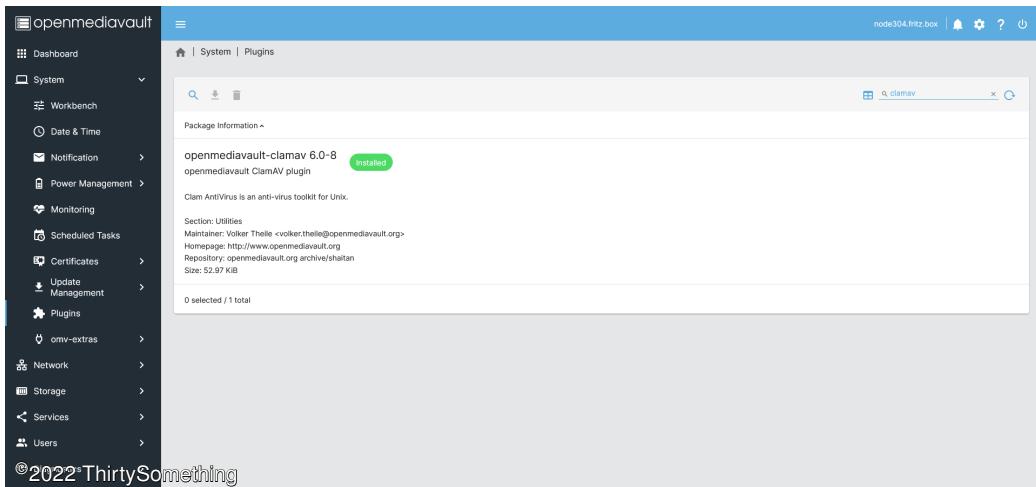


Figure 11: The OMV ClamAV plugin

In the setup we use the previously defined quarantine folder.

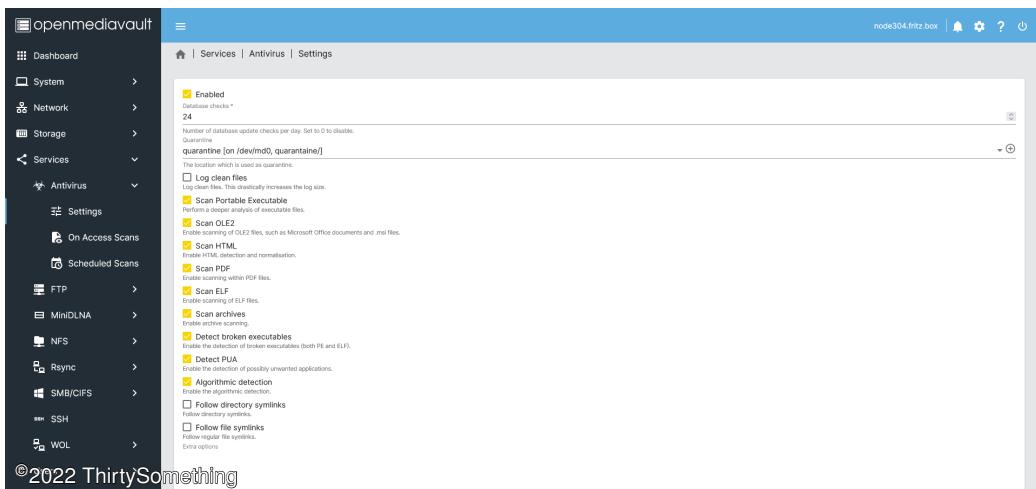


Figure 12: The antivirus settings

I enabled a scan on access for specific folders.

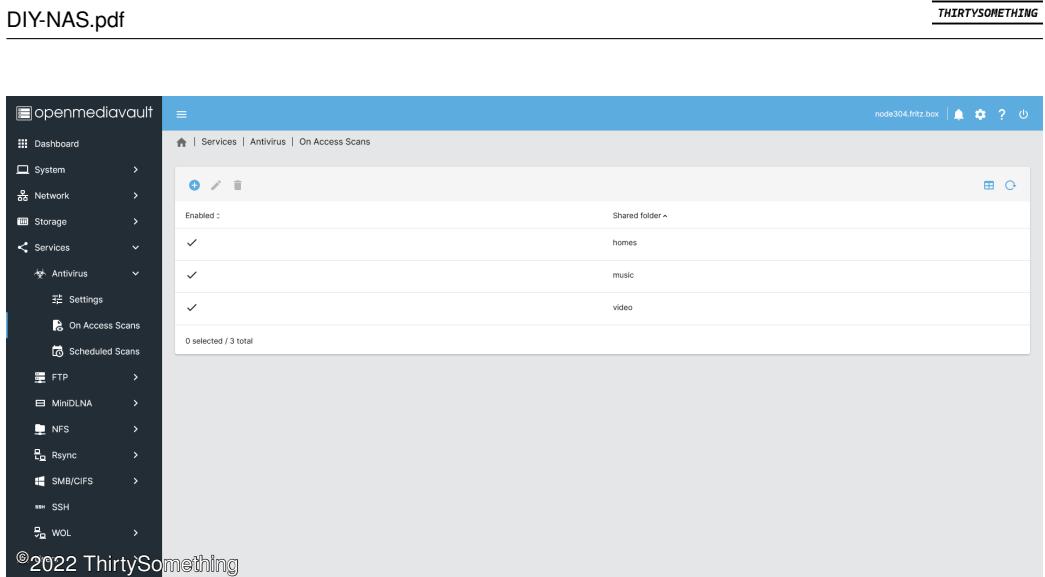


Figure 13: The antivirus on access scan

Also I've enabled a scheduled scan for these folders, too.

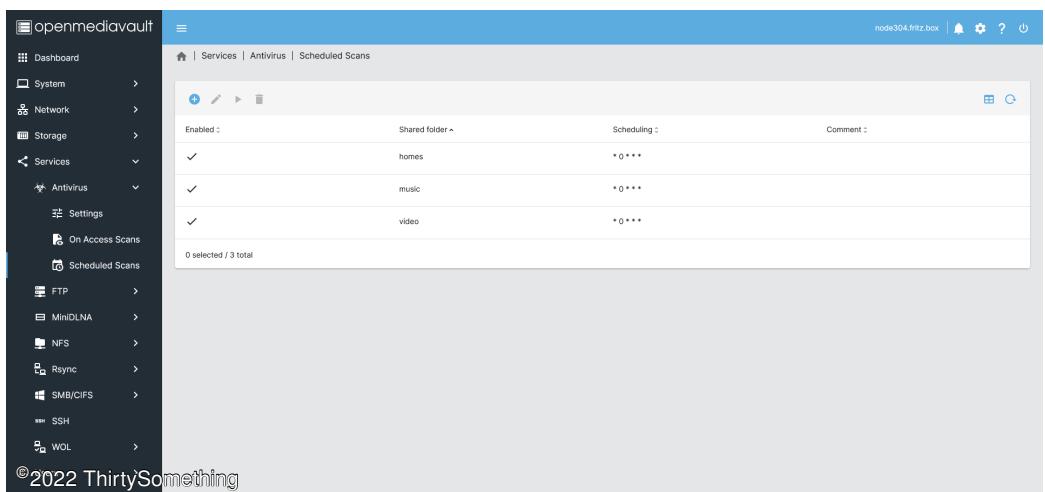


Figure 14: The antivirus scheduled scan

Maybe somebody will claim that all scheduled scans run on the same time. Yes – this was setup to check the power of the CPU. The system load increases to a load of about 3 – that's fantastic from my point of view! This means that there are more than enough reserves. When I'm spreading the schedule I can lower the load.

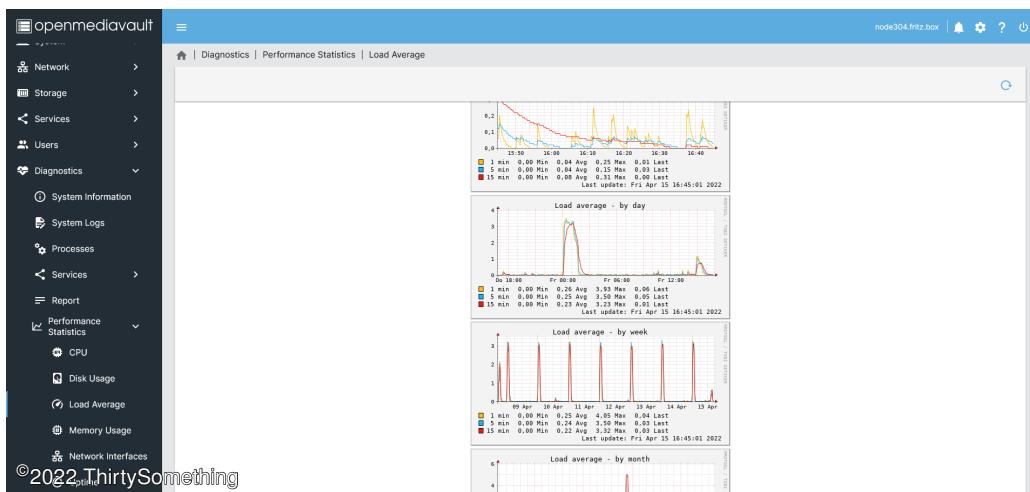


Figure 15: The antivirus system load on scan

5.2 MiniDLNA

To stream music and videos from the [NAS](#) to the network I'm using the [ReadyDLNA](#) media server software. In [OMV](#) this is used with the old name [Minidlna](#).

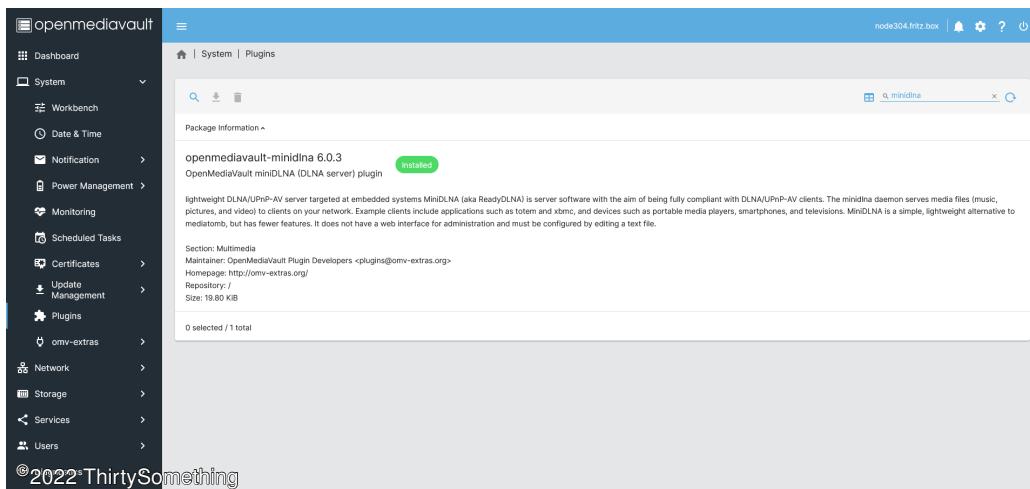


Figure 16: The MiniDLNA plugin

The basic setup is simple - I've checked the [Enable](#) box and that's it.

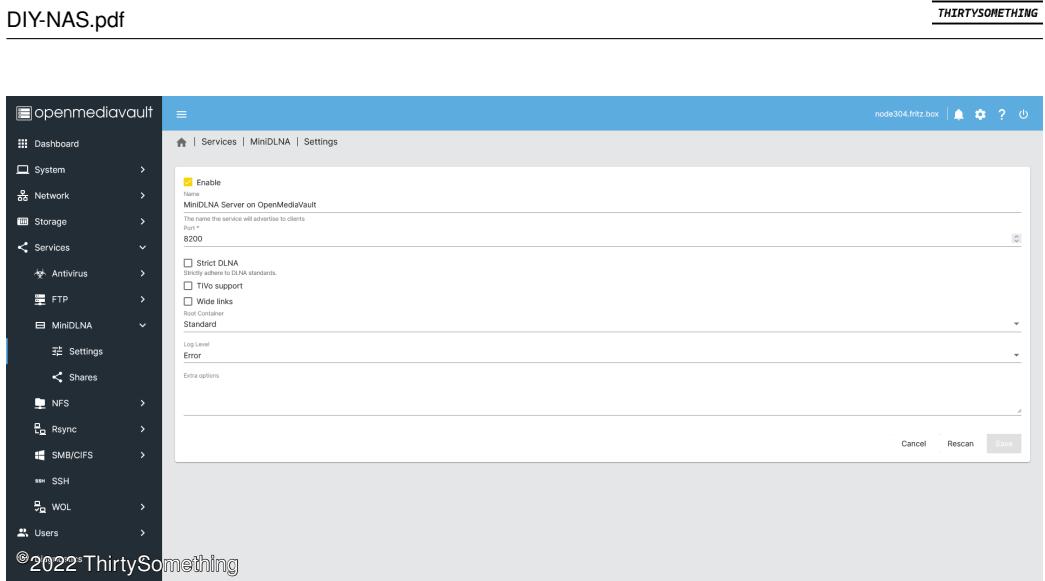


Figure 17: The MiniDLNA settings

Then I have to define the shares and the kind of content of the shares.

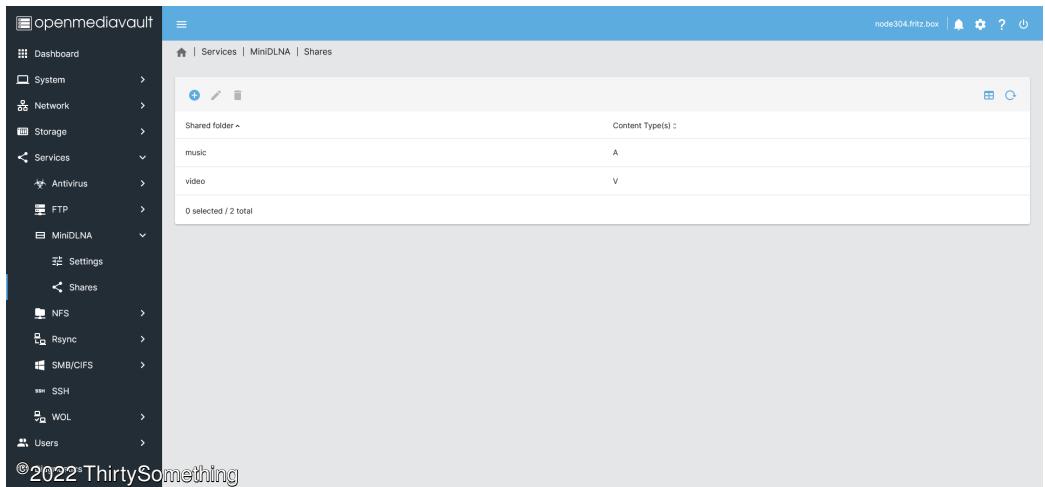


Figure 18: The MiniDLNA shares

5.3 OMV extras

The **OMV extras** are not available in the plugin list. The way to go to install them is described [here](#). Login as user `root` using SSH and enter the following command:

```
sudo su -
wget -O https://github.com/OpenMediaVault-Plugin-Developers/packages/raw/master/install | bash
```

Figure 19: The OMV extras installation

Using this plugin enables the [Docker](#) and [Portainer](#) installation to enhance the capabilities of the [NAS](#).

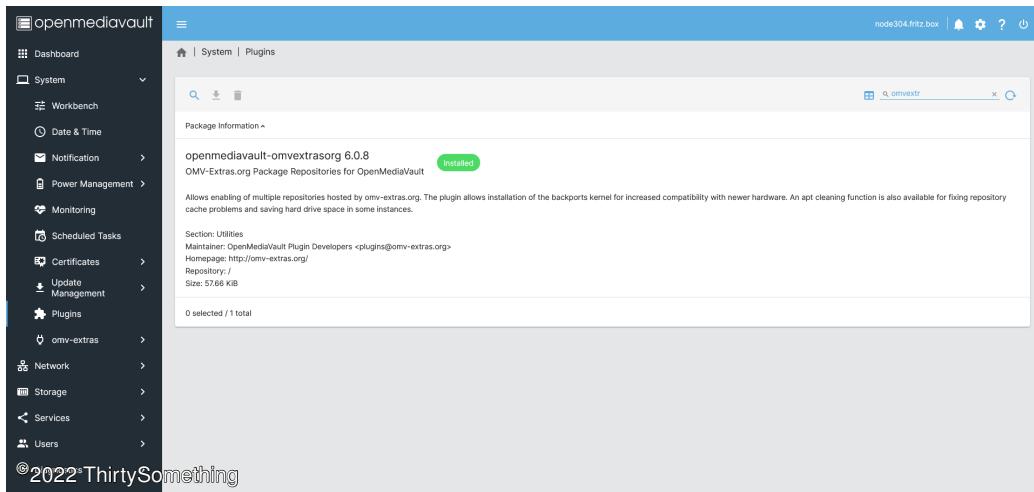


Figure 20: The OMV extras plugin

5.4 Autoshutdown

To save some energy we want the system to shutdown when not used and to wake up when used. So we want to use the autoshutdown plugin and the [WOL](#) feature. **NOTE:** Don't forget to enable [WOL](#) in the BIOS. For my system there have been two settings, one setting on the adapter itself and one setting in the boot options.

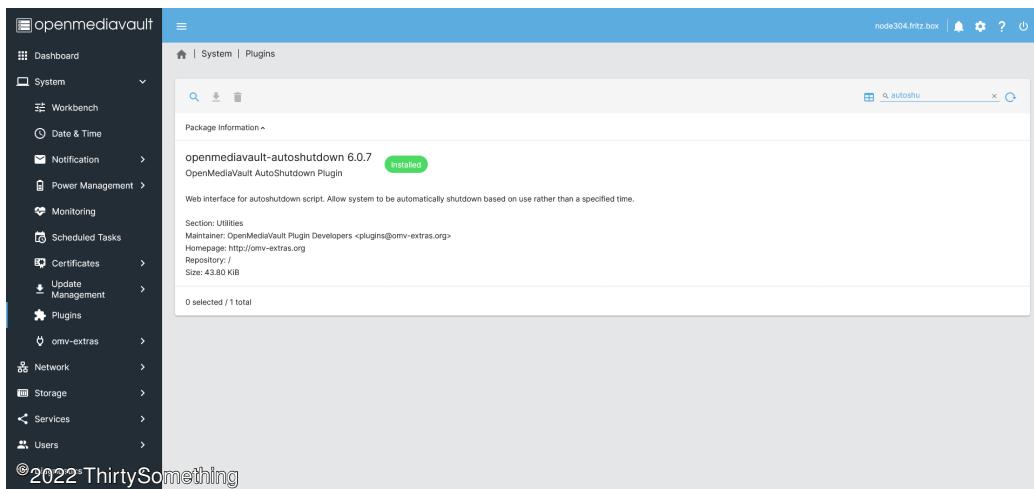


Figure 21: The OMV autoshutdown plugin

As first step we have to enable the **WOL** on the network card. You can find the checkbox as last option of the Advanced settings section.

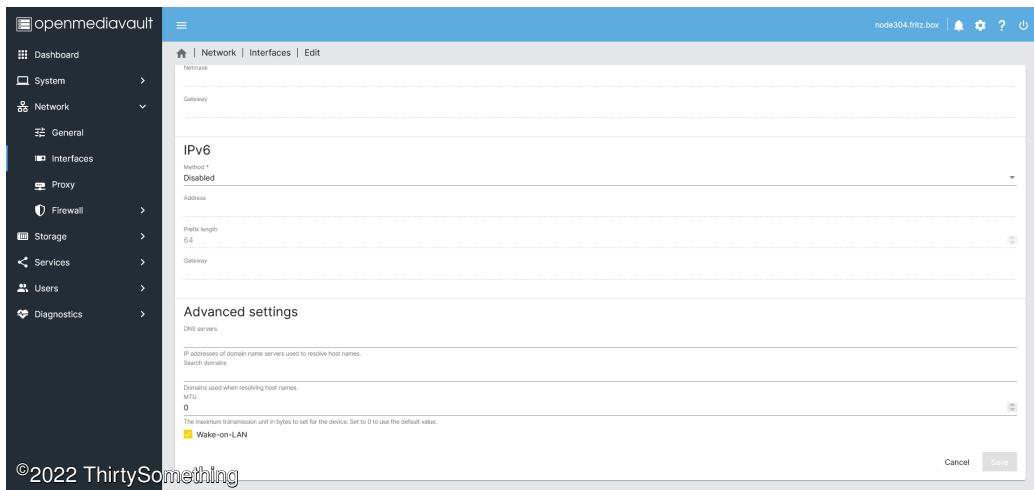


Figure 22: The OMV network card setup

Then we have to configure/setup the autoshutdown plugin. First step is to enable the autoshutdown. Second step is to force an uptime between 23:30 and 02:00 to ensure backup is done. The rest is left with default settings and might be updated at a later point.

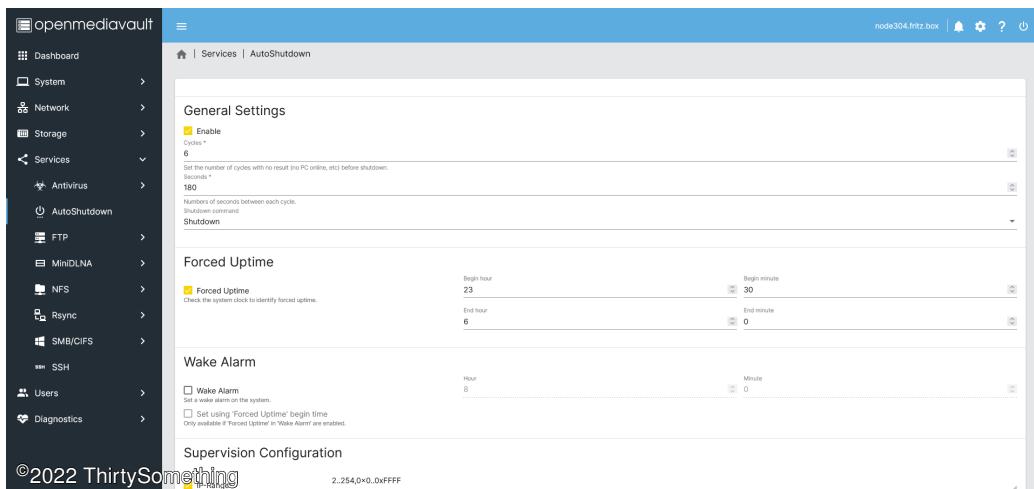


Figure 23: The autoshutdown setup 1

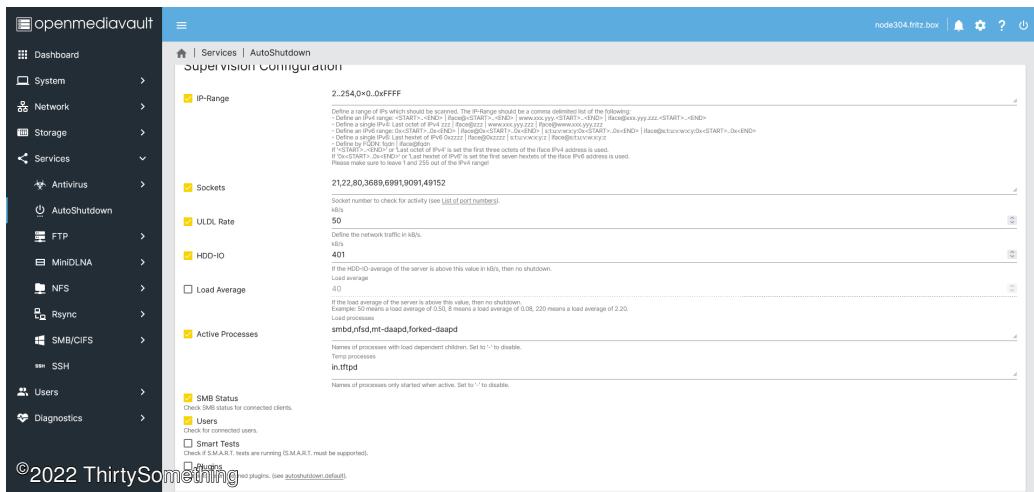


Figure 24: The autoshutdown setup 2

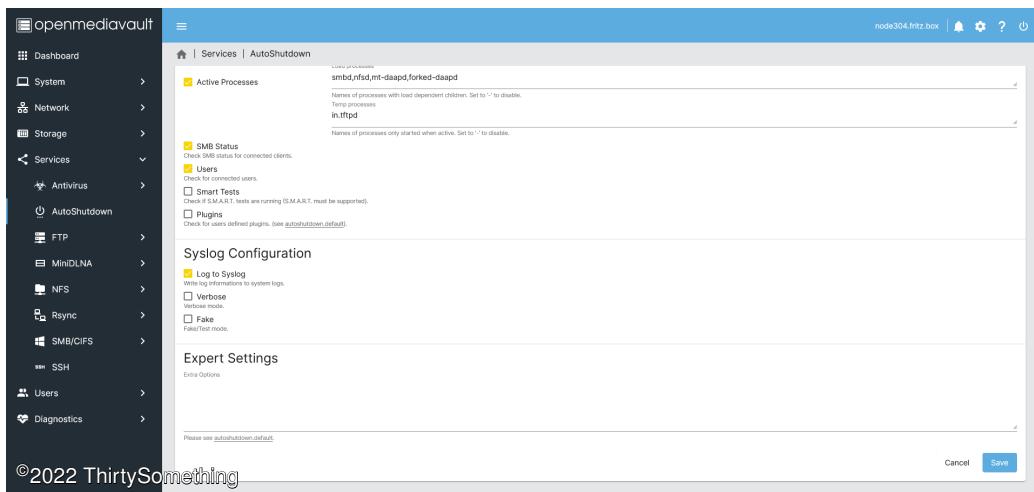


Figure 25: The autoshutdown setup 3

5.5 PhotoPrism

I used the app [PhotoPrism](#) to de-duplicate my images. The last 15 years a lot of duplicates blowed up the collection. Let's start with the first step, the installation of the plugin.

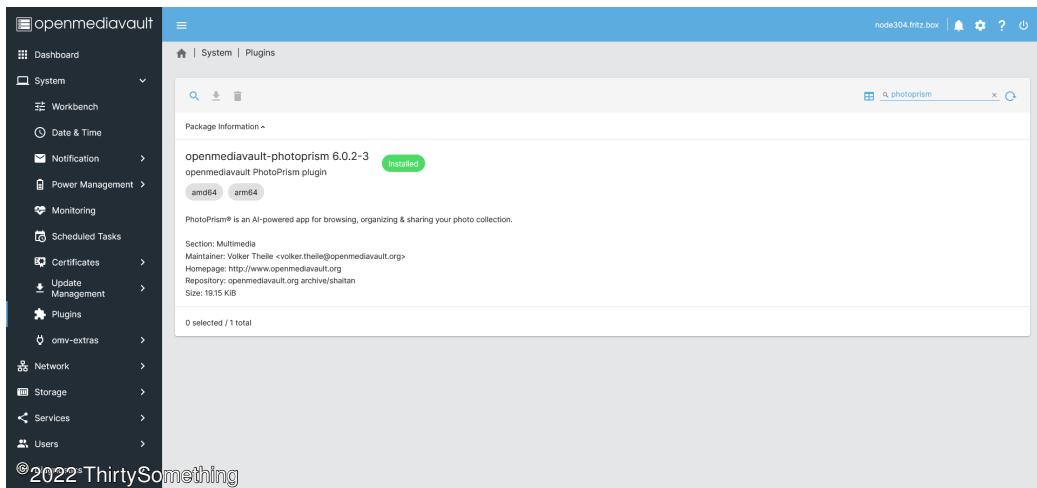


Figure 26: The OMV PhotoPrism plugin

The next step has been the creation of the following shared folders:

- **photoprism** – The location for the image database.
- **photoprism_import** – The share used for image import.
- **photos** – The final location of the photos in an organized way.

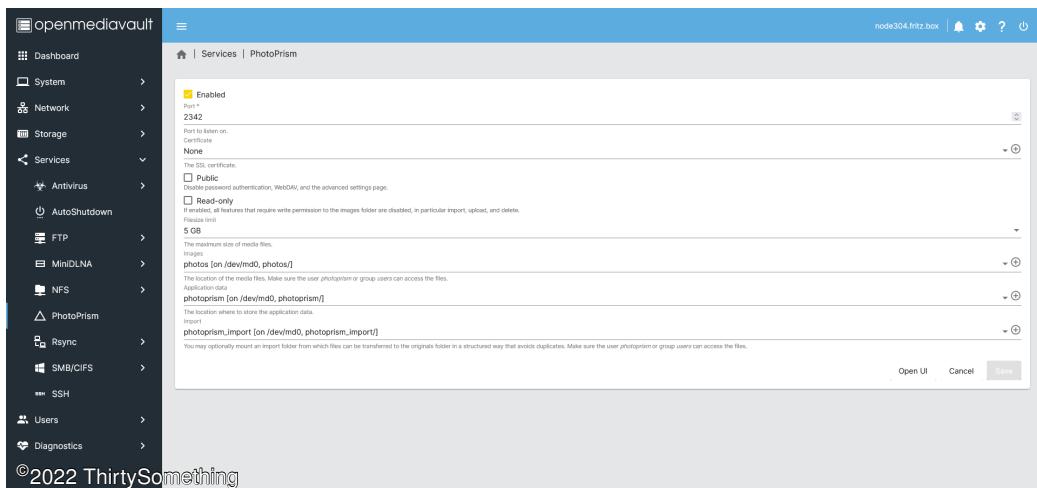


Figure 27: The OMV PhotoPrism setup

The setup is easy, just set the shares – that's all folks. Okay – I remember some images I made with a digital SLR camera. They are large as I remember, so I've increased the filesize limit to 5 GB.



Figure 28: The PhotoPrism login

6 Docker

By using [Docker](#) I want to enhance the [NAS](#) with features which are not available out-of-the-box. Especially with services my previous [NAS](#) offers and which are not native available for [OMV](#).

6.1 Docker installation

The default location of [Docker](#) is `/var/lib/docker` on the system disk. Although the system disk is a fast SSD, I want to install [Docker](#) on the slower RAID storage. So I have to change the path of [Docker](#) storage.

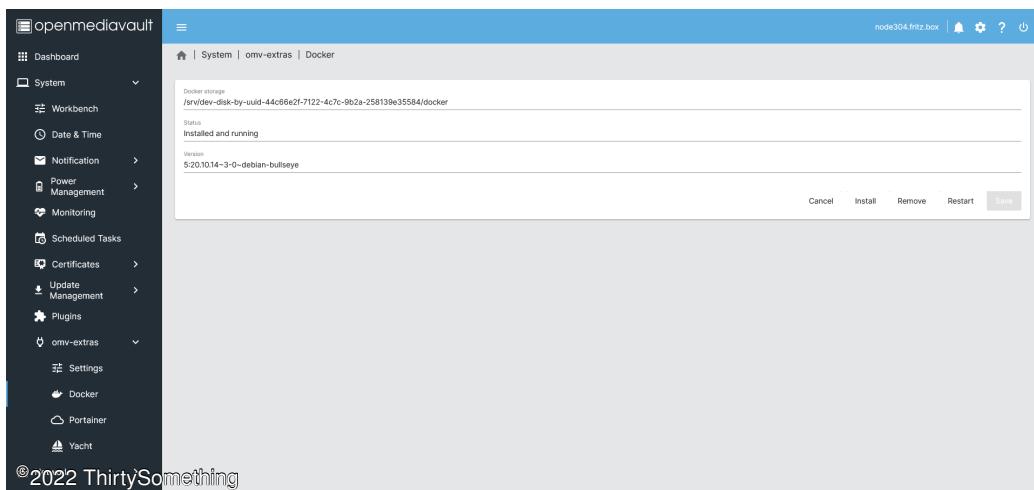


Figure 29: The Docker setup

In case [Docker](#) is already installed, see [here](#) how to move the [Docker](#) storage to another location.

6.2 Portainer

To have more comfort in dealing with [Docker](#) we install also [Portainer](#) from the [OMV extras](#).

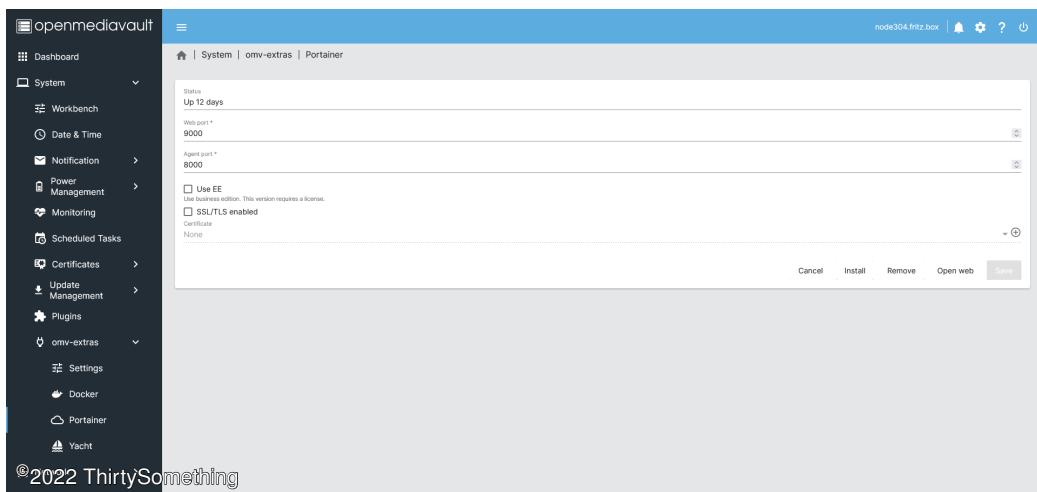


Figure 30: The Portainer setup

After installation **Portainer** is up and running.

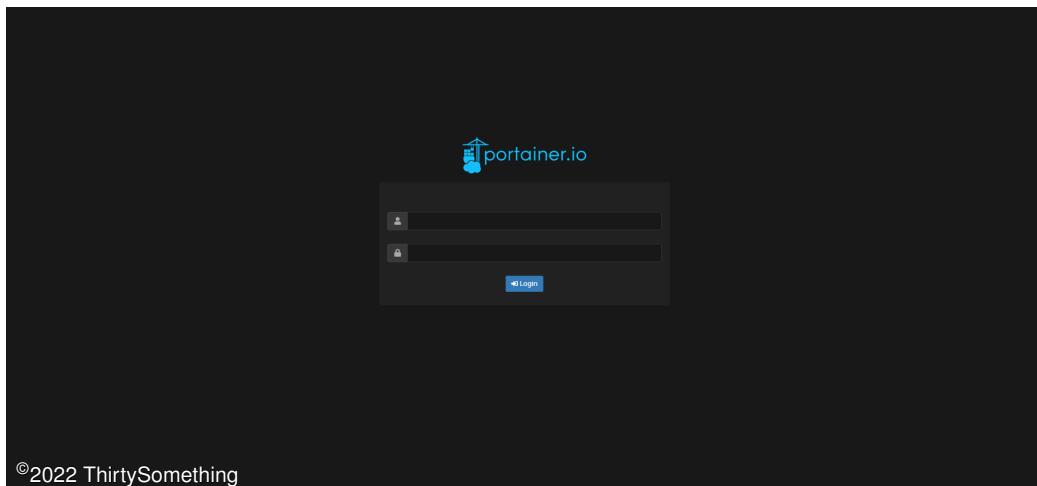


Figure 31: The Portainer login

6.3 Container list

- [Portainer](#) — UI for docker – done with docker installation.
- [SCM-Manager](#) — SCM with git, svn and hg – done.
- [MariaDB](#) — Database for various projects – done.
- [phpMyAdmin](#) — UI for the database – done.
- [Mosquitto](#) — A MQTT broker – done.
- [Syncthing](#) — File synchronization – done.
- [Nextcloud](#) — Own cloud service
- Backup server?
 - [restic](#)
 - [Duplicati](#)
- [MinIO](#) — As data sink for backup?
- [Pi-hole](#) — Adblocker for the network – won't do that, see section [6.4](#) for explanation
- [gotify](#) — Notification server

Figure 32: Containerlist

6.4 Pi-hole

I'm already using [Pi-hole](#) on a old [Raspberry Pi 2B](#) and I'm very pleased with that software. Because of its nature working as a [DNS resolver](#) I won't move this to the NAS. The reason is quite simple – this will influence the [Autoshutdown](#) plugin and/or will make it obsolete. This is not what I want to achieve.

6.5 SCM-Manager

[SCM-Manager](#) provides a comfortable user interface for [git](#), [Mercurial](#) and [Subversion](#). Up to now I use [Subversion](#) for [version control](#). Some of my

repositories are private and I will never publish them to a public hoster like [GitHub](#) although they offer private repositories. All my other repositories are hosted on my [NAS](#) – the plan is to move them to [git](#) if possible – just to have them on a more modern version control system.

The definition for [Docker compose](#) looks like:

```
version: '3.7'
services:
  scmmanager:
    image: clodogu/scm-manager:latest
    restart: unless-stopped
    ports:
      - 2222:2222
      - 8080:8080
    volumes:
      - scm-config:/var/cache/scm/work
      - scm-data:/var/lib/scm
  volumes:
    scm-config:
    scm-data:
```

Figure 33: docker-compose.yaml for SCM-Manager

The startup of the container should work without any problems.

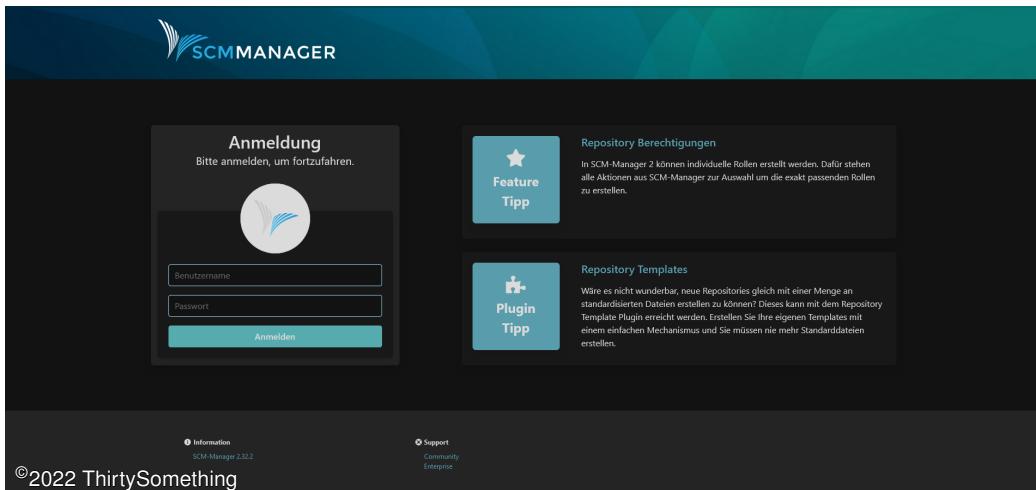


Figure 34: The SCM-Manager login

After importing my repositories, I've setup a backup job. For this I've updated my script [svnExport.sh](#) that it will work for [SCM-Manager](#). Setting up a cronjob inside a [Docker](#) container is a [pita](#). The previously created volume is required to dynamically export all existing [Subversion](#) repositories. The command will be something like this one:

```
/bin/bash /srv/<omv-raid>/<path-to-script>/svnExport.sh >>
/srv/<omv-raid>/<path-to-script>/svnExport.log 2>&1 &
```

Figure 35: Cron command for svnExport

For the script please see appendix [A](#).

The job is then setup in [OMV](#) scheduled tasks accessing the script. **NOTE:** The path to the [SCM-Manager](#) repositories needs to be set inside in the script.

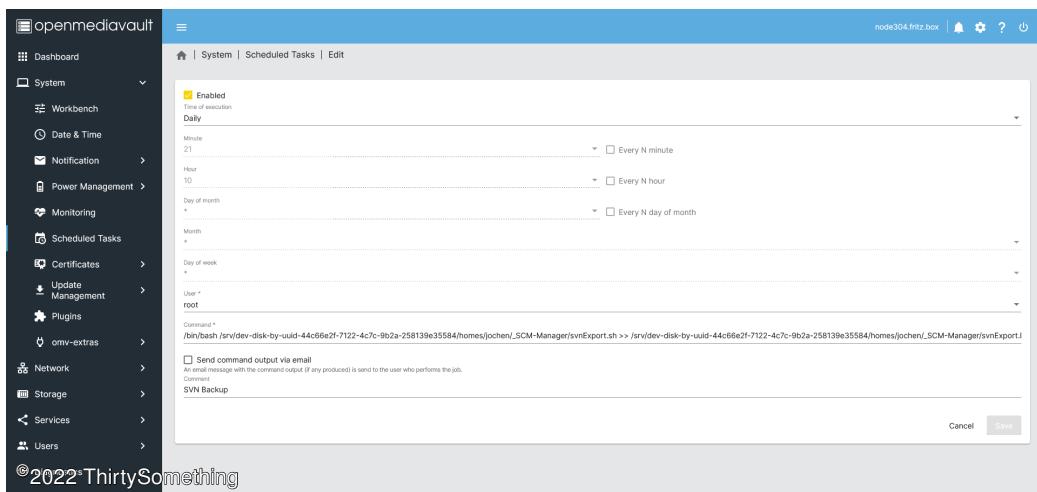


Figure 36: The SCM-Manager backup task

6.6 Syncthing

[Syncthing](#) is a file synchronization service. I use this to backup automatically data from my smartphone to the PC and then from the PC to the NAS. The setup is easy regarding the [Docker README](#) of the project.

The definition for [Docker compose](#) looks like:

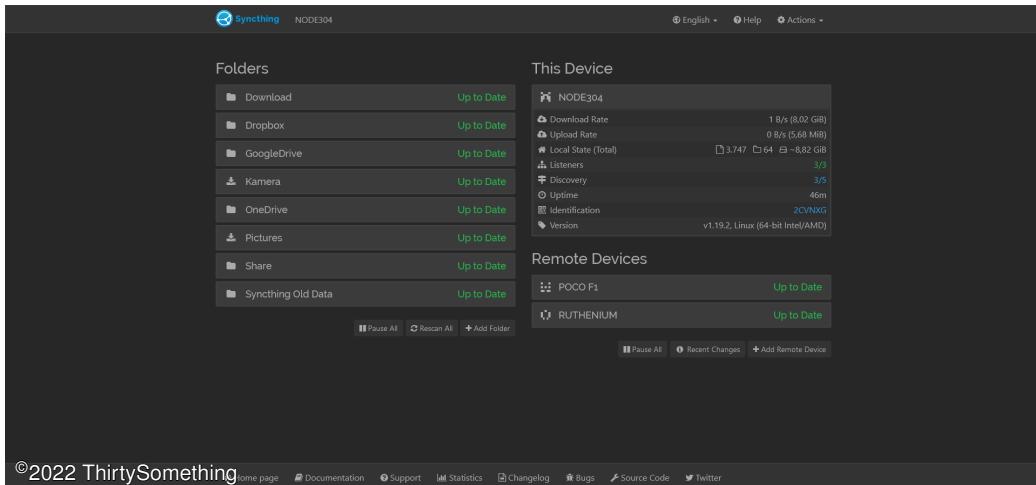
```

version: '3.7'
services:
  syncthing:
    image: syncthing/syncthing:latest
    restart: unless-stopped
    environment:
      PUID: 1000
      GUID: 1000
    ports:
      - 8384:8384
      - 21027:21027/udp
      - 22000:22000/tcp
      - 22000:22000/udp
    volumes:
      - syncthing-data:/var/syncthing
  volumes:
    syncthing-data:

```

Figure 37: docker-compose.yaml for Syncthing

Setting up the synchronized folders is as usual with [Syncthing](#). The result may look like this one.

**Figure 38:** Syncthing

6.7 Watchtower

The [Watchtower](#) container is very simple to install. There is no need for a volume. And – they offer on their website a `docker-compose.yaml` file. Just copy this definition to a new Portainer stack, deploy and run. I've extended the default file with the settings of email notifications.

```
version: "3"
services:
  watchtower:
    image: containrrr/watchtower
    volumes:
      - /var/run/docker.sock:/var/run/docker.sock
    environment:
      # WATCHTOWER_MONITOR_ONLY: 'true'
      WATCHTOWER_NOTIFICATIONS: email
      WATCHTOWER_NOTIFICATION_EMAIL_FROM: developer@derpaul.net
      WATCHTOWER_NOTIFICATION_EMAIL_TO: developer@derpaul.net
      WATCHTOWER_NOTIFICATION_EMAIL_SERVER: <smtp server>
      WATCHTOWER_NOTIFICATION_EMAIL_SERVER_PORT: 587
      WATCHTOWER_NOTIFICATION_EMAIL_SERVER_USER: developer@derpaul.net
      WATCHTOWER_NOTIFICATION_EMAIL_SERVER_PASSWORD: <top secret password>
      WATCHTOWER_NOTIFICATION_EMAIL_DELAY: 2
    restart: unless-stopped
```

Figure 39: docker-compose.yaml for Watchtower

This container does not have any user interface. The purpose of this container is to keep all other containers with the :latest suffix up to date. In concrete means this to check for newer versions of containers and will update/restart them automagically if required. For german users there is an [introduction](#) video available.

6.8 MariaDB und phpMyAdmin

This will become a little bit more complicated. Basically you need three components to run all:

- The database [MariaDB](#)
- A webserver like [Apache](#), [nginx](#) or something else
- And [phpMyAdmin](#)

I chose not to install the web server separately and instead chose a Docker container that contains the web server in addition to phpMyAdmin. But let's start with [MariaDB](#) at first.

```
version: '3.7'
services:
  mariadb:
    image: mariadb:latest
    restart: unless-stopped
    environment:
      MARIADB_ROOT_PASSWORD: <top secret password here>
    volumes:
      - mariadb-data:/var/lib/mysql
    ports:
      - 3306:3306
volumes:
  mariadb-data:
```

Figure 40: docker-compose.yaml for MariaDB

Then we setup the container for [phpMyAdmin](#):

```
version: '3.1'
services:
  phpmyadmin:
    image: phpmyadmin:latest
    restart: unless-stopped
    ports:
      - 8088:80
    environment:
      PMA_HOST: <IP of your host>
```

Figure 41: docker-compose.yaml for phpMyAdmin

And here we go:



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Figure 42: phpMyAdmin

6.9 Mosquitto

I used [Mosquitto](#) in some projects. For testing purposes I've used the public version of [Mosquitto](#) or installed locally one on my developer machine. Now it's time to run it on my [NAS](#). The definition for [Docker compose](#) looks like:

```
version: '2.4'
services:
  mosquitto:
    image: eclipse-mosquitto:latest
    restart: unless-stopped
    environment:
      PUID: 1000
      GUID: 1000
    ports:
      - 1883:1883
      - 9001:9001
    volumes:
      - mosquitto-config:/mosquitto/config
      - mosquitto-data:/mosquitto/data
      - mosquitto-log:/mosquitto/log
volumes:
  mosquitto-config:
  mosquitto-data:
  mosquitto-log:
```

Figure 43: docker-compose.yaml for Mosquitto

7 Ports

It's always a good idea to remember the used ports. This section will give you an overview about the used ports and the name of the program using this port.

Program	Port	Comment
MariaDB	3306	Database connection port
Mosquitto	1883	MQTT
Mosquitto	9001	MQTT
OMV	80	UI
PhotoPrism	2342	UI
phpMyAdmin	8088	UI
Portainer	9000	UI
SCM-Manager	8080	UI
SCM-Manager	2222	ssh
Syncthing	8384	UI
Syncthing	TCP:22000	Filetransfer
Syncthing	UDP:22000	Filetransfer
Syncthing	UPD:21027	Receive local discovery broadcasts

Table 2: Used ports - order by program

Program	Port	Comment
OMV	80	UI
Mosquitto	1883	MQTT
SCM-Manager	2222	ssh
PhotoPrism	2342	UI
MariaDB	3306	Database connection port
SCM-Manager	8080	UI

phpMyAdmin	8088	UI
Portainer	9000	UI
Mosquitto	9001	MQTT
Syncthing	8384	UI
Syncthing	UPD:21027	Receive local discovery broadcasts
Syncthing	TCP:22000	Filetransfer
Syncthing	UDP:22000	Filetransfer

Table 3: Used ports - order by port

A svnExport.sh

```
#!/bin/bash
#+-----+
#| Script to export configured svn repositories |
#+-----+
# Comment line out for debugging purposes
# set -x
#+-----+
#| Variable definitions |
#+-----+
# location of all repositories
VAR_PATH SVN="/srv/dev-disk-by-uuid-44c66e2f-7122-4c7c-9b2a-258139e35584/docker/volumes/scmmanager_scm-data/_data/repositories/*"
# suffix for SCM organized repositories
SUFFIX SVN=data
# filename containing real repository name
META SVN=metadata.xml
# maximum days to keep a backup
INT AGE=5
# file extension
STR EXT=gz
# current date
STR DATE=$(date +%Y-%m-%d)
# get current name of backup folder
DIR EXPORT=$(dirname "${0}")
DIR EXPORT=$(realpath "${DIR EXPORT}")

#+-----+
#| Check for valid SVN repository |
#+-----+
function is_svn_repository {
    svnlk info "${1}" >/dev/null 2>&1
    echo $?
}

#+-----+
#| Get base name for SVN repository |
#+-----+
function get_svn_base_name {
    REPOBASE=$(dirname "${1}")/${META SVN}
    REPONAME=$(xmlstarlet sel -T -t -m "/repositories/name" -v "/repositories/name" < "${REPOBASE}")
    echo "${REPONAME}"
}

#+-----+
#| Create name for SVN repository for export |
#+-----+
function get_svn_destination_name {
    REPOBASE=$(get_svn_base_name "${1}")
    echo "${DIR EXPORT}/${REPOBASE}-${STR DATE}.${STR EXT}"
}

#+-----+
#| Delete backups older than specified age |
#+-----+
function drop_old_exports {
    PATTERN=$(get_svn_base_name "${1}")
    FTK=$((0 + ${INT AGE}))
    echo "$(date +'%Y%m%d-%H:%M:%S'): Keep the last ${INT AGE} backups"
    COUNTER=0
    for CURRENT_DUMP in $(find "${DIR EXPORT}" -name "${PATTERN}.*.${STR EXT}" | sort -nr); do
        if [[ "${CURRENT_DUMP}" -lt "${FTK}" ]]; then
            echo "Keep dump [${CURRENT_DUMP}]"
        else
            echo "Delete dump [${CURRENT_DUMP}]"
            rm "${CURRENT_DUMP}"
        fi
        COUNTER=$((COUNTER + 1))
    done
    echo ""
}

#+-----+
#| Export SVN repository |
#+-----+
function export_svn_repository {
    VAR_DEST_NAME=$(get_svn_destination_name "${1}")
    echo "$(date +'%Y%m%d-%H:%M:%S'): Dumping repo [${1}] to [${VAR_DEST_NAME}]"
    svnadmin dump "${1}" | gzip > "${VAR_DEST_NAME}"
}

#+-----+
```

```
#| Loop over all repositories |  
#+-----+  
echo "===== Start export of SVN repositories for date [${STR_DATE}]"  
for VAR_CURRENT_DIR in ${VAR_PATH SVN}; do  
    SVN_REPO="${VAR_CURRENT_DIR}/${SUFFIX SVN}"  
    if [[ ${is_svn_repository "${SVN_REPO}"} -eq 1 ]]; then  
        echo "$(date +'%Y%m%d-%H:%M:%S'): Skip non SVN repository [${SVN_REPO}]."  
        echo ""  
    else  
        export_svn_repository "${SVN_REPO}"  
        drop_old_exports "${SVN_REPO}"  
    fi  
    echo "-----"  
done  
echo ""
```

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Glossary

ClamAV ClamAV, an open source antivirus software [13](#)

Docker Container based virtualization [4, 5, 9, 17, 22, 25](#)

Docker compose Definition of container using Docker compose [25, 26, 30](#)

git git, a version control system [24, 25](#)

MariaDB MariaDB, a RDBMS [28, 31](#)

Mosquitto Mosquitto, an open source MQTT broker [30–32](#)

NAS Network Attached Storage [3–5, 12, 15, 17, 22, 25, 30](#)

OMV Open Media Vault, a NAS operating system [5, 7, 10, 13, 15, 22, 26, 31](#)

OMV extras Open Media Vault Extras, value added plugins to OMV [16, 22](#)

PhotoPrism PhotoPrism, AI powered photo manager [19, 31](#)

phpMyAdmin phpMyAdmin, an UI for MariaDB [28, 29, 31, 32](#)

Pi-hole Pi-hole, network-wide ad blocking [24](#)

Portainer Portainer, a container management tool [17, 22, 23, 31, 32](#)

SCM-Manager SCM-Manager, a version control system server [24–26, 31](#)

Subversion Subversion, a version control system [24, 25](#)

Syncthing Syncthing, file synchronization [26, 27, 31, 32](#)

Synology Manufacturer of NAS systems [3](#)

WOL Wake On LAN, starts computer by specific network signal [17, 18](#)