Application of containerization in the BM@N experiment

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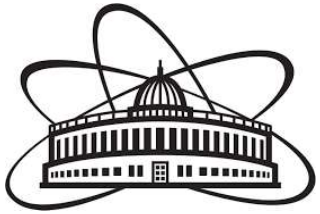


What has been done

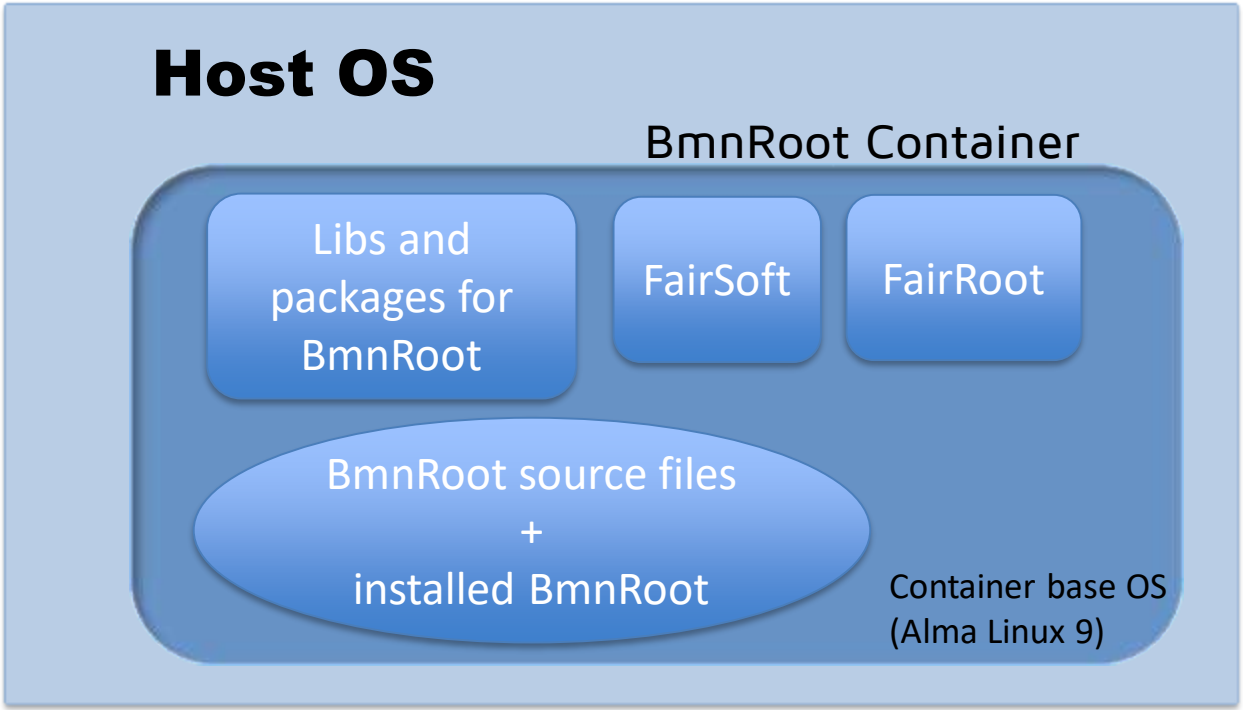
Task: simplify the process of installation and using the BmnRoot by making it's **containers.**

- Two containers were made based on Ubuntu 22.04 and Alma Linux 9 with **full local installation** in it.
- Two containers were made based on Ubuntu 22.04 and Alma Linux 9 with **CernVM-FS client and BmnRoot source files** in it.

Apptainer

- Docker and Apptainer are the containerization platforms.
- **Apptainer**, the container system for high-performance computing (HPC) formerly known as Singularity.
- With Docker and Dockerfiles **images** of BmnRoot were created.
- With Apptainer containers build and startup were implemented.

Full local installation



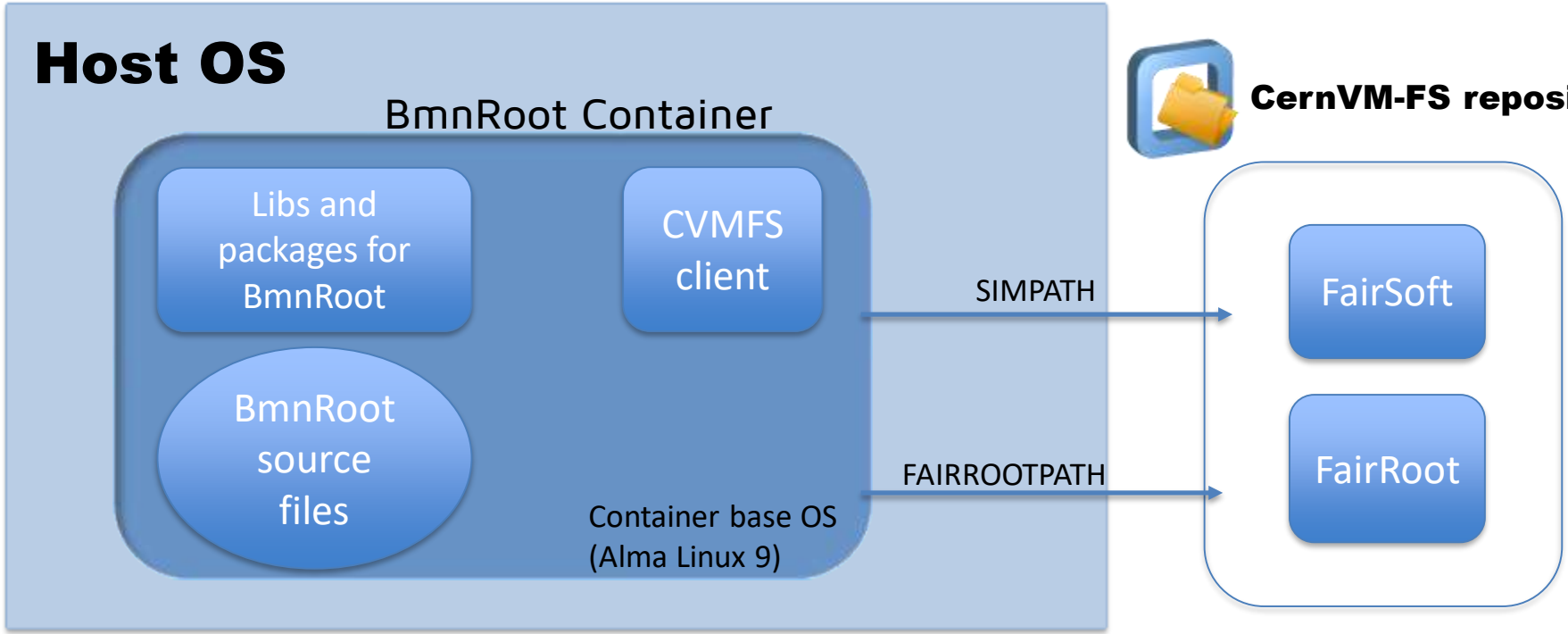
- Isolated from host OS.
- All dependences (libs, packages) and required software are already inside the container.

Why Alma Linux?

What is AlmaLinux?
From the AlmaLinux website:
An Open Source, community owned and governed, forever-free enterprise Linux distribution, focused on long-term stability, providing a robust production-grade platform. AlmaLinux OS is ABI compatible with RHEL®.

CERN, stated that they will offer AlmaLinux as the standard Linux distribution for experiments at their facilities, based on discussions with researchers. (Thu 8 Dec 2022)

Installation with CernVM-FS



How it works using CernVM-FS

1. There is no FairSoft and FairRoot inside the container.
2. They only appear there when the container is started, using the **pre-mount option** in Apptainer.
3. Only when SIMPATH and FAIRROOTPATH variables are pointing to the right directory, BmnRoot installation can be started:
   - It means, that in the very first start of the container the BmnRoot installation is performed.
   - In subsequent container launches, only *config.sh* is executed.
4. Thus, this BmnRoot container is **more lightweight**, uses **officially approved central software repository** on CVMFS and includes only BmnRoot sources downloaded inside. But it requires stable internet connection to download libraries requested while working to the local cache.

Installation script

Installation script is created to simplify the installation of BmnRoot container, without worrying about missing applications (like Apptainer) or it's dependencies.

Script provide 3 options configuring the installation:

- *--force/-f* : installs/reinstalls the apptainer package, even if it is already installed.
- *--os=containerOS* : **ubuntu** OR **almalinux**. Allows one to choose an operating system of the BmnRoot container from the set (AlmaLinux 9 chosen by default).
- *--cvmfs* : deploys BmnRoot container that employs the central CernVM-FS repository with pre-installed FairSoft and FairRoot frameworks instead of their fully-installed versions in containers.

Installation script

Script checks and installs *wget, xauth, xhost and Apptainer* packages in case of their absence.

To start:

```
git clone https://git.jinr.ru/nica/Docker-Images.git docker-images
cd docker-images/images/bmn/
source install_bmn_container.sh
```

After build it adds *aliases* to easy operate the BmnRoot container, after that and in all the subsequent runs user can just use one command (alias):

```
bmn_container
```

Future usage

Containers can be used in HPC Workloads, keeping all the benefits of containers (isolated, pre-made application packages).

But: All containers must run under unprivileged (i.e. rootless) invocation. All commands are called by Slurm as the user with no special permissions.

Thank you for your attention!