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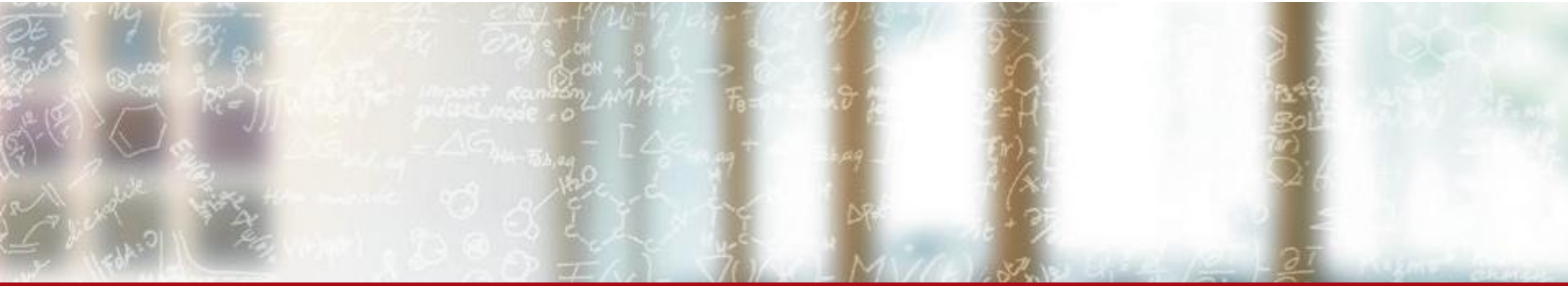

Introduction to containers and Docker

Summer School on Effective HPC for Climate and Weather

Alberto Madonna, CSCS

August 27, 2020

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1. Introduction to containers and Docker (30 min)
2. Tutorial / live demo (60 min)

- Break -

3. Next part: containers on HPC with Sarus

- Slides and code available at https://github.com/eth-cscs/containers-hands-on

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Containers

- Isolated environments to run applications/services
- Images include all software dependencies
- Prescriptive, portable, easy to build, quick to deploy

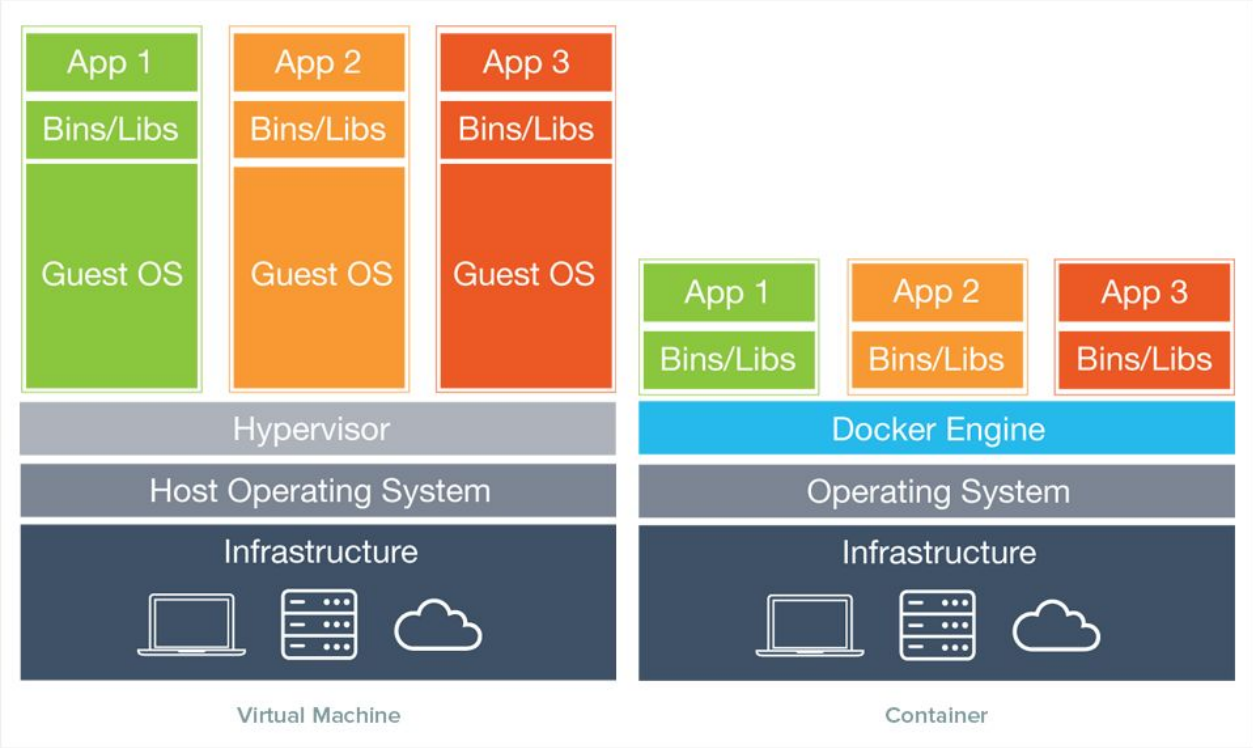
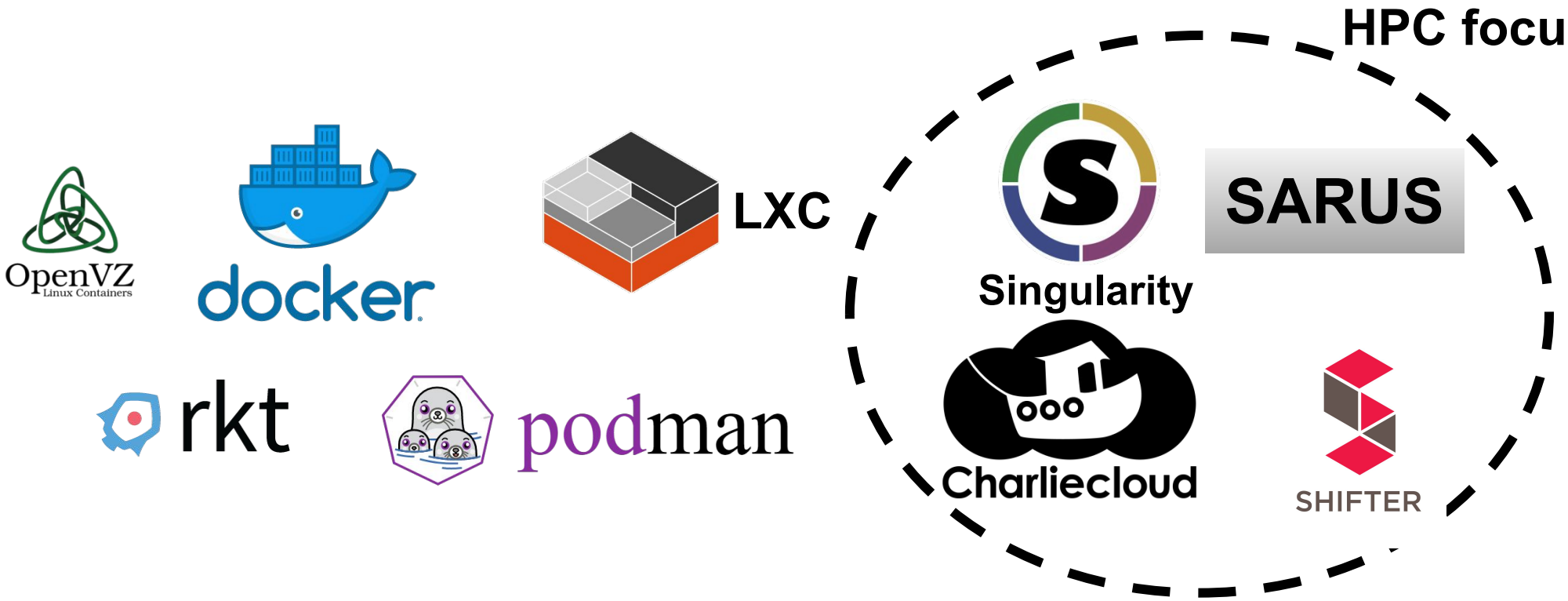


Image credit: Docker Inc.

Linux containers ecosystem

- Linux containers rely on abstraction features (*namespaces*[1]) provided by the kernel
- Different design decisions and use cases gave rise to several solutions:



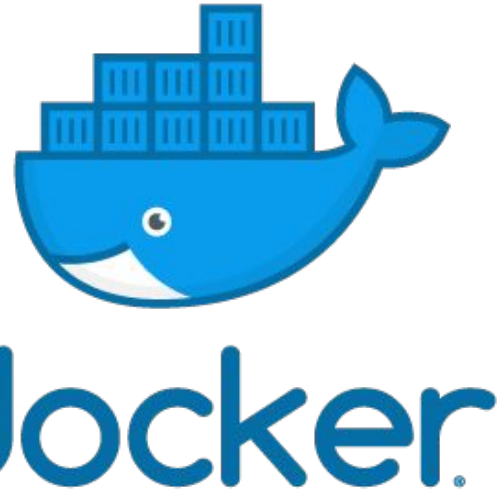
[1] "Namespaces in operation, part 1: namespaces overview" at https://lwn.net/Articles/531114/

Docker

- Extremely popular container implementation

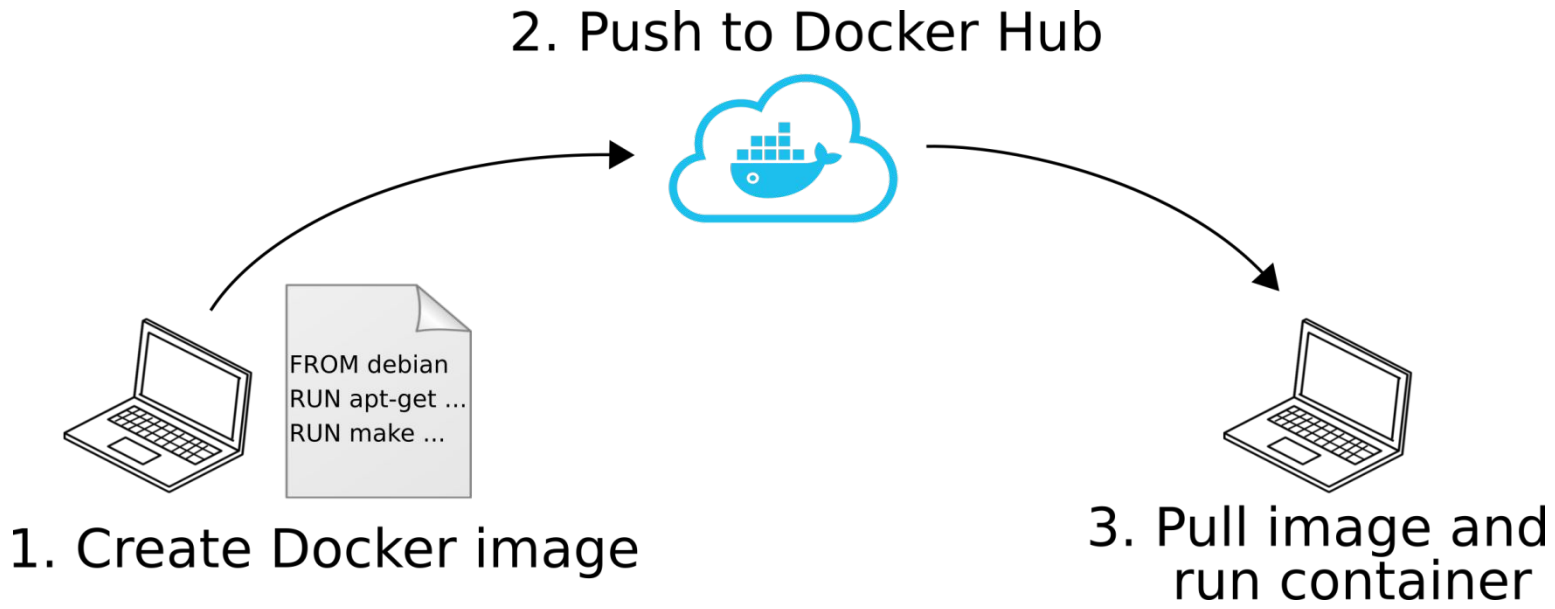
- Easy to use authoring tools
  - Container images are created from recipe-like files
  - Images can be named, tagged and built on top of other images

- Cloud-based image distribution strategy
  - Several remote registries available (e.g. Docker Hub)
  - Client includes facilities to authenticate, push and pull images



Docker workflow

1. An image is created locally from a Dockerfile
2. Push (i.e. upload) the image to a remote registry
   DockerHub is the public registry maintained by the Docker company
3. Pull (i.e. download) the image on a target machine and run the container



Key terms

- **Image**: standalone, executable package that includes everything needed to run a piece of software (code, runtime libraries, configuration files). Provides the filesystem and metadata (e.g. environment variables, initial working directory) for a container.

- **Container**: a process isolated from the rest of the system through abstractions created by the kernel. The level of isolation can be controlled, allowing access to host resources. Its filesystem content comes from an image.
  - Can be thought as the runtime *instance* of an image: what the image becomes in memory when actually executed.

So… how are containers useful?

- Containers give the possibility to create (scientific) applications that are:

1. Portable
2. Prescriptive
3. Easy to deploy
4. Easy to test

Live demo!

Cheatsheet

Step-by-step guide: https://github.com/eth-cscs/containers-hands-on

```
docker pull <user/image:tag>
```

```
docker run <image:tag> <command>
```

```
docker run -it <image:tag> bash
```

```
docker run <image:tag> mpiexec -n 2
```

```
docker images
```

```
docker build -t <user/image:tag> .
```

```
docker login
```

```
docker push <user/image:tag>
```

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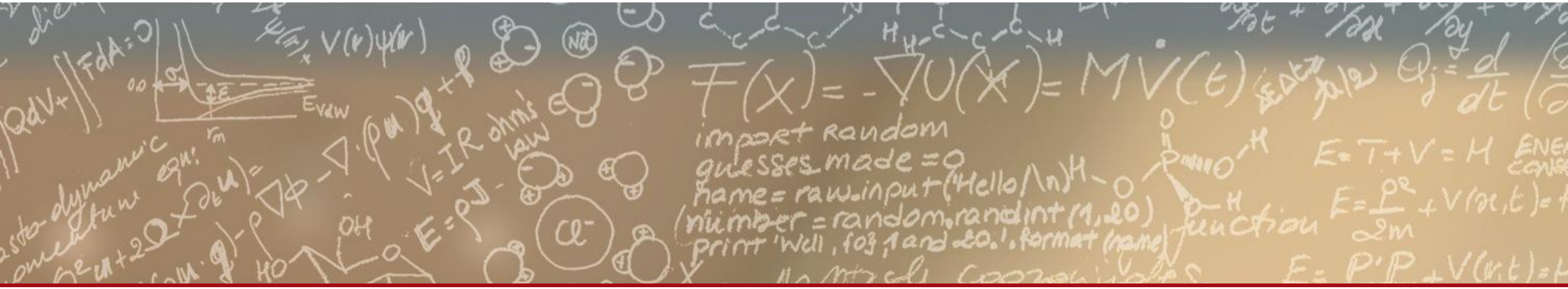

Thank you for your attention.