

Kathará

A container-based framework for experimenting computer networking

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Web	https://www.kathara.org/
Description	An introduction to the architecture, setup and usage of Kathará – based on a similar presentation of Netkit

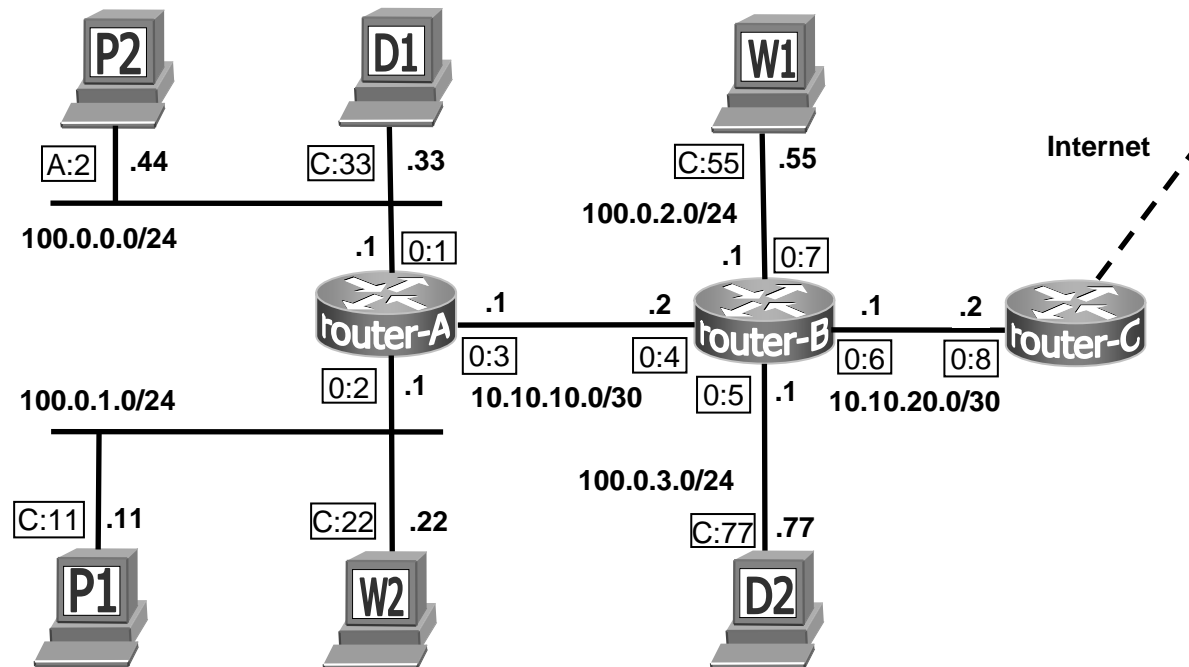
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About computer networks

- Computer networks are quite complex
 - Several devices (computers, routers, etc.)
 - Several interfaces
 - Several protocols running
 - Physical interconnections originate complex topologies

Example of a computer network



How to perform experiments?

- Performing experiments may be unfeasible
- A live network cannot be exploited for experiments
 - It hosts services that are critical for the company
 - It would be necessary to coordinate different departments of the company
- Network equipment is expensive
 - Sometimes, even for performing simple experiments, several equipment should be available in the same test bed

Simulation vs. emulation

- Emulation and simulation systems put at user's disposal a virtual environment that can be exploited for tests, experiments, measures
- **Simulation systems** aim at reproducing the **performance** of a real-life system (latency time, packet loss, etc.)
 - e.g.: ns, real, ...
- **Emulation systems** aim at accurately reproducing the **functionalities** of a real-life system (configurations, architectures, protocols), with limited attention to performance

Kathará

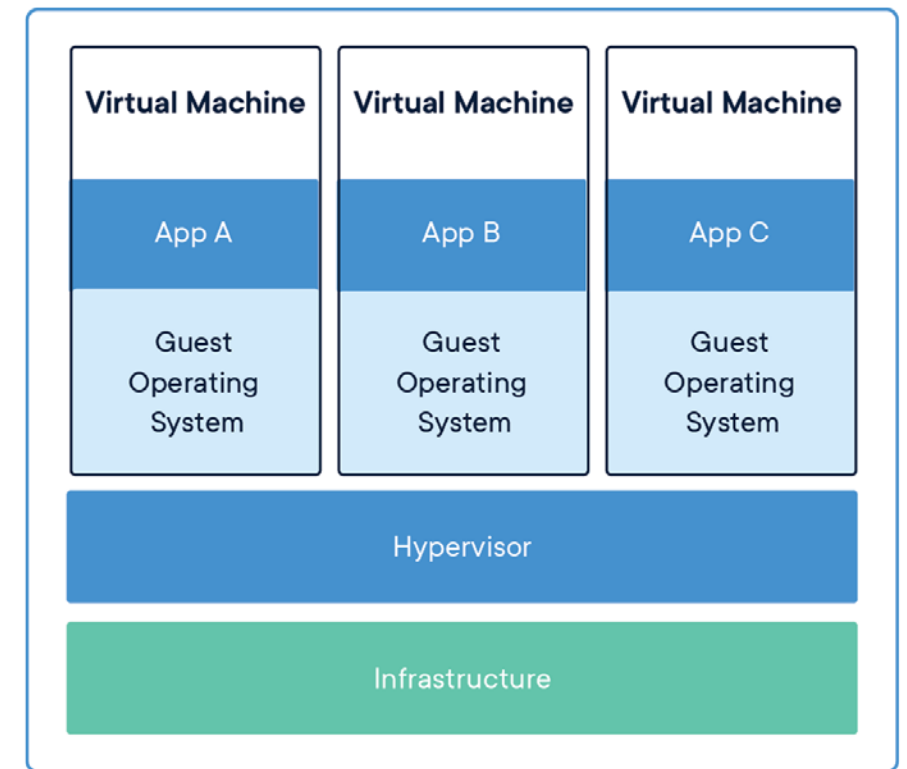
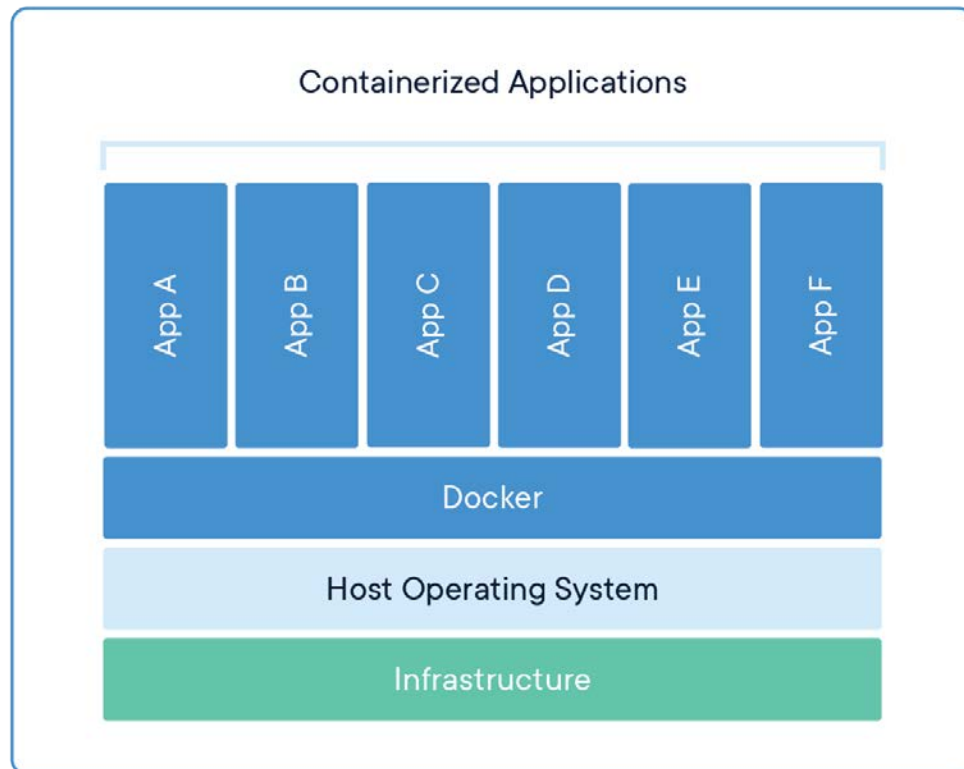
a system for emulating
computer networks

Emulating a network

- Basic idea:
 - several containers are created inside a single host machine
 - containers are connected to virtual collision domains and thus can communicate with each other
- Each container can be configured as a device that plays the role of a regular host, of a router, of a switch,

Docker and containers

A container is a standard unit of software that packages up code and all its dependencies, so the application runs quickly and reliably from one computing environment to another.



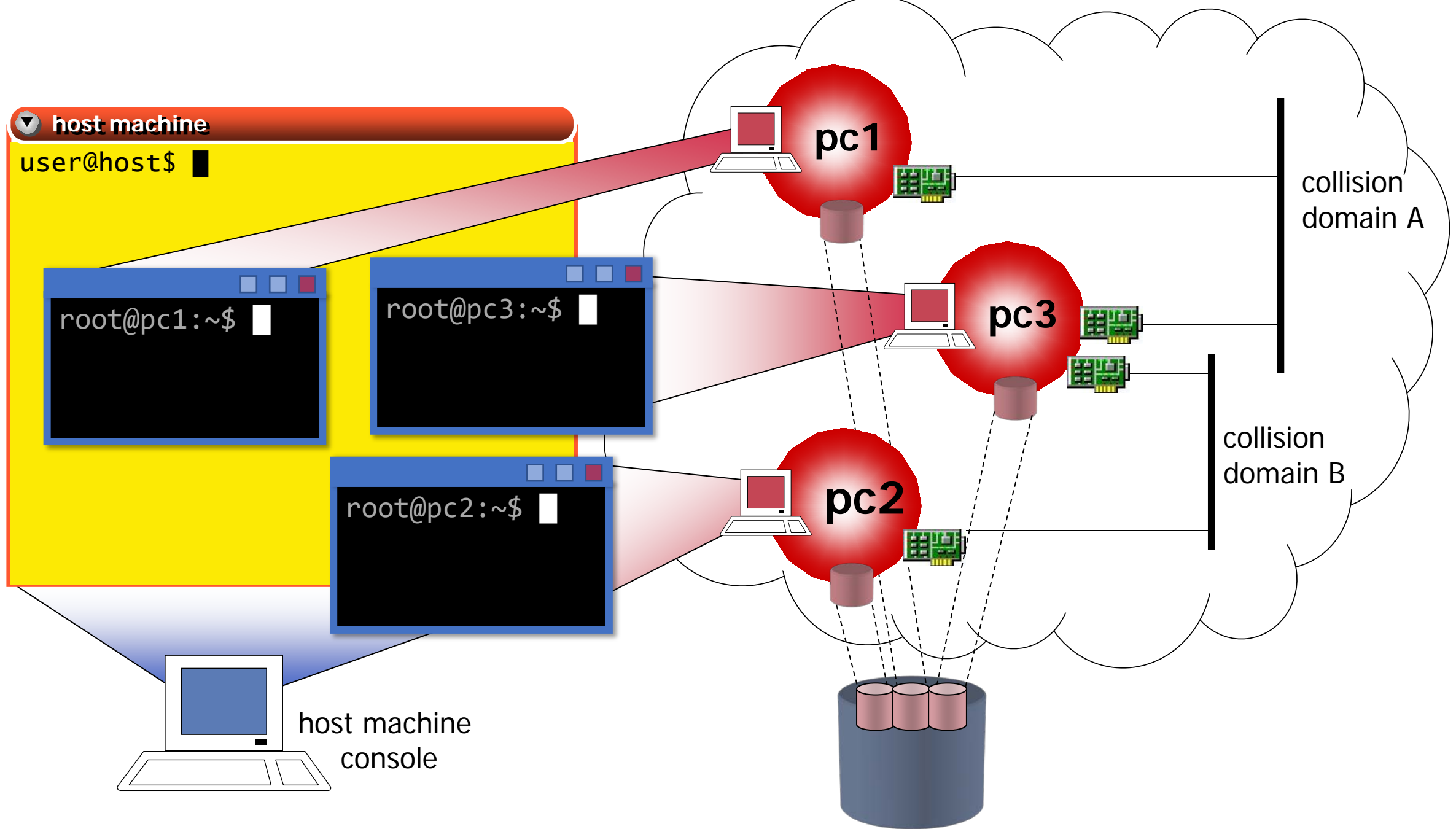
<https://www.docker.com/resources/what-container>

Kathará

- Based on Docker
- Each emulated network device (in what follows *device*) is a container
- Note: several container images available, e.g.:
 - Base (DNS, Web Server, network utilities)
 - Quagga (standard routing protocols)
 - **FRRouting (standard routing protocols + EVPN + MPLS)**
 - Open vSwitch (Open Flow enabled switch)
 - Behavioral Model (software implementation of a P4 switch)

Emulated network devices

- Each device has:
 - A console (a terminal window)
 - A memory
 - A filesystem
 - (zero, one or more) network interfaces
- Each network interface is connected to a single (virtual) collision domain
- Each virtual collision domain can be connected to several interfaces



Setting up Kathará

Setup manual

Installing Kathará

- Available for:
 - Windows
 - Linux
 - MacOS
- Download at <http://www.kathara.org/>
- Follow the wiki

Changing the default Docker Image

- Run `kathara settings`
- Select `Choose default image` by pressing 2
- Select `kathara/frr` by pressing 2
- Confirm and exit

Using Kathará

Kathará commands

- Kathará provides users with three sets of commands
 - v-prefixed commands (v-commands)
 - l-prefixed commands (l-commands)
 - Global commands
- v-commands act as low-level tools for configuring and starting up a single device
- l-commands provide an easier-to-use environment to set up complex labs consisting of several devices
- Global commands are mainly management commands

Kathará v-commands

- Allow to startup a single device with arbitrary configurations (network interfaces, etc.)
 - `vstart`: starts a new device
 - `vconfig`: attaches network interfaces to a running device
 - `vclean`: halts a device

Kathará I-commands

- Ease setting up complex labs consisting of several virtual machines
 - **Istart**: starts a Kathará lab
 - **Iclean**: halts all the devices of a lab
 - **Irestart**: halts all the devices of a lab and start them again
 - **Iinfo**: provides information about a lab

Kathará global commands

- Management commands
 - `check`: Check your system environment
 - `connect`: Connect to a running Kathará machine
 - `list`: Show all running Kathará machines of the current user
 - `settings`: Show and edit Kathará settings
 - `wipe`: Delete all Kathará machines and links, optionally also delete settings

Testing Kathará

Testing Kathará

- To test if your setup works correctly run:
 - `kathara check`
 - This command will run automatic tests to your environment
 - `kathara vstart -n pc1 --eth 0:A`
 - This command will start a new device called **pc1** and connected to the virtual collision domain **A**
 - A terminal window will open allowing to run commands inside the device
 - `kathara vclean -n pc1`
 - This command will stop the previous started device

Preparing a Kathará lab

Kathará lab

- a **Kathará lab** is a set of preconfigured devices that can be started and halted together
- a basic Kathará lab is a directory tree containing:
 - a **lab.conf** file describing the network topology
 - a set of **subdirectories** that contain the configuration settings for each device
 - **<device_name>.startup** files that describe actions performed by devices when they are started

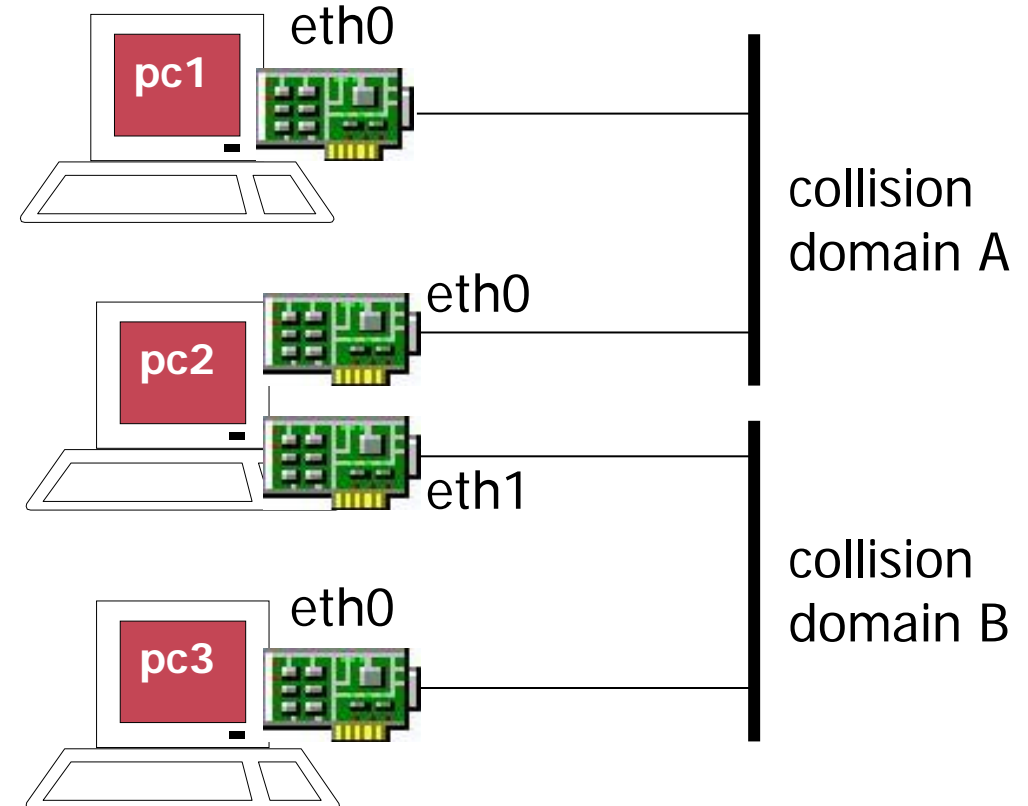
lab.conf

- describes:
 - The topology of the network that interconnects the lab's devices
 - The devices to be started
- contain a list of **machine[arg]=value** lines where:
 - **machine** is the name of the device (e.g. pc1)
 - if **arg** is a number, then **value** is the name of a collision domain to which eth**arg** should be attached
 - if **arg** is not a number, then it must be an option and **value** the argument

lab.conf

■ example

```
pc1[0]=A  
  
pc2[0]=A  
pc2[1]=B  
  
pc3[0]=B
```



Share files between the host and the devices

- There are two ways to share files between the host filesystem and the device filesystem:
 - Share files mirrored to the device
 - A change inside the device will reflect in the host filesystem
 - A change in the host filesystem will reflect in the device
 - Share files copied to the device
 - Two independent copies of the same files

Share files mirrored to the device

- There are two ways to share mirrored files:
 - the **/shared** directory inside a device directly points to the **shared** directory inside the lab
 - by default it is **ENABLED**, you can disable it in the settings
 - the **/hosthome** directory inside a device directly points to the **home directory** of the current user of the host
 - by default it is **DISABLED**, you can enable it in the settings

Share files copied to the device

- Can be done through the subdirectories of a lab
- The contents of subdirectory **device** are copied into the root (/) of the device named **device** filesystem
 - for example, **pc1/foo/file.txt** is copied to **/foo/file.txt** inside the device **pc1**

.startup files

- Shell scripts that are executed inside a device right after its startup
- Typical usage of a **.startup** file is to configure network interfaces and/or start network services
 - For example:

```
ifconfig eth0 10.0.0.1/24 up  
/etc/init.d/frr start
```

Launching/halting a lab

- Open a terminal
- Enter the lab directory (**cd lab_directory**)
- Kaunch a Kathará I-command
 - Where I-command could be one of the following
 - **kathara lstart**, to start the lab
 - **kathara lclean**, to stop the lab
 - **kathara lrestart**, to restart the lab

More information

- Further information can be found:
 - On GitHub's Kathará wiki
 - On the official website <http://www.kathara.org>
 - Inside Kathará man pages
 - On Linux and MacOS accessible by the terminal **man kathara**
 - Available online at <https://www.kathara.org/man-pages/kathara.1.html>