

Kathará

A container-based framework for experimenting computer networking

Version	2.0
Author(s)	L. Ariemma, G. Bonofiglio, G. Di Battista, V. Iovinella, G. Lospoto, M. Patrignani, M. Pizzonia, M. Rimondini
E-mail	contact@kathara.org
Web	http://www.kathara.org/
Description	An introduction to the architecture, setup and usage of kathará – based on a similar presentation of Netkit

Copyright notice

- All the pages/slides in this presentation, including but not limited to, images, photos, animations, videos, sounds, music, and text (hereby referred to as “material”) are protected by copyright.
- This material, with the exception of some multimedia elements licensed by other organizations, is property of the authors and/or organizations appearing in the first slide.
- This material, or its parts, can be reproduced and used for didactical purposes within universities and schools, provided that this happens for non-profit purposes.
- Information contained in this material cannot be used within network design projects or other products of any kind.
- Any other use is prohibited, unless explicitly authorized by the authors on the basis of an explicit agreement.
- The authors assume no responsibility about this material and provide this material “as is”, with no implicit or explicit warranty about the correctness and completeness of its contents, which may be subject to changes.
- This copyright notice must always be redistributed together with the material, or its portions.

About computer networks

- computer networks are quite complex
 - several devices (computers, routers, etc.)
 - several interfaces
 - several protocols running
 - physical interconnections originate complex topologies

How to perform experiments?

- performing experiments may be unfeasible
- the currently used 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

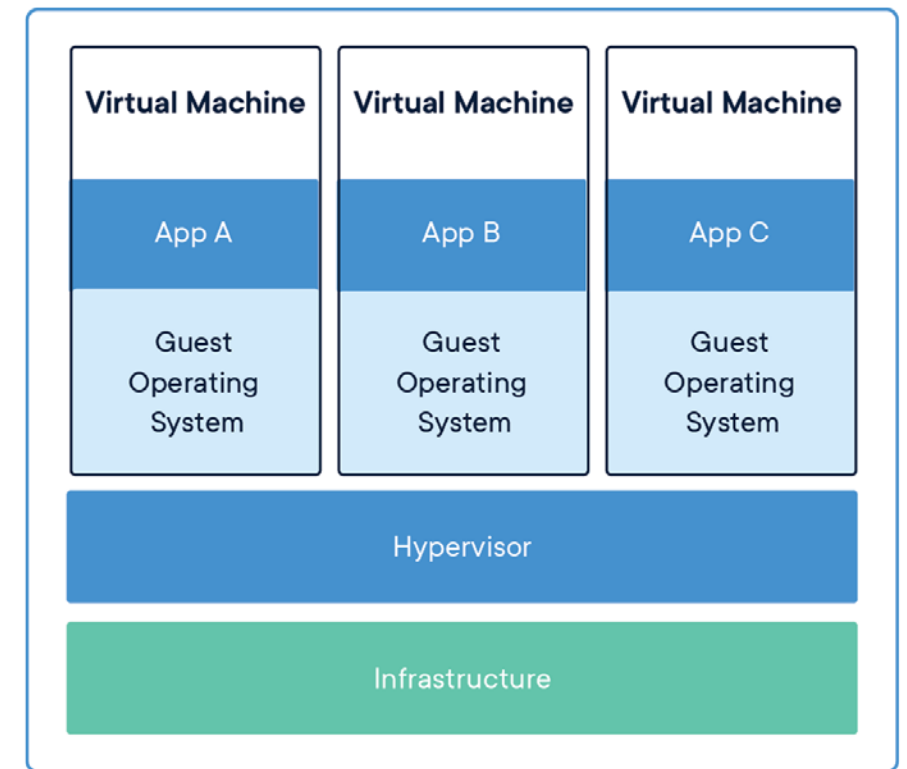
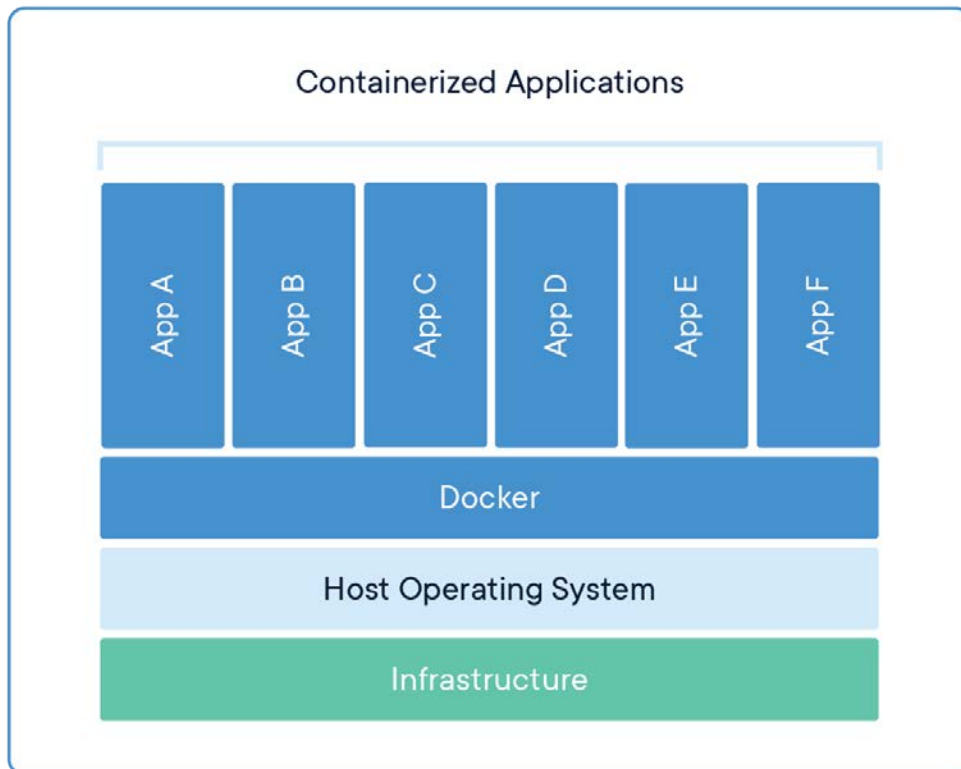
- basic idea:
 - several containers are created inside a single host machine
 - containers are connected to virtual collision domains and thus can communicate with each other
- each container can be configured as a device that plays the role of a regular host, of a router, of a switch,

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)

Docker and containers

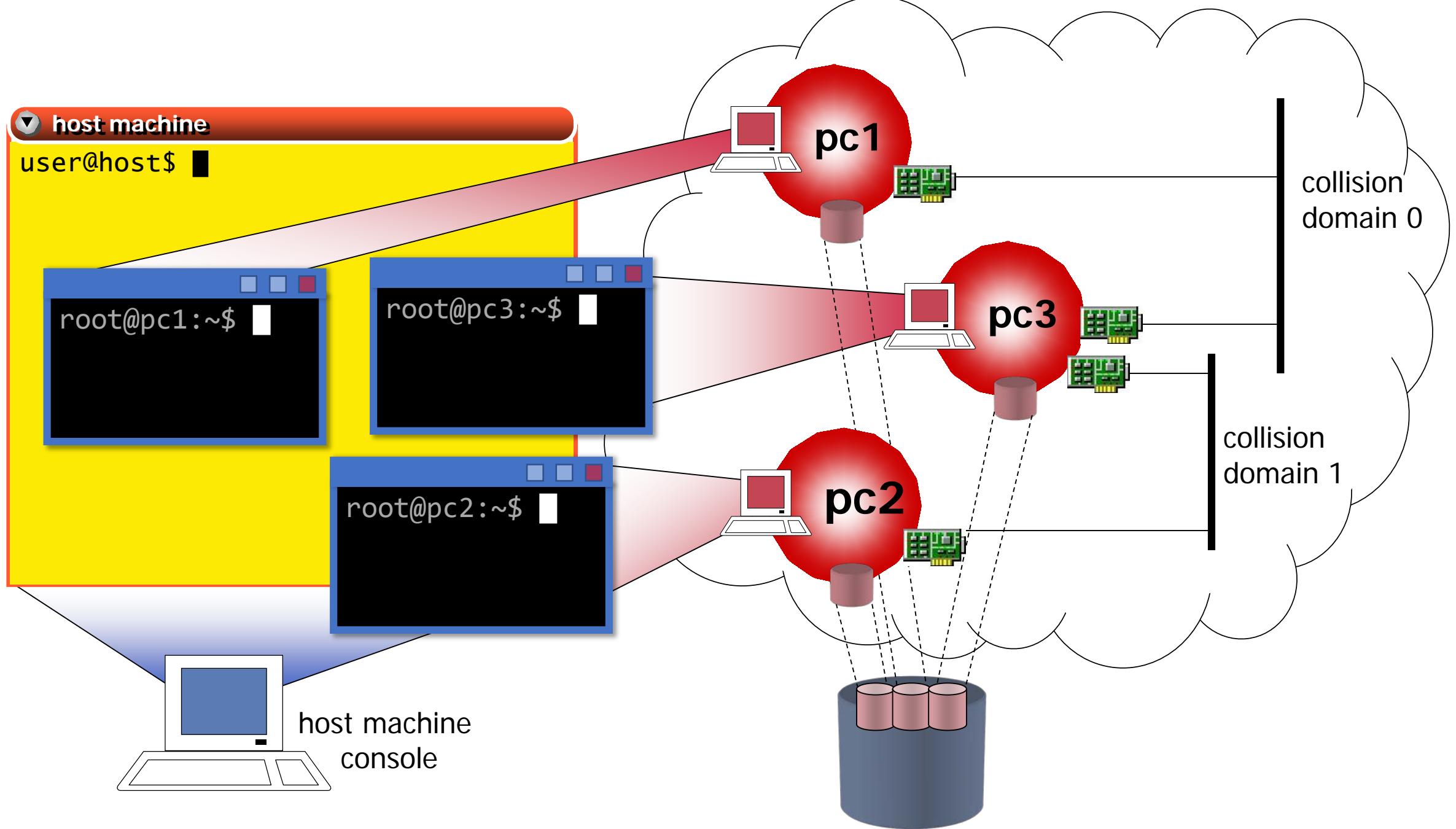
A container is a standard unit of software that packages up code and all its dependencies, so the application runs quickly and reliably from one computing environment to another.



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

Emulated network devices

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



Setting up Kathará

Setup manual

Setting up Kathará

- available for:
 - Windows 10 Pro
 - Linux
 - MacOS
- download at <http://www.kathara.org/>
- follow the wiki

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

Share files between the host and the devices

- there are two ways to share files between the host filesystem and the device filesystem:
 - 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
 - read/write access is allowed
 - 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
 - read/write access is allowed

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

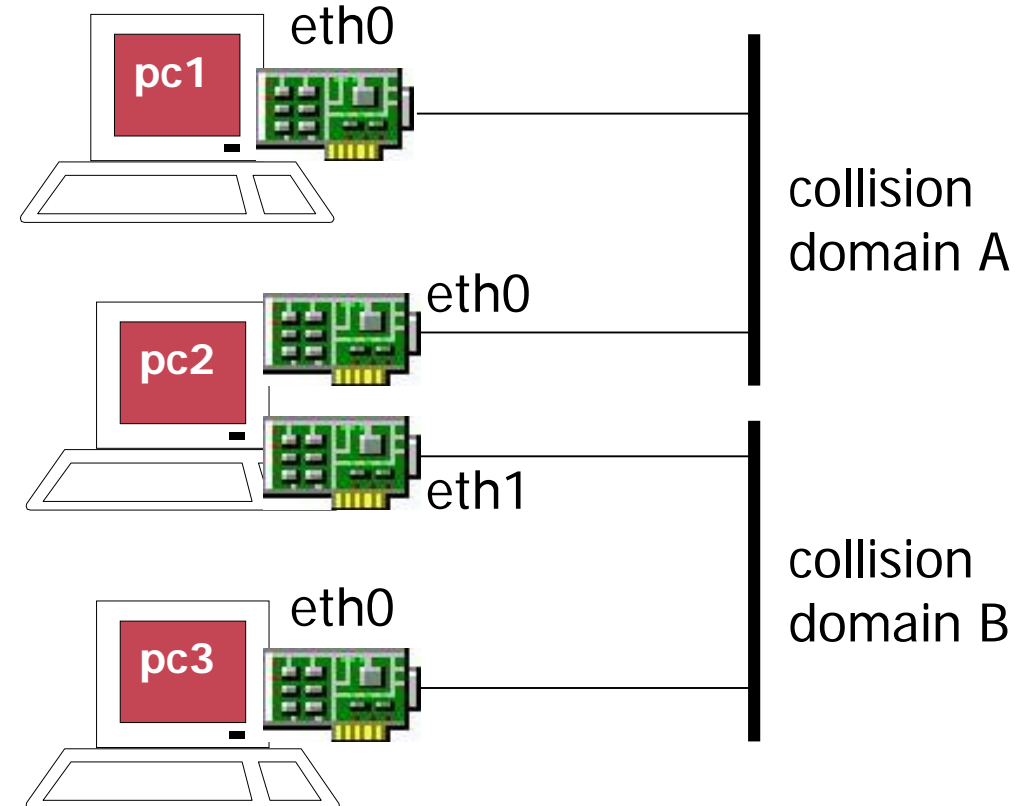
lab.conf

- describes:
 - the settings of the devices that make up the lab
 - the topology of the network that interconnects the lab's devices
- 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 **etharg** 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
```



lab subdirectories

- Kathará starts a device for every device specified in lab.conf file and every subdirectory of the lab folder
- 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 up  
/etc/init.d/zebra start
```

launching/halting a lab

- open a terminal
- enter the lab directory (**cd lab_directory**)
- launch a Kathará l-command
 - where l-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
 - you can start from **man kathara**
 - available only on Linux and MacOS