WORKSHOP GARR 2026

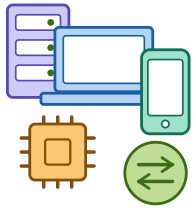
NET MAKERS

Kathará: un emulatore di rete leggero e scalabile

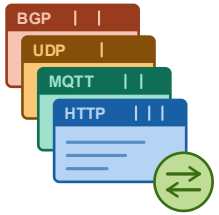
Tommaso Caiazzi **Lorenzo Ariemma**

Kathara Development Association

Computer networks are complex



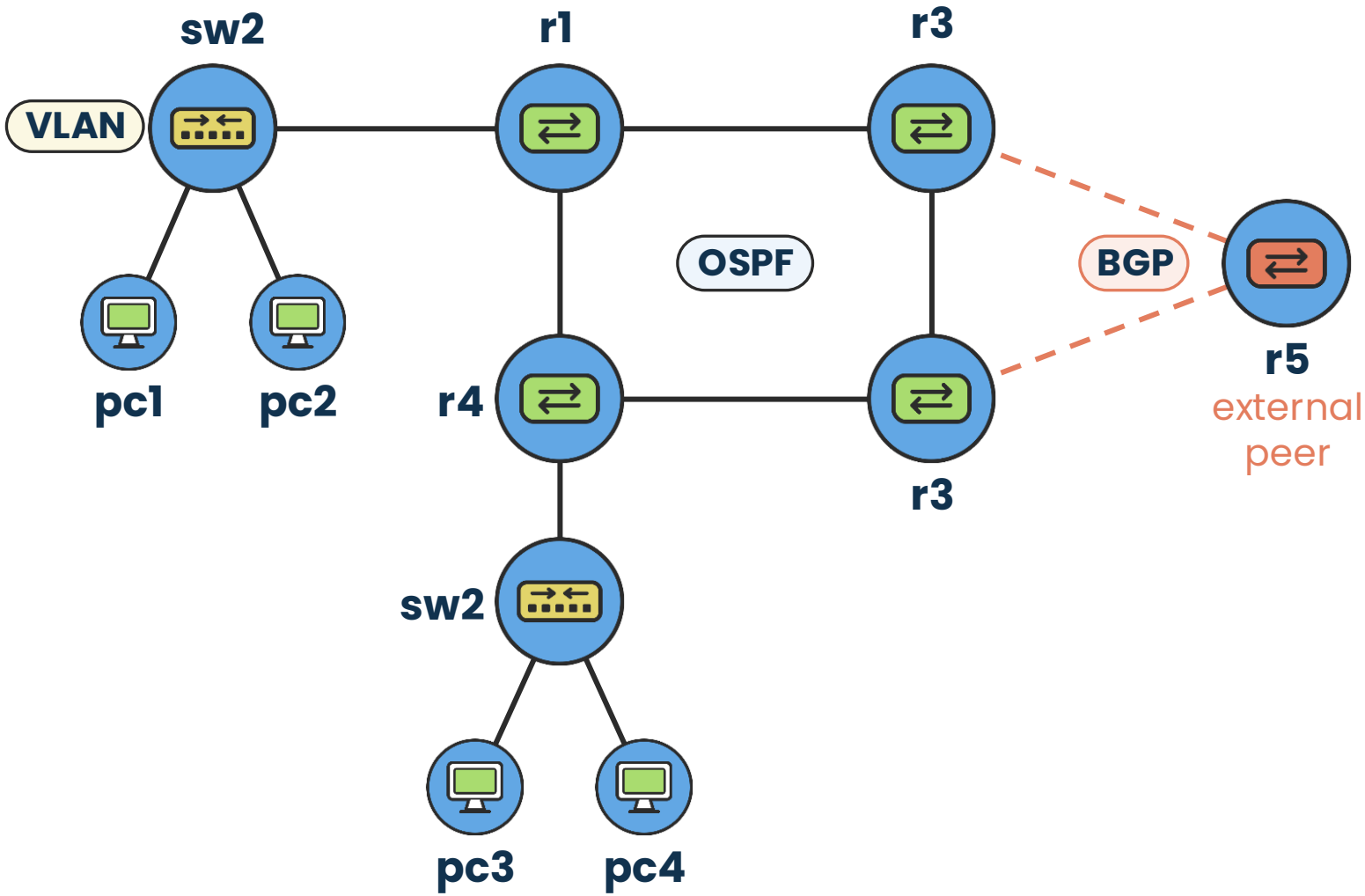
Heterogeneous devices



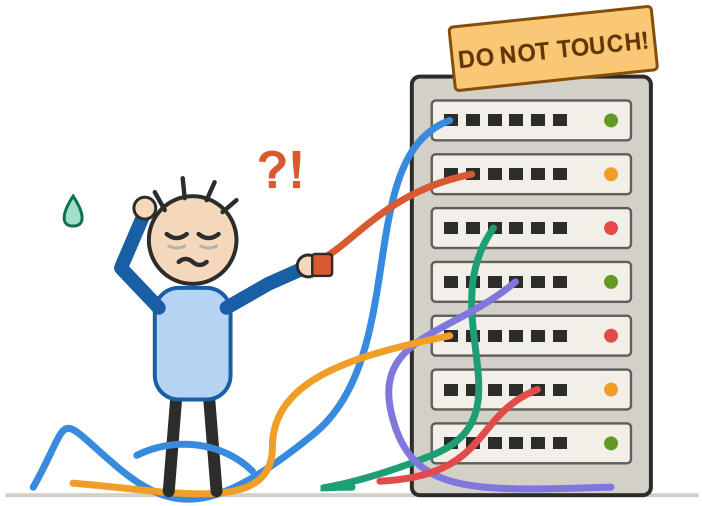
Heterogeneous protocols



Many Configurations

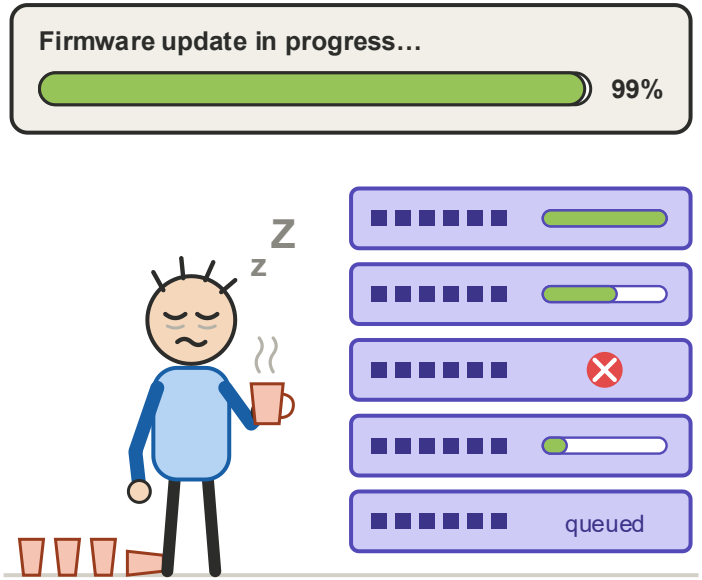


Maintaining, updating, testing…



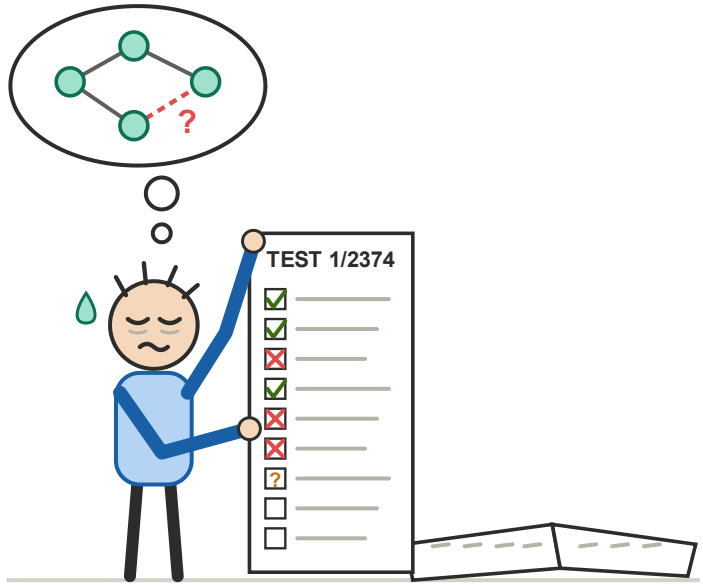
Maintaining

Nobody knows where this cable goes



Updating

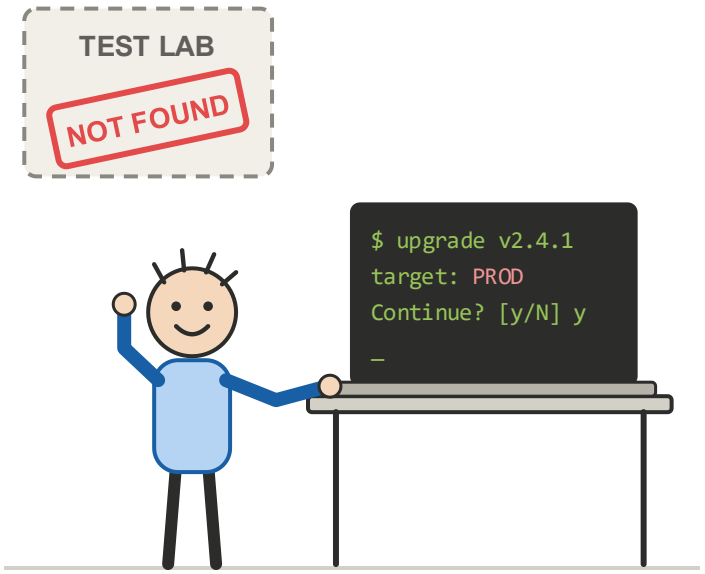
Stuck at 99% for 3 hours. 299 to go.



Testing

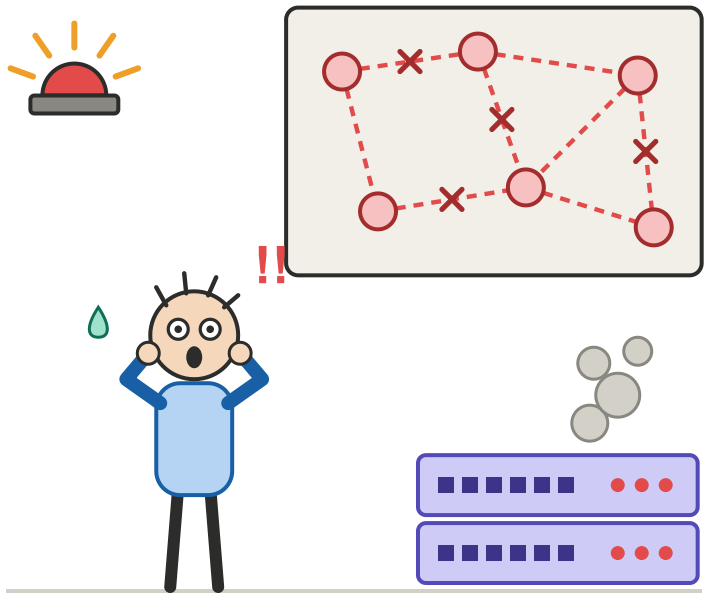
Passed: 3. Remaining: all the rest.

Testing in production...



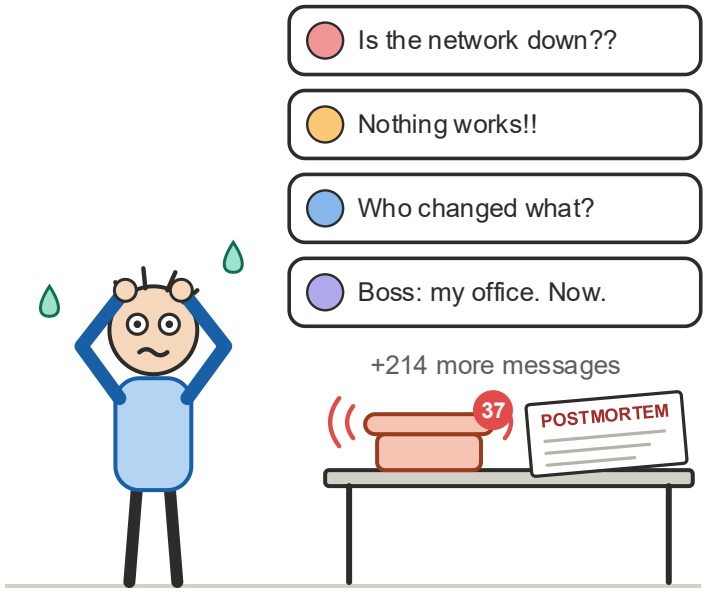
Just a quick test

No test lab? Straight to production!



Oops

Every link down!



Everyone noticed

37 missed calls. Postmortem due Monday.

Virtual Environments



Simulation

Models performance

Node behaviour is a model inside the simulator: latency, loss, queues, throughput

ns-3 | OMNeT++ | RouteNet

- \+ Scales to thousands of nodes on one host
- \+ Reproducible, measurable experiments
- \- Simplified protocols: no real bugs
- \- Configurations not reusable on devices



Emulation

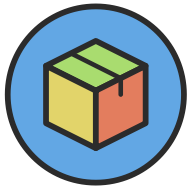
Runs the real software

Same daemons (FRR, Bind, Open vSwitch), same configuration files, same CLI as the devices

Containerlab | GNS3 | EVE-NG | **Kathará**

- \+ Configurations portable to production
- \+ Reproduces bugs and daemon interactions
- \- Latency and throughput not reliable
- \- Scale limited by host CPU and RAM

Kathará



A container-based network emulator

Based on Docker containers

Can run on Kubernetes to scale up the emulation in a cluster



Open-source project developed at Roma Tre University

More than 100K downloads

654 stars on GitHub



Widely adopted for academic teaching and research

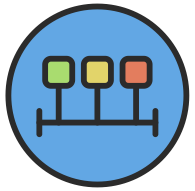
Used in 40+ different courses, in more than 30 universities and 16 countries

Several publications and framework based on Kathará

Why Kathará?

GNS3, eve-ng, containerlab and Mininet are solid emulators.

Only Kathará offers all of this together:



L2 collision domains



No-code syntax



Complete Python API



Any OS



Scalable

docker

kubernetes

coming soon **Vendor images via vrnetlab** as in containerlab. Already usable and used in several projects; documentation is in progress and will be published soon.

How can it help?



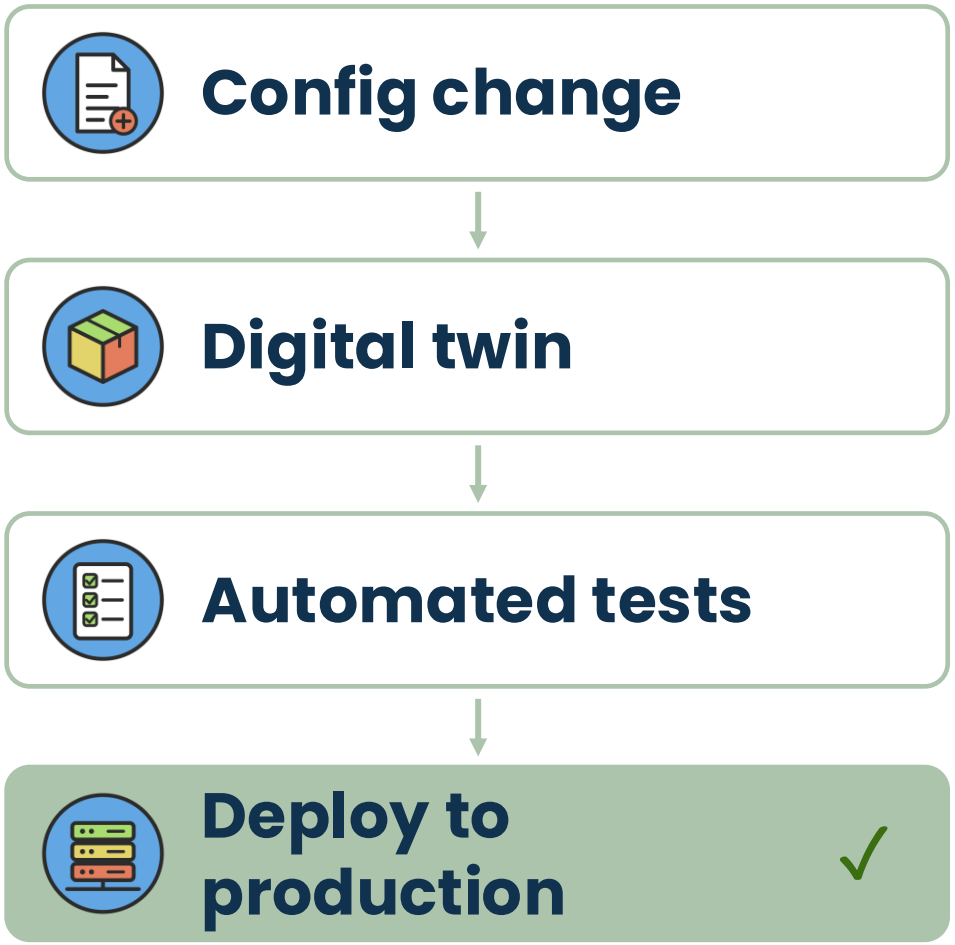
A secure testing environment



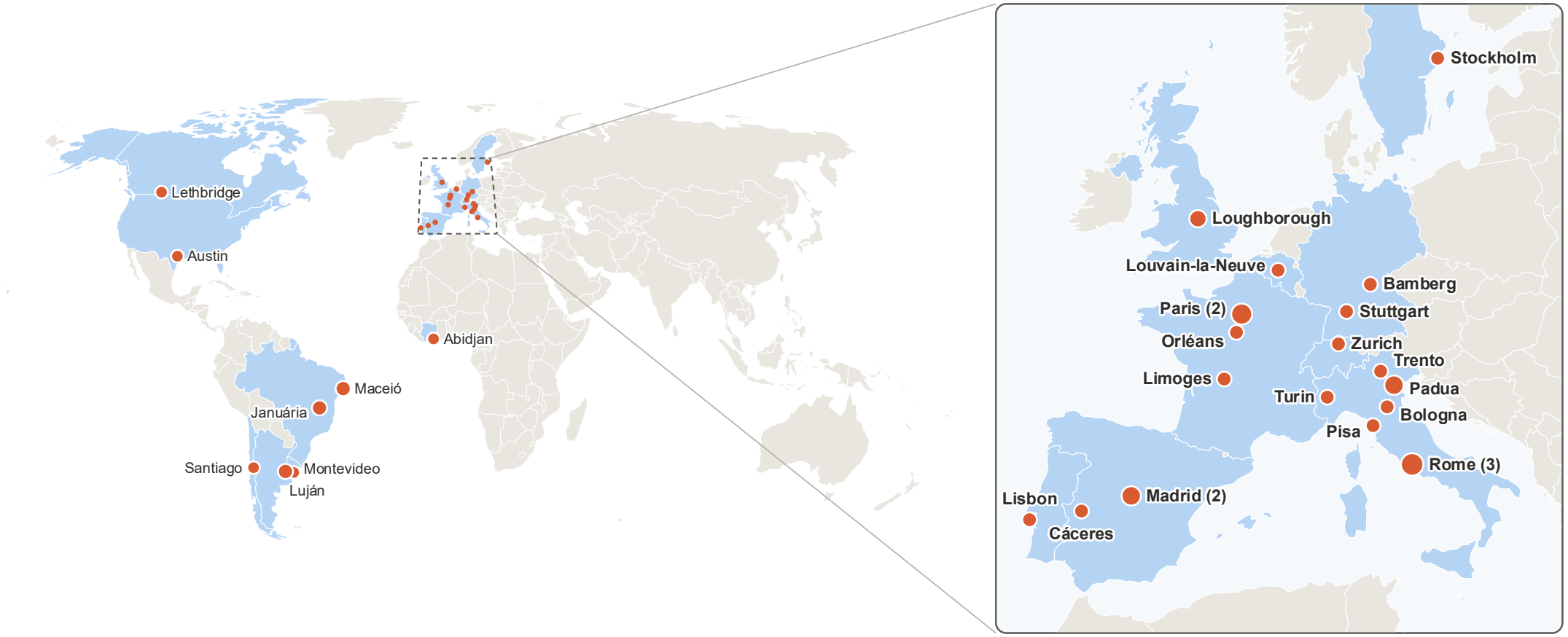
Building Digital Twin of the production network



Building Configuration CI through automated actions



An ever-growing project



16
countries

30
universities

41
courses

Kathara Development Association



No-profit Organization to maintain and manage Kathará



Committed to keeping Kathará free and open-source



A community for sharing ideas and projects

The Kathará projects

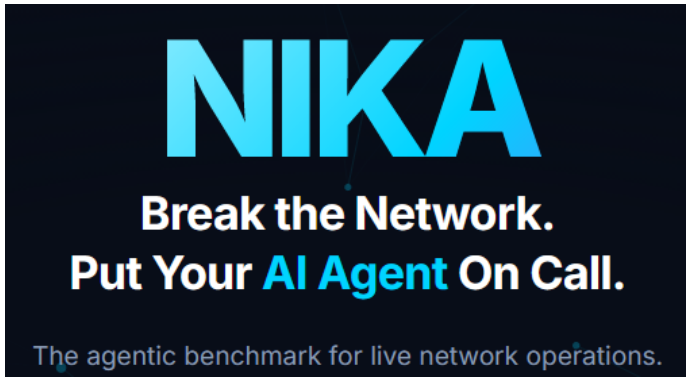
Routing Security Tool

Rose-T

01 Routing Security

ROSE-T

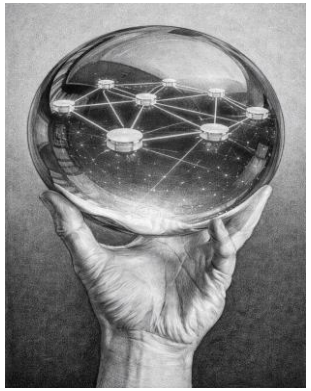
Tests router configurations for MANRS compliance before the audit



02 AI agents

NIKA

Benchmarks AI agents on live incidents in emulated networks



03 IXP operations

IXP Digital Twin

Every change tested in the twin, in production at NAMEX and VSIX

ROSE-T: ROuting SEcurity Tool

github.com/KatharaFramework/roset

Routing Security Tool

Rose-T

MANRS Mutually Agreed Norms for Routing Security asks operators to:

- **Filter announcements**
- **Block spoofing**
- **Publish correct routing data**

The problem

Checking compliance is expensive

The audit is complex and is done when the router is already in production

ROSE-T builds an emulated environment and **tests the configuration before the audit**

- **Production images and configurations**
- **Neighbours rebuilt with data taken from the Internet**

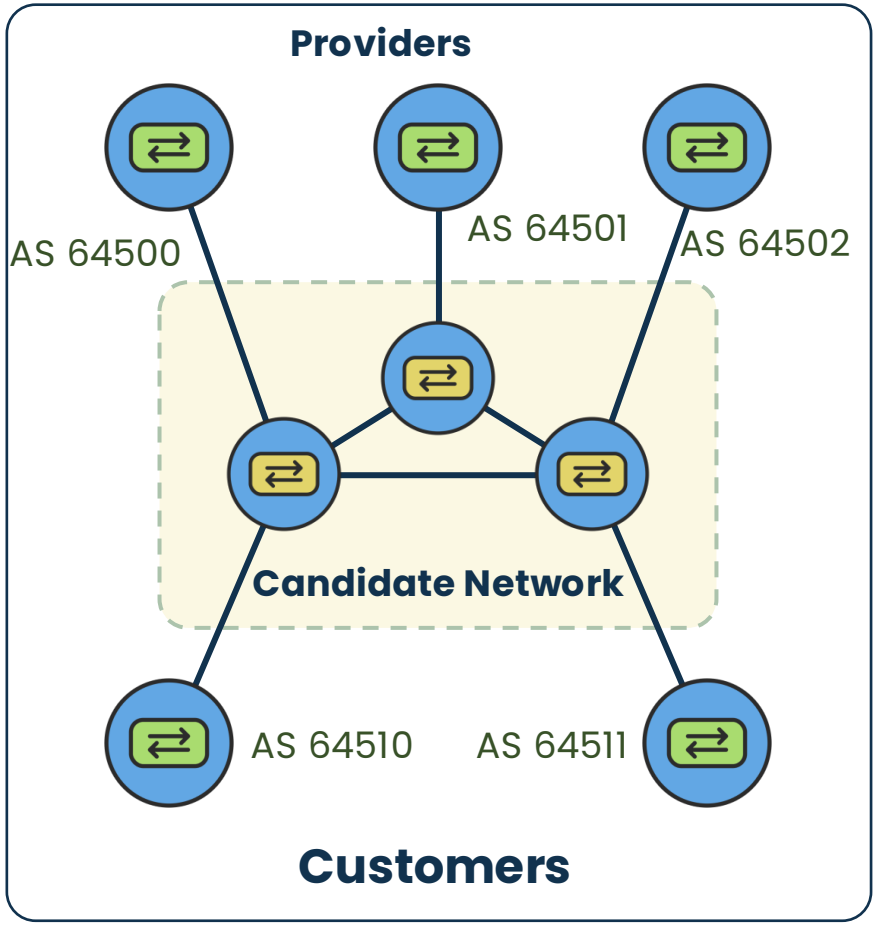
ROSE-T: ROuting SEcurity Tool

1 Collect the inputs

Router configuration
Juniper · Cisco · MikroTik

Routing data from the Internet
IRR databases · route collectors

2 Emulate with Kathará



3 Verify MANRS

Filtering
Action 1

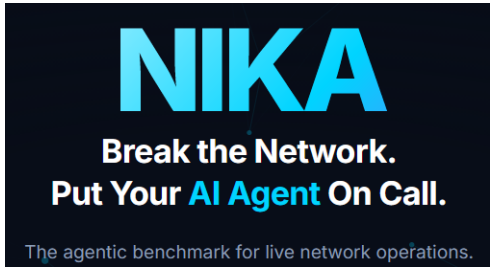
Anti-spoofing
Action 2

Global information
Action 4

Compliance report

NIKA: a network arena for AI agents

github.com/sands-lab/nika



NIKA (Network Incident Benchmark for AI Agents) evaluates AI agents on live incidents in emulated networks built using Kathará

01 · Environments

Different scenarios

From data center to ISP backbone

02 · Incidents

60 faults

727 variants, injected live

03 · Agents

Any agent

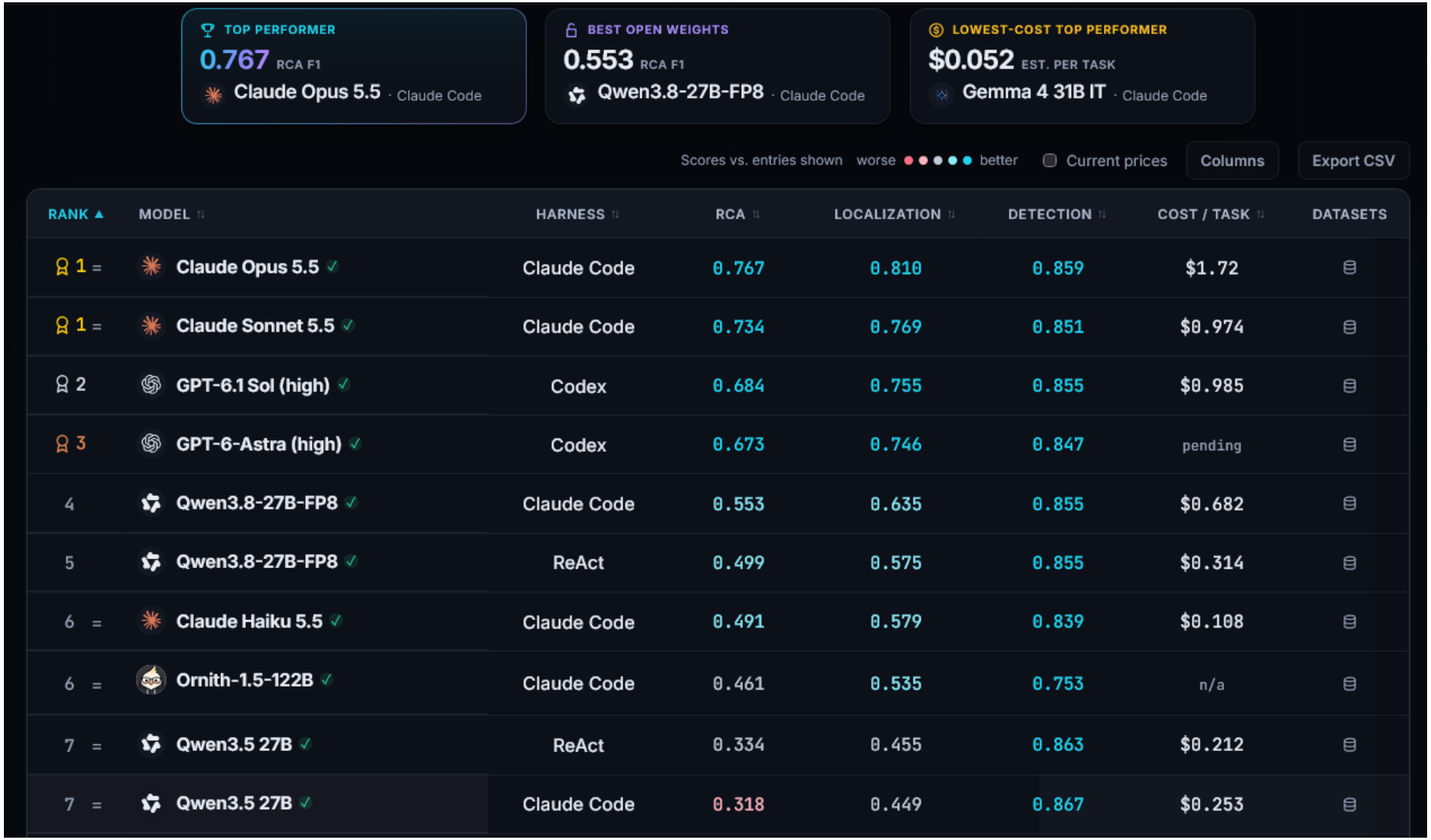
Connected to the network via MCP

04 · Evaluation

3 skills

Detect, localize, diagnose

NIKA: a network arena for AI agents



TOP PERFORMER
0.767 RCA F1
Claude Opus 5.5 · Claude Code

BEST OPEN WEIGHTS
0.553 RCA F1
Qwen3.8-27B-FP8 · Claude Code

LOWEST-COST TOP PERFORMER
$0.052 EST. PER TASK
Gemma 4 31B IT · Claude Code

Scores vs. entries shown worse better Current prices Columns Export CSV

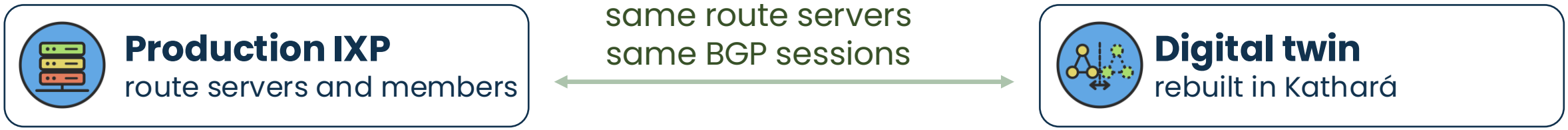
RANK ▲	MODEL	HARNESS	RCA	LOCALIZATION	DETECTION	COST / TASK	DATASETS
1 =	Claude Opus 5.5 ✓	Claude Code	0.767	0.810	0.859	$1.72	
1 =	Claude Sonnet 5.5 ✓	Claude Code	0.734	0.769	0.851	$0.974	
2	GPT-6.1 Sol (high) ✓	Codex	0.684	0.755	0.855	$0.985	
3	GPT-6-Astra (high) ✓	Codex	0.673	0.746	0.847	pending	
4	Qwen3.8-27B-FP8 ✓	Claude Code	0.553	0.635	0.855	$0.682	
5	Qwen3.8-27B-FP8 ✓	ReAct	0.499	0.575	0.855	$0.314	
6 =	Claude Haiku 5.5 ✓	Claude Code	0.491	0.579	0.839	$0.108	
6 =	Ornith-1.5-122B ✓	Claude Code	0.461	0.535	0.753	n/a	
7 =	Qwen3.5 27B ✓	ReAct	0.334	0.455	0.863	$0.212	
7 =	Qwen3.5 27B ✓	Claude Code	0.318	0.449	0.867	$0.253	

github.com/sands-lab/nika · arXiv 2512.16381, dicembre 2025 · KAUST, Politecnico di Torino, UESTC

IXP Digital Twin

github.com/KatharaFramework/ixp-digital-twin

A digtal twin that exposes the same control plane as production



Use cases



1. Test before production

Every change is tried in the twin first, synced daily with production

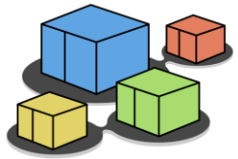


2. Customer onboarding



In production at NAMEX (Rome) and VSIX (Padua) · more in the next talk

Conclusion



Kathará



Test before production, not in production

Emulation runs the real daemons and configurations: what passes in Kathará behaves the same on the devices



Ready for operators, not only for teaching

Open source, runs on Docker or Kubernetes, complete Python API, vendor images and GUI coming soon



Already running in real networks

IXP digital twin in production at NAMEX and VSIX

Contacts

Documentation

Official website kathara.org
Installation, news, use cases

Man page kathara.org/man-pages
Commands, lab.conf, lab.ext

Wiki Kathara/wiki
Setup by OS, Python API, Megalos

Repositories and social

Kathara	Source code, releases, issue tracker
Kathara-Labs	Ready-to-use labs and tutorials
kathara-lab-checker	No-code automated lab checking
Docker-Images	Dockerfiles for kathara/* images
NetworkPlugin	katharanp plugin: VDE and bridge
Megalos-CNI	CNI for Kathará on Kubernetes
LinkedIn	linkedin.com/company/kathara Releases and news

Kathará Development Association O.D.V.: non-profit that develops and maintains Kathará
Contact: contact@kathara.org · kathara.org/association

Grazie a tutti!

Domande?



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WORKSHOP GARR 2026
NET MAKERS