WORKSHOP GARR 2026

NET MAKERS

Building a Secure Test Environment for an IXP

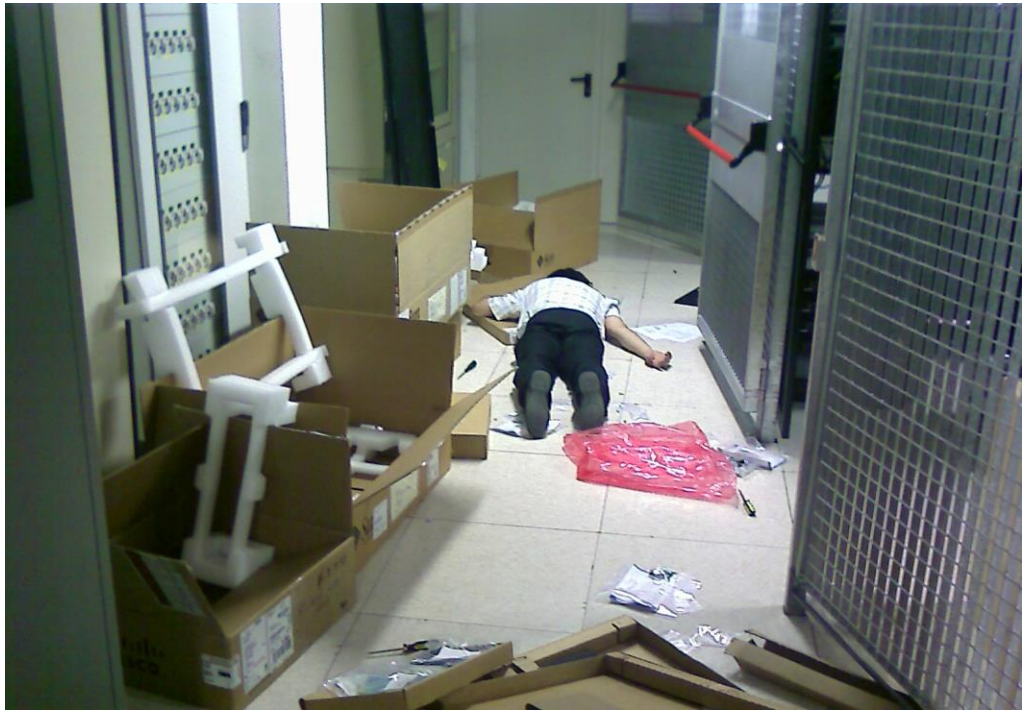
Marta Burocchi

Namex

Do you know when you make a small change in the production configuration...

...and everything breaks?





*Please note this is a real life Namex picture
- courtesy of Francesco Ferreri / Namex Archives

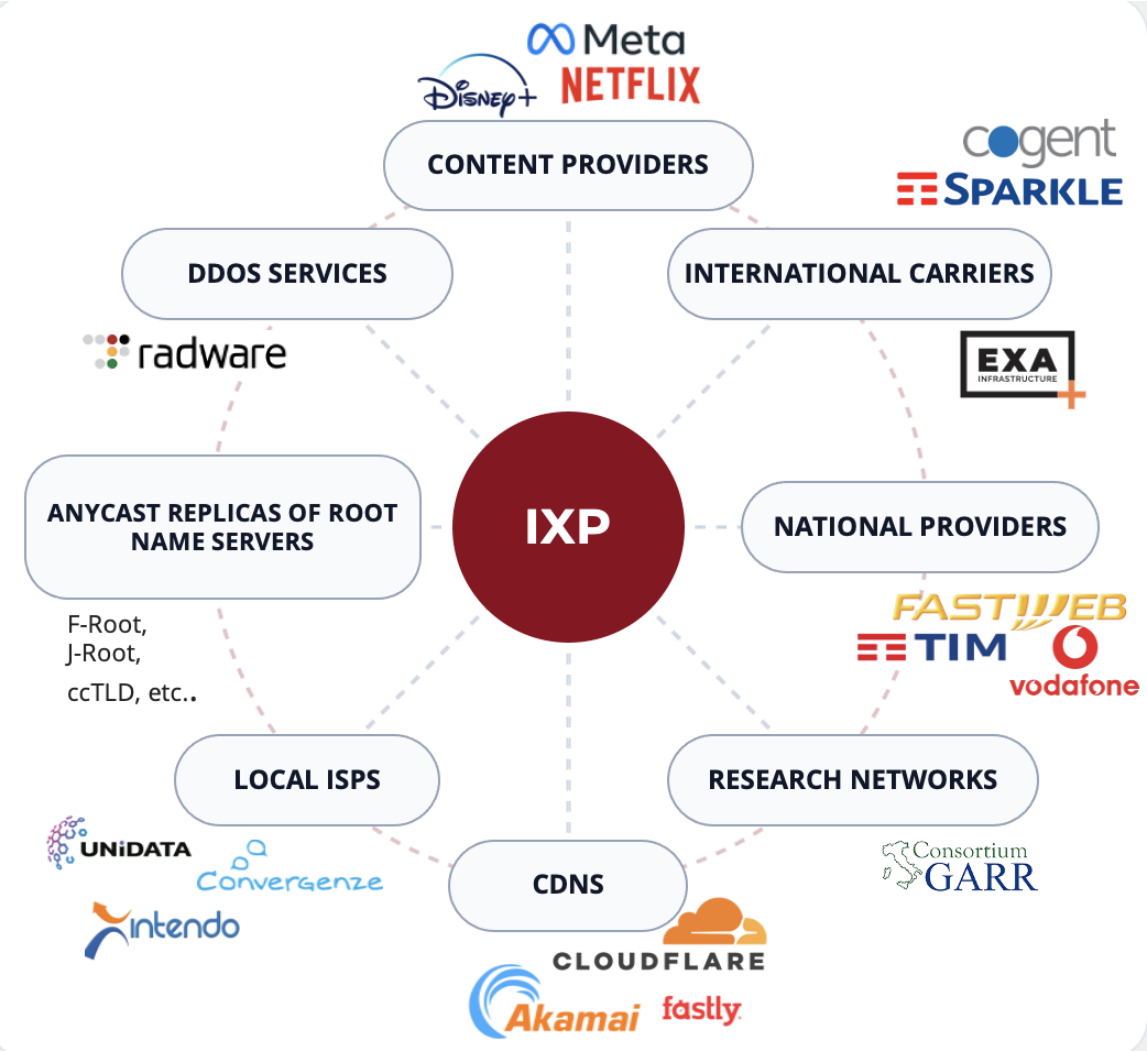
The idea

The idea comes from a very practical need

Create a **secure**, **live** pre-production environment that mirrors the **real peering LAN**:

- To validate members' configurations
- To test our services before deploying them to production

Do you know what is an IXP?



Neutral Interconnection Hub:

IXPs offer a carrier-neutral infrastructure where ISPs, CDNs, and Content Providers converge to establish direct peering sessions and optimize connectivity costs.

Direct AS-to-AS Traffic Exchange:

Allows ASNs to interconnect directly, rather than through third-party upstream providers (Transit)

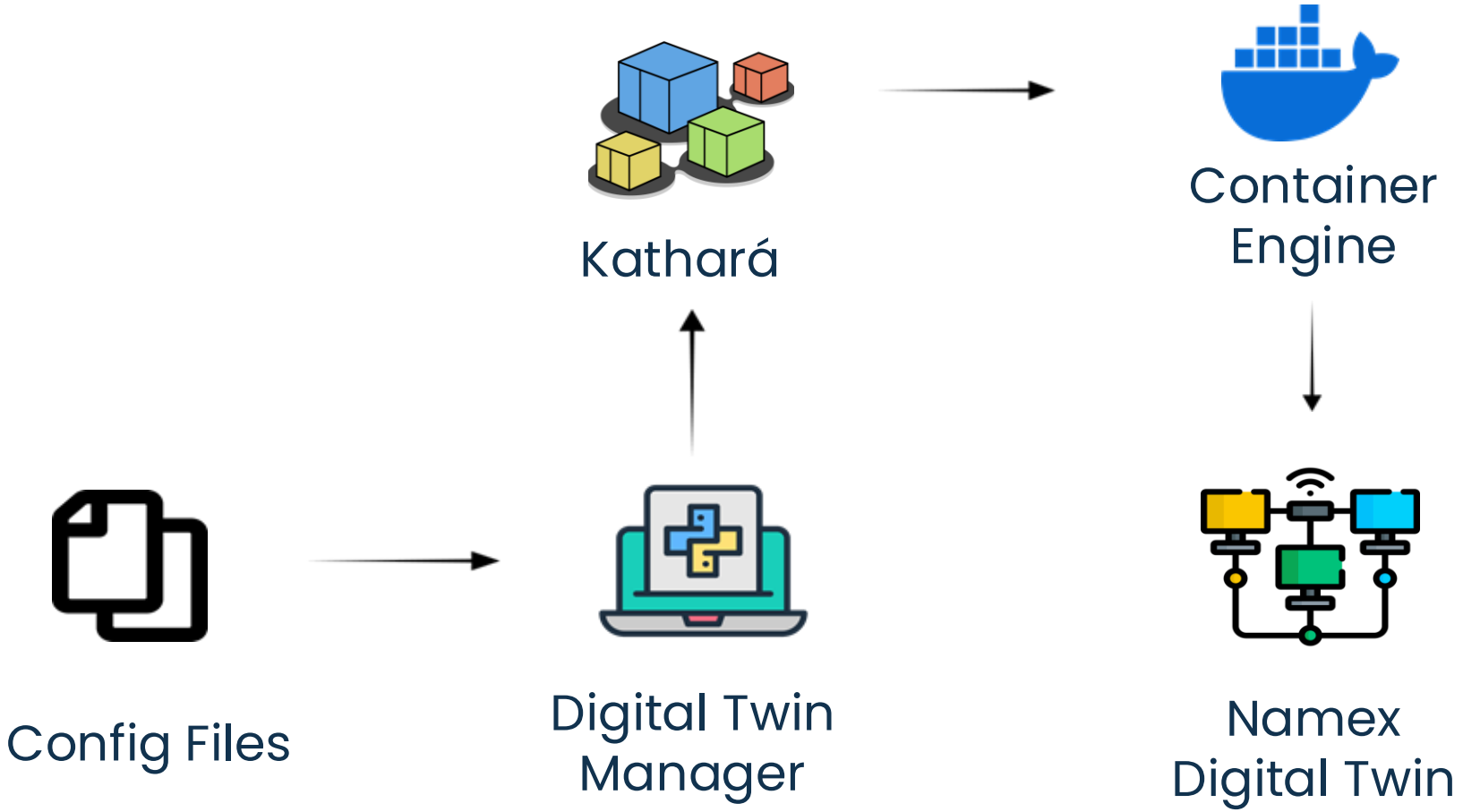
Namex Digital Twin

What? A faithful replica of the Namex Peering LAN with the same members, Route Servers, IP addressing and even MAC addresses using Kathará network emulator

How? Members and Route Servers from the Peering LAN are emulated as dedicated Kathará devices

Where? On a pre-production environment (quarantine VLAN)

The Architecture



Digital Twin is a Snapshot of the Real LAN

The virtual environment is **synchronized** with the production network, using real-time data

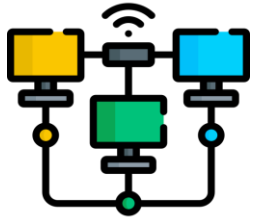
List of all the peers on the Peering LAN

Dumps of the actual Route Servers' RIBs (v4/v6)

Real Route Servers' configuration files



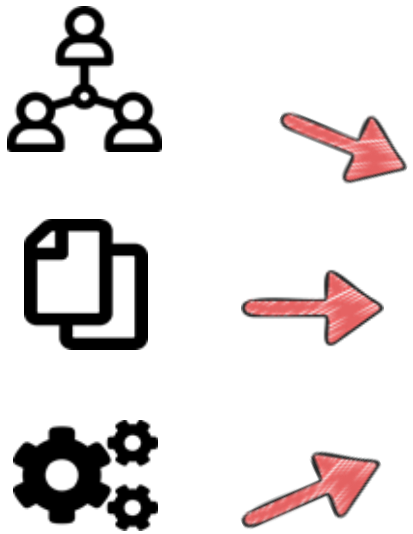
Digital Twin Manager
Manages the lifecycle of the Digital Twin



Namex Digital Twin

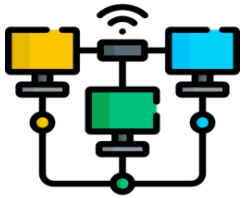
Digital Twin is a Snapshot of the Real LAN

The output is a **faithful replica** of the peering LAN





Digital Twin Manager
Manages the lifecycle of the Digital Twin



Namex Digital Twin

One Kathará device for each peer

One Kathará device for each Route Serves

The virtual peering LAN

Digital Twin: Use Cases

- New members can connect their router to the quarantine VLAN and **safely test and tune** their BGP setup **without affecting** the production network
- New members can use the Digital Twin to **test their configurations** according to the Route Servers' policies in a **safe sandbox**
- NOC can **validate** Route Servers' configurations changes or new services **before deploying** them to the production environment

Extending the Digital Twin

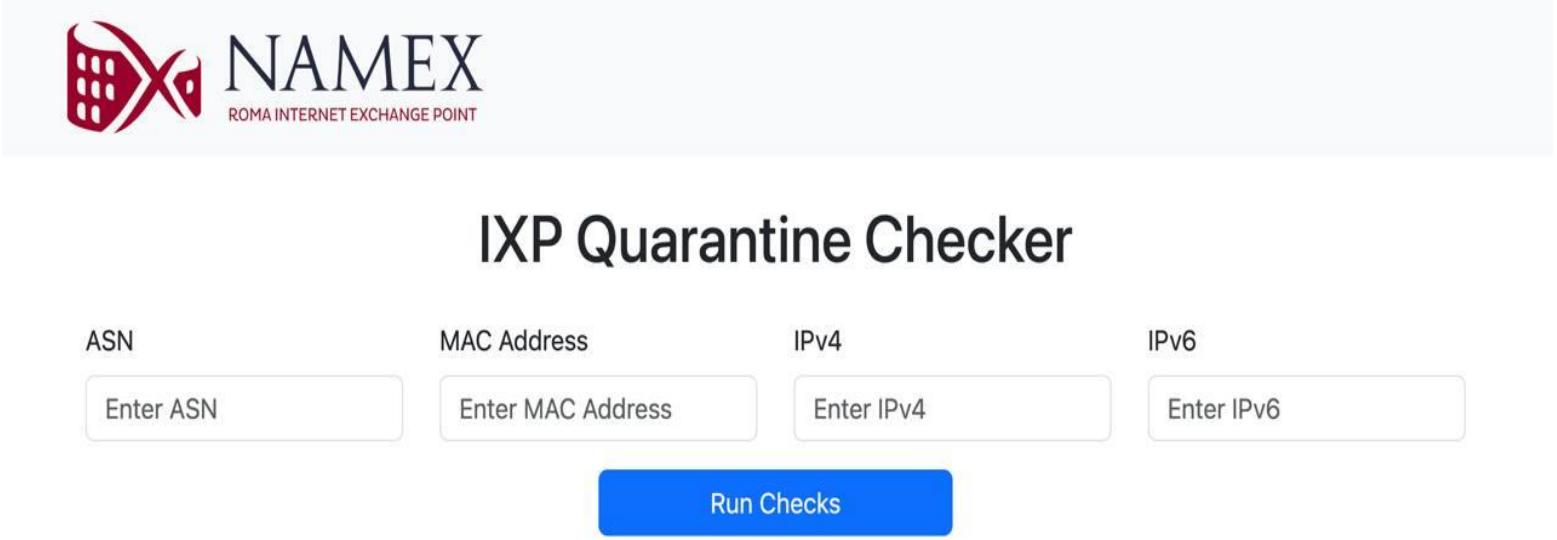
The Digital Twin can be **extended** to support **more features** and **use cases**:

1. Quarantine Dashboard
2. RPKI Validation
3. ASPA Testing
4. Traffic Generation
5. ROSE-T (MANRS Compliance)

Quarantine Dashboard

New members can **test** their configuration **compliance** to our technical rules.

Immediate feedback helps members fixing issues before going into the production network.



Checks Performed

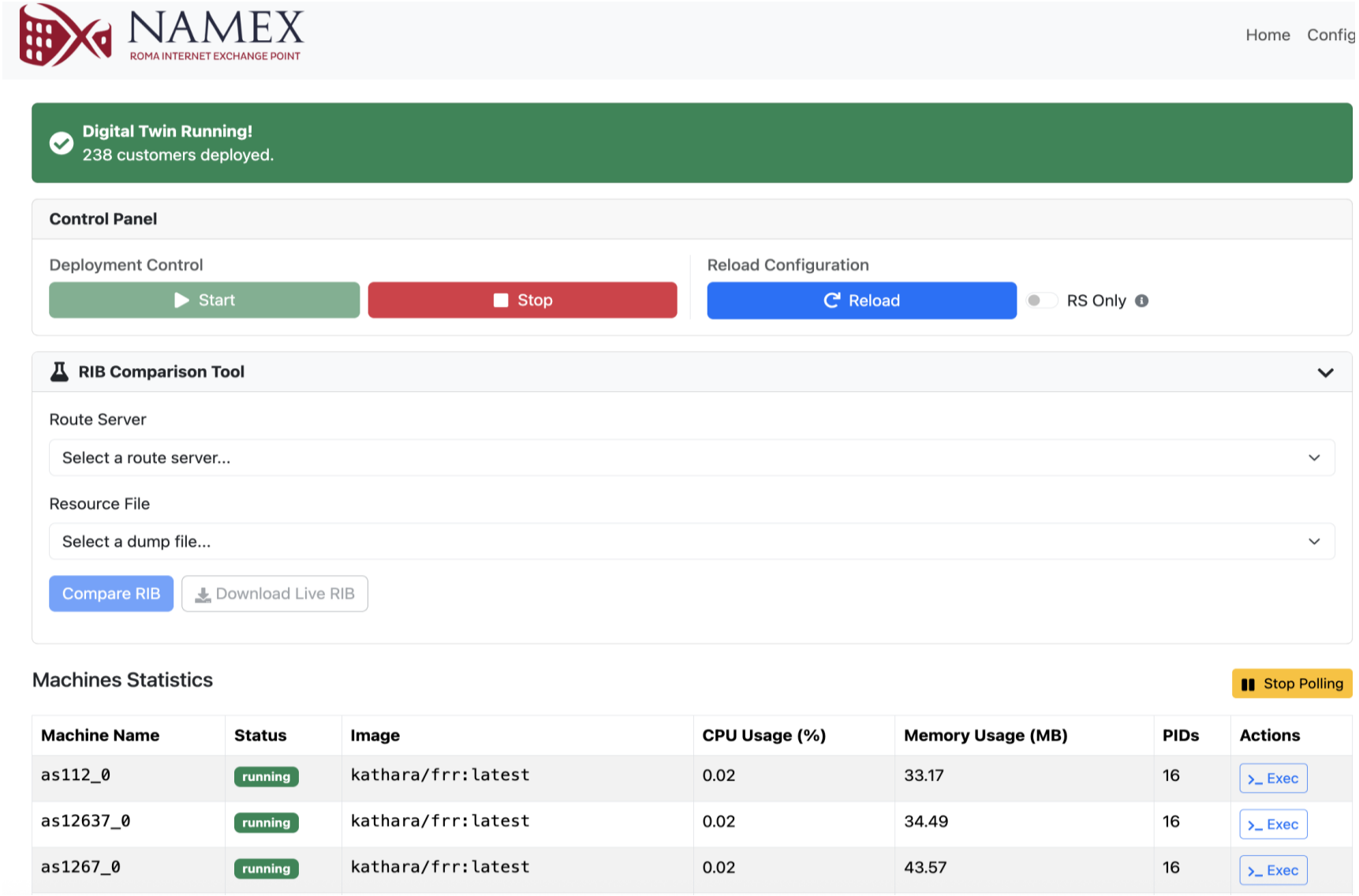
- Connectivity Tests (ping/ping6, MTU, proxy ARP)
- BGP Checks (established sessions, prefix limit check, default route advertisement, private prefix advertisement, next hop validation, AS path consistency, announcement consistency)
- Unauthorized Traffic Detection (neighbour discovery protocols, internal routing protocols, or router advertisements)
- Security Tests (open ports for DNS, NTP, SNMP)

These checks confirm that configurations are correct **when they are performed**



Note that router configurations may change and unwanted traffic needs continuous monitoring

A dashboard for IXP operators



Conclusions

The Digital Twin provides a **secure and isolated** testing ground to support the development of new services

The **Quarantine Dashboard** provides a sandbox to validate members' compliance with technical rules and services in the onboarding phase

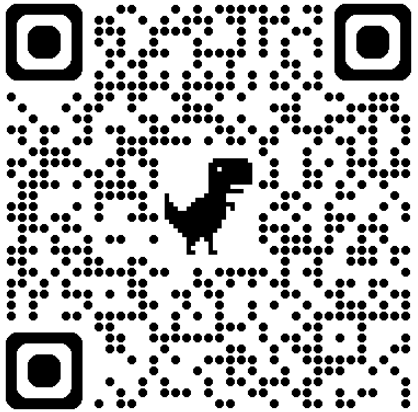
The Dashboard is just **one of many applications** we can imagine:
ASPA Testing, Traffic Generation, ROSE-T, etc.

You can read more about our experience on RIPE Labs
- Building a secure test environment for an ixp
- Testing IXP Configurations Without Breaking Production: A Digital Twin Approach

How to build your Digital Twin?

The Kathará IXP Digital Twin is **open source.**

Learn how to build your Digital Twin from production configuration, with full documentation and a comprehensive tutorial!



VSIX UNIVERSITÀ DEGLI STUDI DI PADOVA also runs its Digital Twin on Kathará

Q&A

Marta Burocchi, Namex
m.burocchi@namex.it

WORKSHOP GARR 2026
NET MAKERS

Digital Twin Scalabilty

Currently emulating:

- ~280 members
- 4 Route Servers (2 for IPv4, 2 for IPv6)
- Hardware specs:
  - Memory: 32GiB
  - Processors: 4 cores

Designed to scale with Namex's growth

For large IXPs, the full network can be deployed using the **distributed emulation feature** supported by Kathará