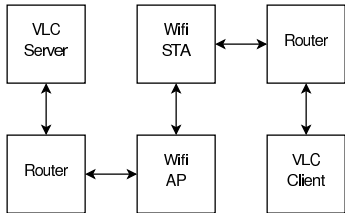


# Network Experiment Programming Interface (NEPI)

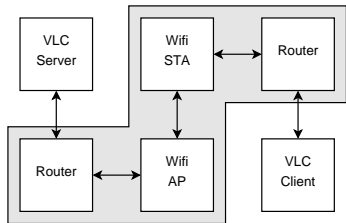
Alina Quereilhac    Martin H. Ferrari  
Thierry Turletti    Walid Dabbous  
**Mathieu Lacage**

# Objective Scenario

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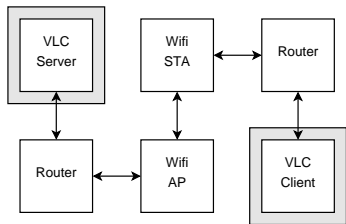
Simulated links/networks

ns-3 simulation models ✓

Realtime scheduler ✓

Tap device ✓

# Objective Scenario



Simulated links/networks

ns-3 simulation models ✓

Realtime scheduler ✓

Tap device ✓

Light weight Virtual Machines

Linux Network Namespaces ✓

# Easy Deployment

# Easy Deployment

Problem

Tap/VM creation and setup

# Easy Deployment

## Problem

Tap/VM creation and setup

Coherent IP address assignment across  
simulation and VMs



# Easy Deployment

## Problem

- Tap/VM creation and setup

- Coherent IP address assignment across simulation and VMs

- Coherent IP forwarding tables across simulation and VMs

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## Solution

- Automate everything

# Easy Deployment

## Problem

- Tap/VM creation and setup

- Coherent IP address assignment across simulation and VMs

- Coherent IP forwarding tables across simulation and VMs

## Solution

- Automate everything

## BUT

- Need global view of experiment topology

# Related Work

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Emulab Tcl: ad hoc, hard to generalize

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OMF Ruby: unclear how to extend it to model  
complex topologies

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SSF DML: hard to ensure correctness

Geni RSPEC: hard to ensure correctness

Geni Omnispec: hard to ensure correctness

# NEPI Object Model

# NEPI Object Model

Functional unit / Box

Example:

IP stack

TCP stack

Ethernet card

# NEPI Object Model

Functional unit / Box  
Attributes

Example:

IP checksum

IP forwarding

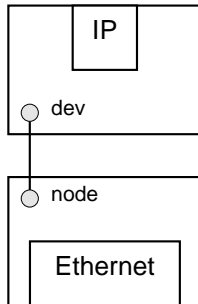
# NEPI Object Model

Functional unit / Box  
Attributes  
Trace sources

Example:  
Out packets  
In packets

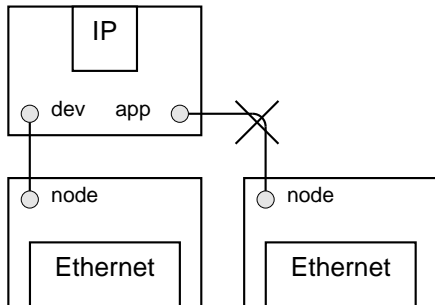
# NEPI Object Model

Functional unit / Box  
Attributes  
Trace sources  
Connectors



# NEPI Object Model

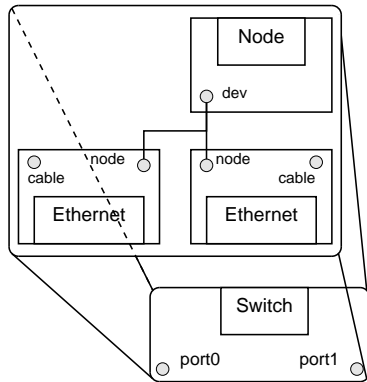
Functional unit / Box  
Attributes  
Trace sources  
Connectors  
Allowed connections



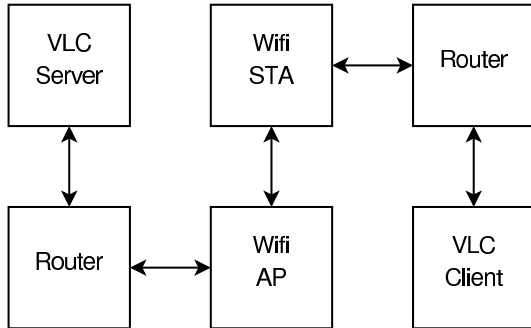


# NEPI Object Model

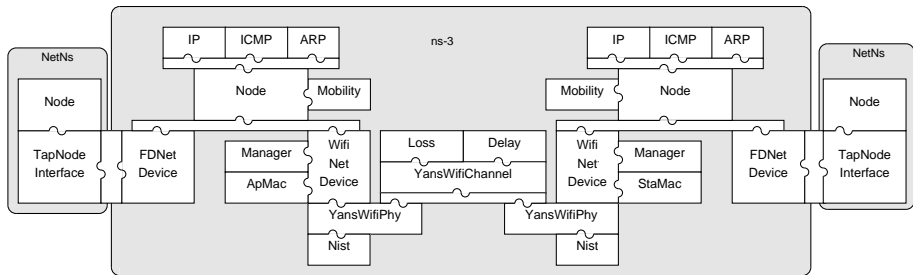
Functional unit / Box  
Attributes  
Trace sources  
Connectors  
Allowed connections  
Hierarchical



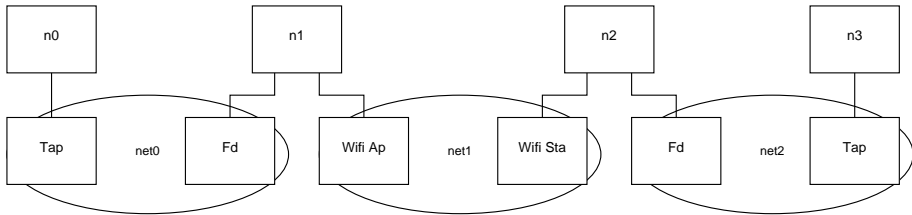
# Objective Scenario



# NEPI Representation



# Global IP topology



# Demo screenshot

The screenshot displays a Linux desktop environment with several open windows:

- client**: A terminal window showing network configuration for the 'client' machine. It lists the interface 'eth0' with IP 10.0.0.10 and 'lo' (loopback) with IP 127.0.0.1. It also shows the output of a ping command to 10.0.0.6, indicating successful connectivity.
- server**: A terminal window showing network configuration for the 'server' machine. It lists the interface 'eth0' with IP 10.0.0.10 and 'lo' (loopback) with IP 127.0.0.1. It also shows the output of a ping command to 10.0.0.10, indicating successful connectivity.
- NEPI DEMO (as superuser)**: A window displaying a network diagram. It shows two nodes, 'node0' and 'node1', connected by a dashed line. The diagram includes a coordinate system with values 22.4, 100.0, and 100.013.1. There are 'Start' and 'Stop' buttons at the bottom.
- test.ts - VLC media player**: A window showing a video player with a traffic cone icon. The video is playing at 1.00x speed.

The desktop environment includes standard Linux window management icons and a taskbar at the bottom with application titles: [Terminal], [NEPI DEMO (as super...], [xterm], [xterm], [rtp://10.0.0.10:5004/t...], and [test.ts - VLC media pl...].

# Conclusion

Well chosen Object Model  
GUI

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Well chosen Object Model

GUI

Expressive

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Simple coherent API



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Connection checking

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Automates deployment thanks to global  
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# Conclusion

Well chosen Object Model

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Connection checking

Automates deployment thanks to global  
topology knowledge

More details: <http://yans.pl.sophia.inria.fr/trac/nepi>

# Future work

Support SFA/rspec  
Support ...?

Martin H. Ferrari, twice über Intern:  
implementation, ns-3 backend, NetNs

Alina Quereilhac, Engineer: bugfixing,  
cleanup, refactoring

Thierry Turletti: First user

Walid Dabbous: Initiated this work

# Questions ?

Email: [mathieu.lacage@inria.fr](mailto:mathieu.lacage@inria.fr)

# IP endpoints

Cannot use DNS:

- Some backends do not support it

- Hard to deploy

# IP endpoints

Cannot use DNS:

- Some backends do not support it

- Hard to deploy

Instead:

- Resolve endpoint names to IP/port before deployment



# IP assignment

Currently stupid algorithm:

Allocate consecutive IP addresses  
 $n$  entries per forwarding table

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Allocate consecutive IP addresses  
 $n$  entries per forwarding table

Planned:

*Automatic IP Address Assignment on Network Topologies*, by John Byers, Jay Lepreau, Jonathon Duerig and Robert Ricci