



# OPENRASE

**Open** Resource **Allocation** to **Service** Function  
Chains **Emulator**

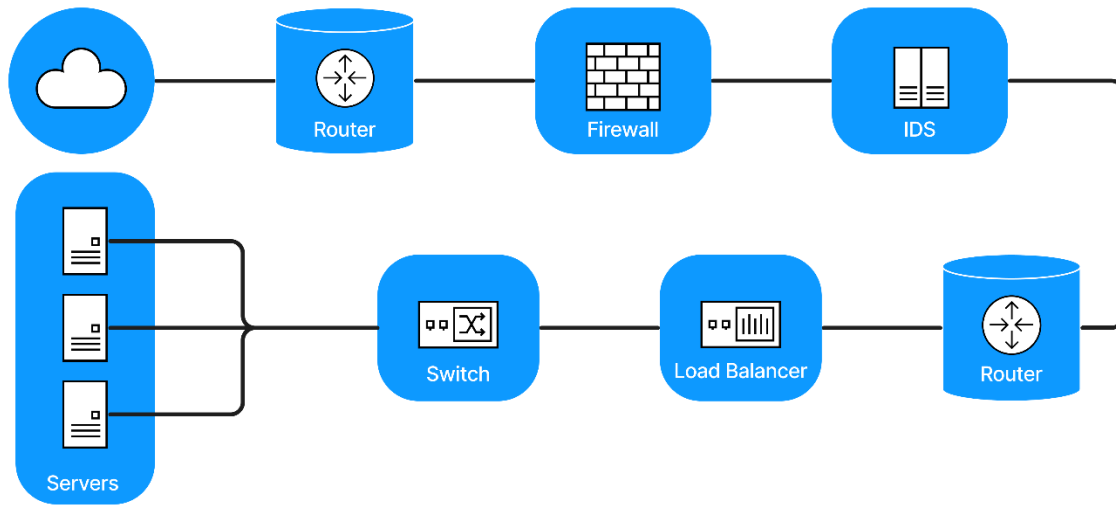
Theviyanthan K.

# Background

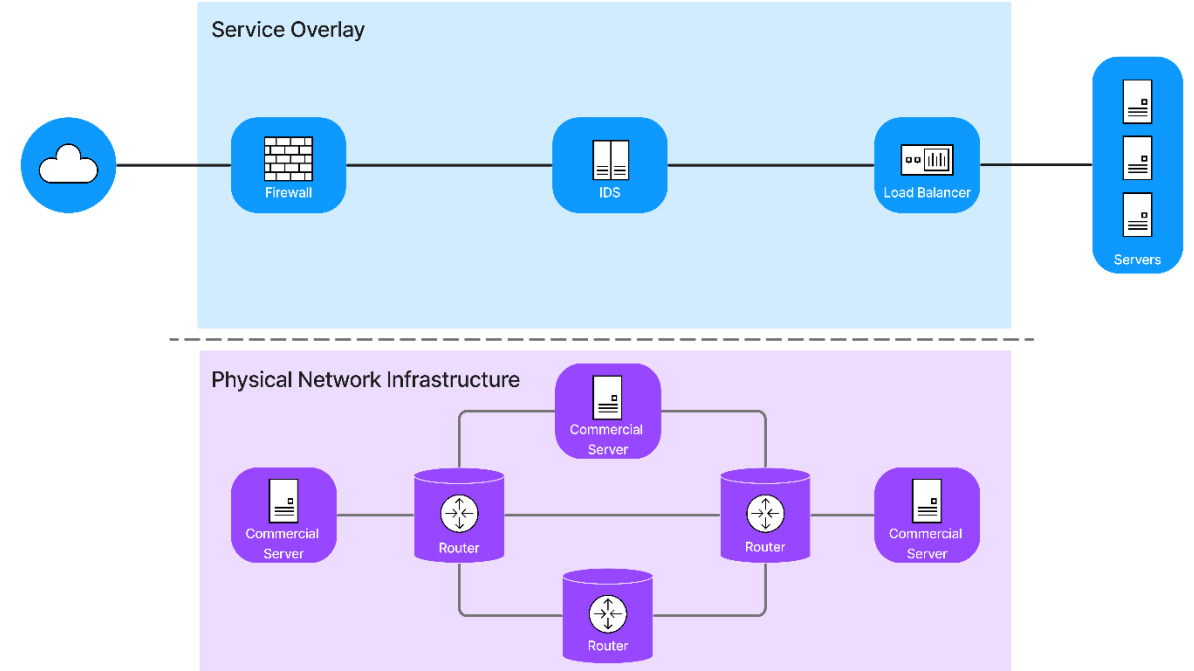
# What are Service Function Chains (SFCs)?

- SFCs combine both Network Function Virtualization and Software Defined Networking and create a service overlay over the physical network.

*A traditional network:*



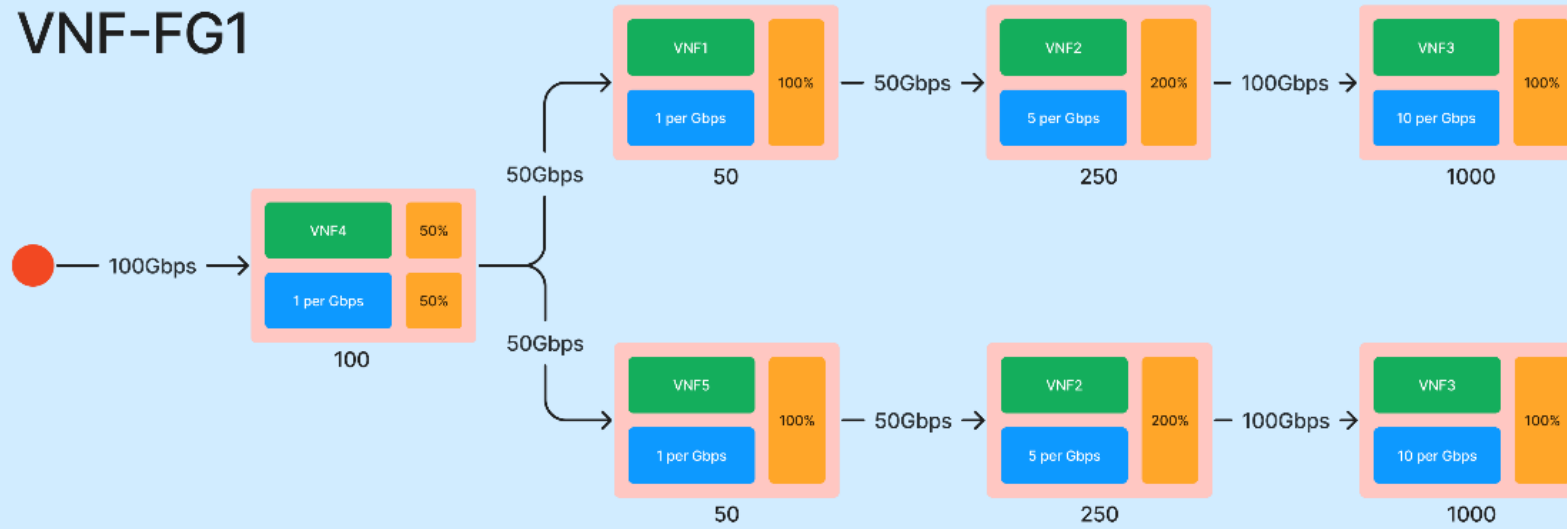
*A Service Function Chain:*



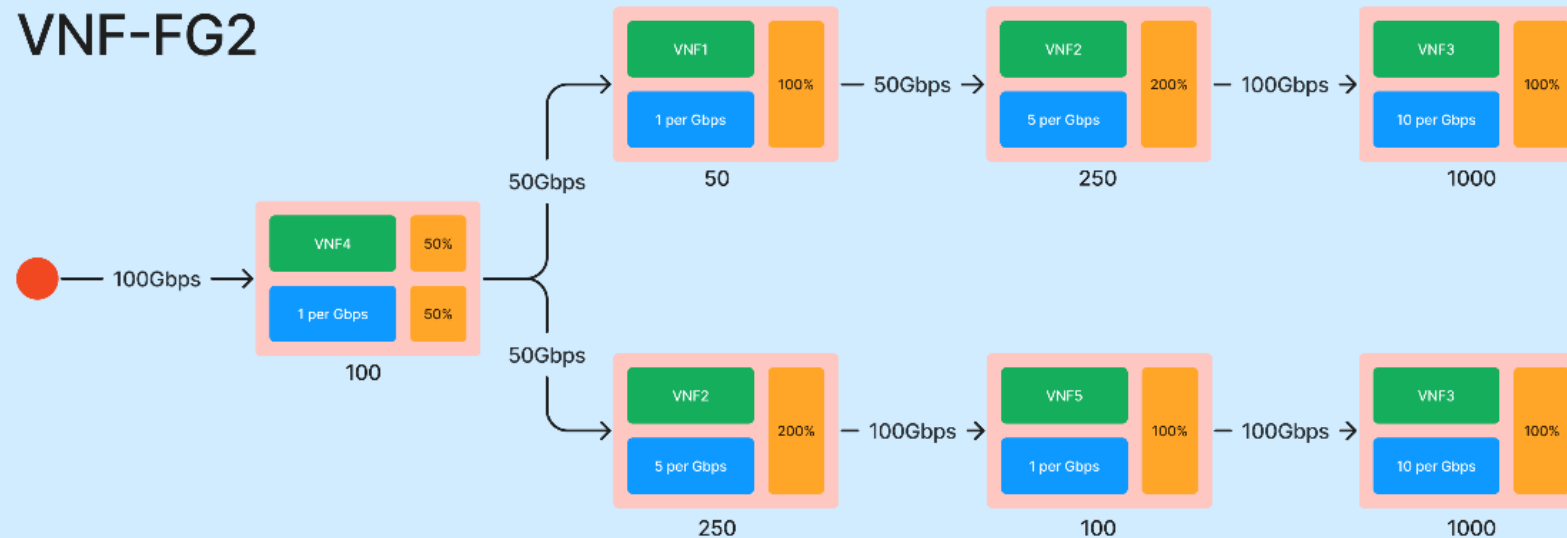
# Network Function Virtualization Resource Allocation (NFV-RA)

- The NFV-RA problem deals with the composition of and resource allocation to SFCs.
- It is composed of three sub-problems:
  - Virtual Network Function (VNF) Chain Composition (VNF-CC)
  - Virtual Network Function Forwarding Graph Embedding (VNF-FGE)
  - Virtual Network Function Scheduling (VNF-SCH)

## VNF-FG1



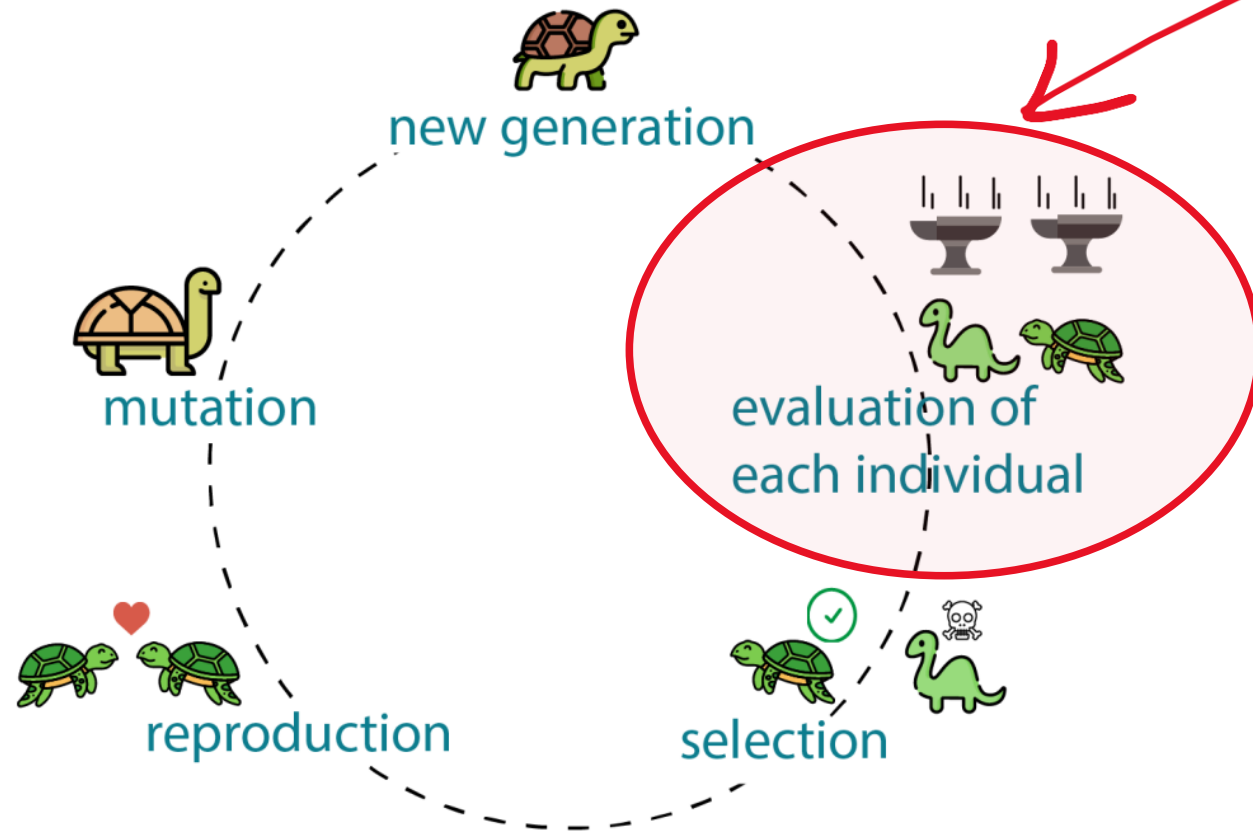
## VNF-FG2



**What am I trying to do?**

# My Research

Evaluation is done on a live network, so it is going to be time-consuming.



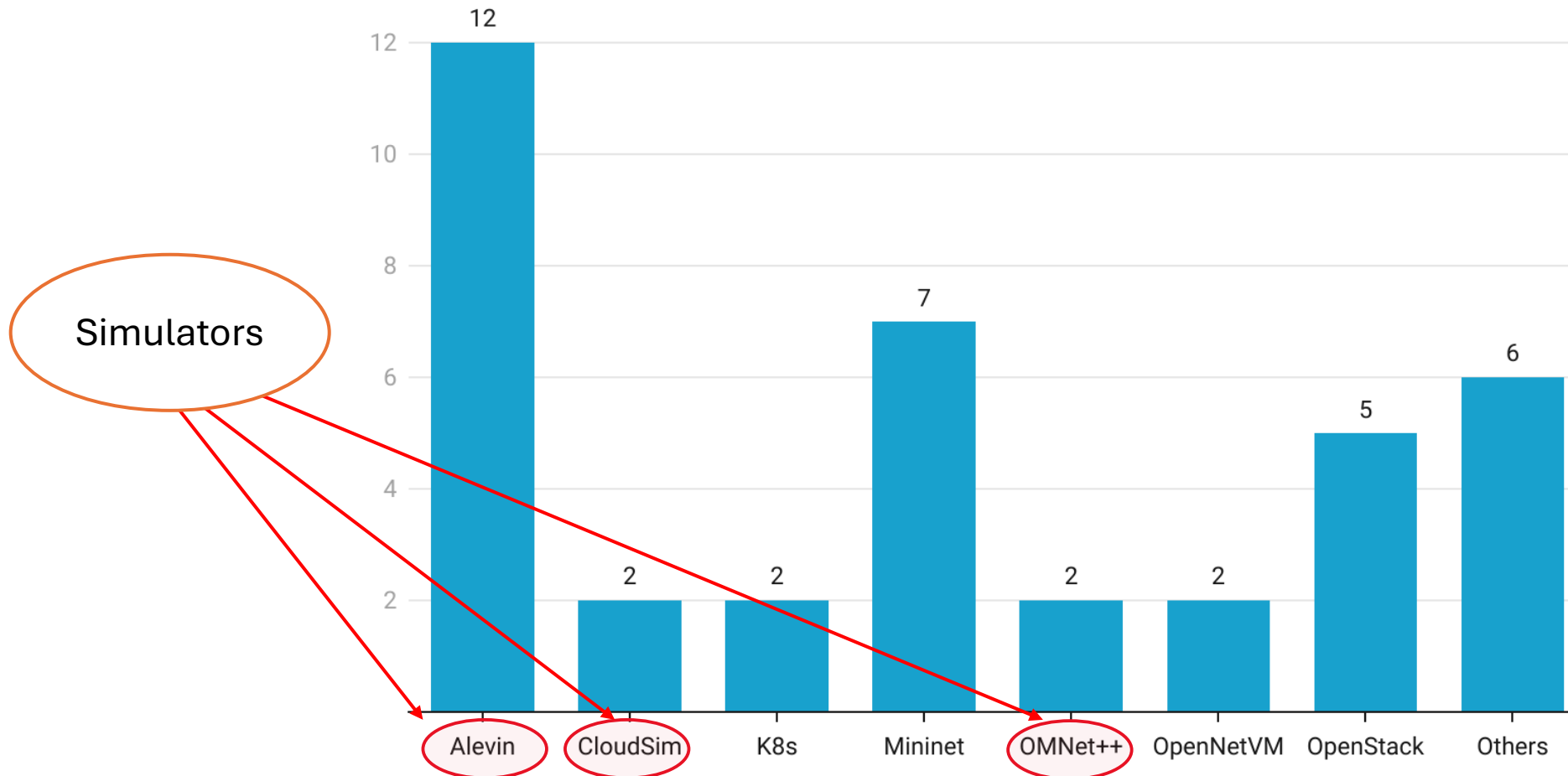
- I plan to use Genetic Algorithms to solve the VNF-CC and VNF-FGE problems.

**Why do I need OpenRASE**



# Tools used in literature

Tools used to evaluate solutions to the NFV-RA problem



# Why can't I use a simulator?

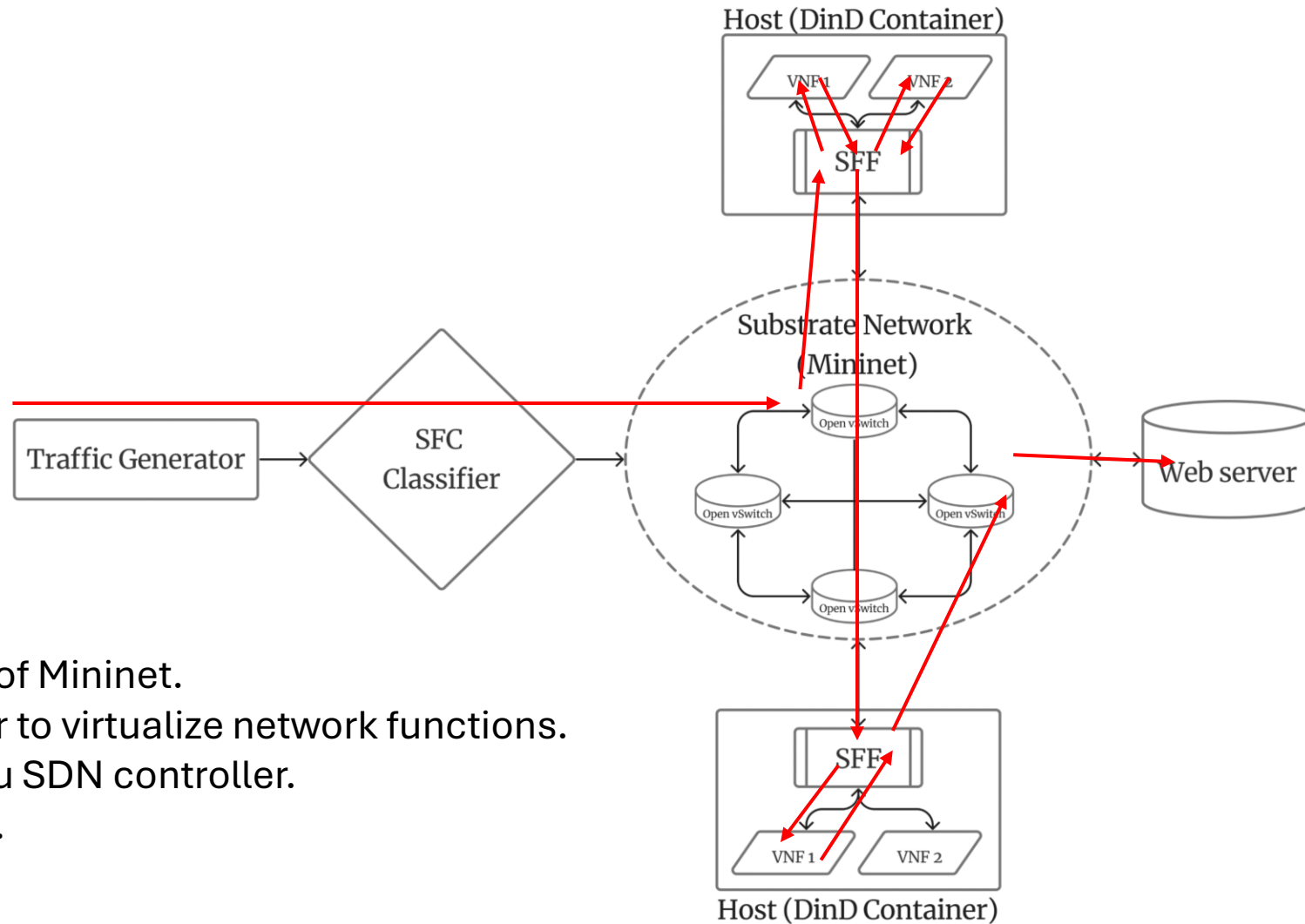
- Simulators don't provide high fidelity.
- A major challenge in online experimentation is excessive time consumption.
- The use of simulators nullifies this challenge.
- This means an algorithm that runs fast on a simulator may not necessarily be fast on a real network.
- An algorithm's ability to adapt to an uncertain environment cannot be tested.

# Why do I need an emulator?

- Emulators offer higher fidelity than simulators.
- They are closer to real networks. So, online experimentations on emulators consume time just like real networks.
- This means that an algorithm's ability to address such challenges can be tested with high fidelity.
- Provides a more uncertain environment than a simulator.

**How does OpenRASE work?**

# Architecture



- Built on top of Mininet.
- Uses Docker to virtualize network functions.
- Uses the Ryu SDN controller.
- HTTP based.

# Future Work

- Evaluating OpenRASE
- Developing Genetic Algorithms on top of OpenRASE

# Challenges

Running a 4ary fat tree topology with a Ryu controller running the REST router app exhausts all CPU cores.

```
1 [|||||] 100.0% 9 [|||||] 100.0% 17 [|||||] 100.0% 25 [|||||] 100.0%
2 [|||||] 100.0% 10 [|||||] 100.0% 18 [|||||] 100.0% 26 [|||||] 100.0%
3 [|||||] 100.0% 11 [|||||] 100.0% 19 [|||||] 100.0% 27 [|||||] 100.0%
4 [|||||] 100.0% 12 [|||||] 100.0% 20 [|||||] 100.0% 28 [|||||] 100.0%
5 [|||||] 100.0% 13 [|||||] 100.0% 21 [|||||] 100.0% 29 [|||||] 100.0%
6 [|||||] 100.0% 14 [|||||] 100.0% 22 [|||||] 100.0% 30 [|||||] 100.0%
7 [|||||] 100.0% 15 [|||||] 100.0% 23 [|||||] 100.0% 31 [|||||] 100.0%
8 [|||||] 100.0% 16 [|||||] 100.0% 24 [|||||] 100.0% 32 [|||||] 100.0%
Mem[|||||] 4.81G/62.8G Tasks: 349, 2492 thr; 32 running
Swp[|||||] 0K/2.00G Load average: 11.97 2.84 0.94
Uptime: 1 day, 22:40:17

PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
56377 root 10 -10 2393M 328M 11648 S 45.7 0.5 48:00.93 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1173186 systemd-n 20 0 33.5G 1023M 956M S 23.2 1.6 0:09.34 java -Xmx1G -Xmx1G -XX:+UseZGC -XX:+ZGenerational -XX:+ExitOnOutOfMemoryError -jar ./lib/sf
1173501 systemd-n 20 0 33.5G 1023M 956M S 18.2 1.6 0:03.54 java -Xmx1G -Xmx1G -XX:+UseZGC -XX:+ZGenerational -XX:+ExitOnOutOfMemoryError -jar ./lib/sf
1171651 root 20 0 9560M 528M 277M S 16.3 0.8 0:38.72 /root/.cache/py poetry/virtualenvs/openrase-72N34duu-py3.9/bin/python -c import sys; from im
1173504 systemd-n 20 0 33.5G 1023M 956M S 4.4 1.6 0:00.92 java -Xmx1G -Xmx1G -XX:+UseZGC -XX:+ZGenerational -XX:+ExitOnOutOfMemoryError -jar ./lib/sf
1178566 root 10 -10 2393M 328M 11648 S 4.4 0.5 0:00.38 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178558 root 10 -10 2393M 328M 11648 S 3.1 0.5 0:00.39 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178541 root 10 -10 2393M 328M 11648 S 3.1 0.5 0:00.34 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1174405 thivi 20 0 12680 6144 3324 R 2.5 0.0 0:01.34 htop
1178556 root 10 -10 2393M 328M 11648 S 2.5 0.5 0:00.33 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178540 root 10 -10 2393M 328M 11648 S 2.5 0.5 0:00.37 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178570 root 10 -10 2393M 328M 11648 S 2.5 0.5 0:00.32 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178567 root 10 -10 2393M 328M 11648 S 1.9 0.5 0:00.34 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178564 root 10 -10 2393M 328M 11648 S 1.9 0.5 0:00.35 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178575 root 10 -10 2393M 328M 11648 S 1.9 0.5 0:00.34 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178542 root 10 -10 2393M 328M 11648 R 1.9 0.5 0:00.37 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178572 root 10 -10 2393M 328M 11648 S 1.9 0.5 0:00.35 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178539 root 10 -10 2393M 328M 11648 S 1.9 0.5 0:00.32 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178547 root 10 -10 2393M 328M 11648 R 1.9 0.5 0:00.36 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178563 root 10 -10 2393M 328M 11648 S 1.9 0.5 0:00.31 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178571 root 10 -10 2393M 328M 11648 S 1.9 0.5 0:00.30 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178574 root 10 -10 2393M 328M 11648 S 1.9 0.5 0:00.31 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178559 root 10 -10 2393M 328M 11648 S 1.3 0.5 0:00.37 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178568 root 10 -10 2393M 328M 11648 S 1.3 0.5 0:00.38 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178565 root 10 -10 2393M 328M 11648 S 1.3 0.5 0:00.31 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178569 root 10 -10 2393M 328M 11648 S 1.3 0.5 0:00.38 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
1178562 root 10 -10 2393M 328M 11648 S 1.3 0.5 0:00.30 ovs-vswitchd unix:/var/run/openvswitch/db.sock -vconsole:emer -vsyslog:err -vfile:info --ml
F1Help F2Setup F3Search F4Filter F5Tree F6SortBy F7Nice F8Nice F9Kill F10Quit
```

**Questions?**



# Appendix

# ALEVIN vs. OpenRASE

	ALEVIN	OpenRASE
Test	Simulated	Emulated.
Hosts	Simulated	Docker containers as hosts
Switches	Simulated	Open vSwitches using Mininet
VNFs	Simulated & abstract	7 distinct, real VNFs. Allows addition of more VNFs
VNF resource requirements	Arbitrary, static, & user-specified	VNF demands are calibrated through benchmarking
VNF behavior	Static	Dynamic based on input traffic
Deployment	Simulated	Emulated real code deployment using Docker containers and Mininet
Programming language	Java based	Python based
Tool resource requirements	Low	High
Use case	Rapid designing and prototyping	High-fidelity testing
New resource demands and metrics	Can be added	Adding new demands and metrics need changes to the emulator

# Design

