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## Motivation

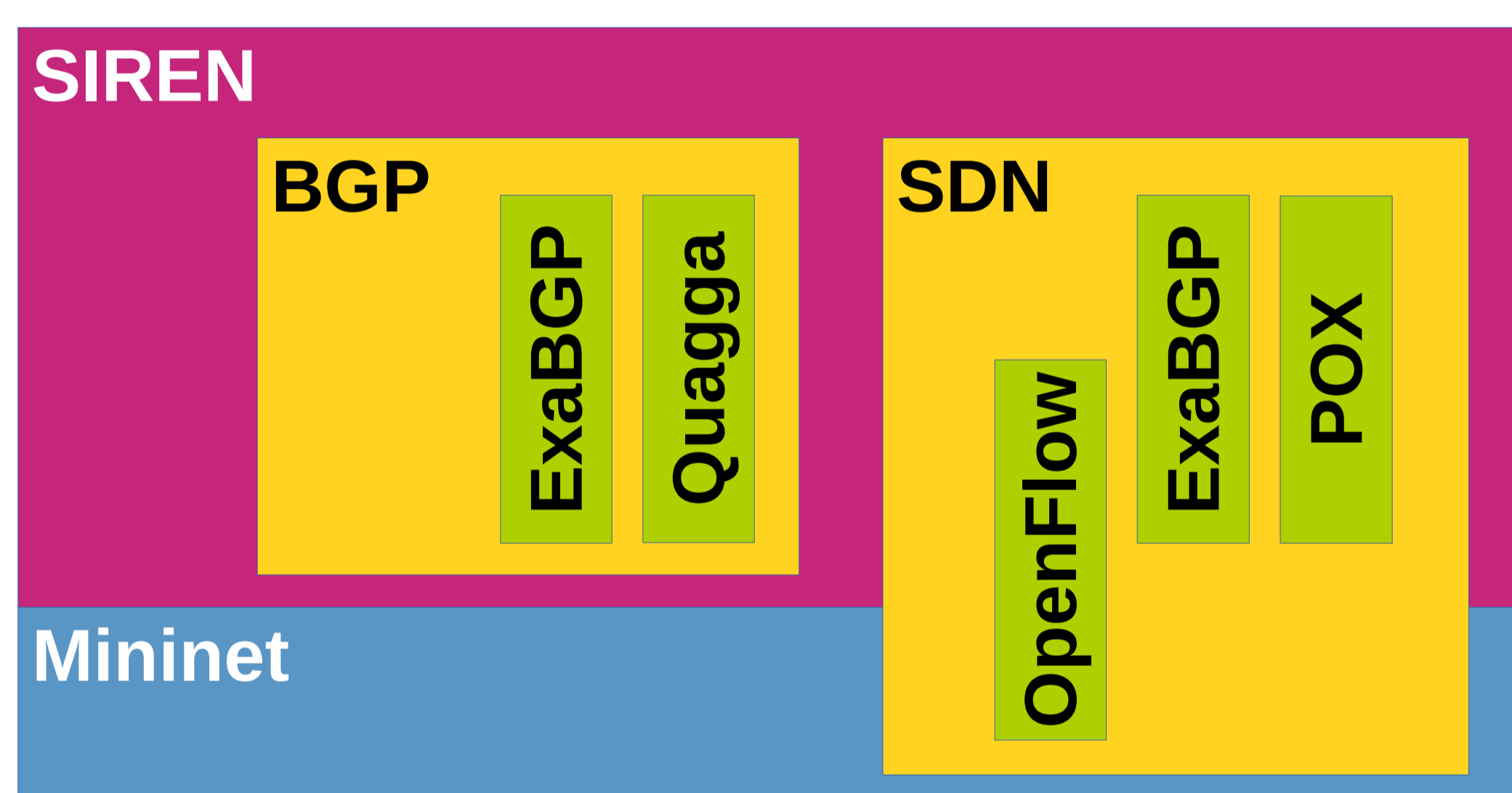
- BGP routing has problems
  - Can take several minutes to converge
  - Does not support QoS
  - Is complex to manage
- Can SDN help improve BGP?
  - SDN centralization at the inter-domain level [1]
  - Software Defined Internet Exchanges (SDX) [2]
- **BUT: No hybrid BGP-SDN emulator to test ideas!**

## Objectives

- **Develop hybrid BGP-SDN emulation framework**
  - Use real router software
  - Emulate multiple Autonomous Systems (AS)
  - Simplify experiment management
- **Evaluate effect of SDN centralization on BGP convergence time**
  - Design centralized multi-AS controller [1]
  - Run over emulation framework



Hybrid SDN Inter-domain Routing Emulation



## Features

- Based on Mininet, Quagga, POX, and ExaBGP
- Automated configuration generation
- Experiment management over computing nodes
- Live visualization of routing changes
- Log collection and analysis
- Packet loss measurements between end-points

## Live Visualization

ws://80.240.131.36:8888/ln  
start visualization

Elapsed time since last command:  
5min 44sec

convergence time  
2min 58sec

Legend

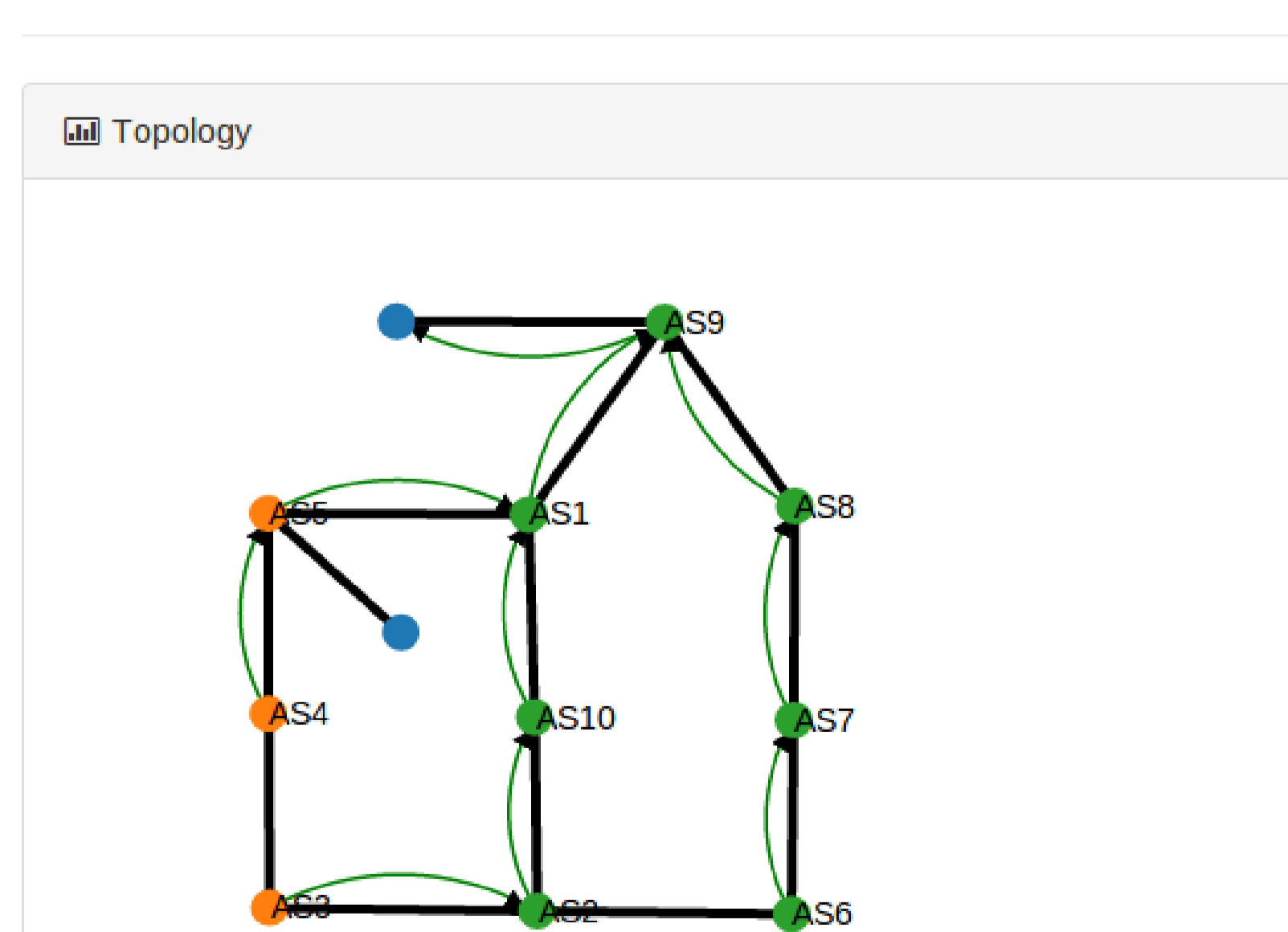
Edges

- Link up
- Link down
- Forwarding direction

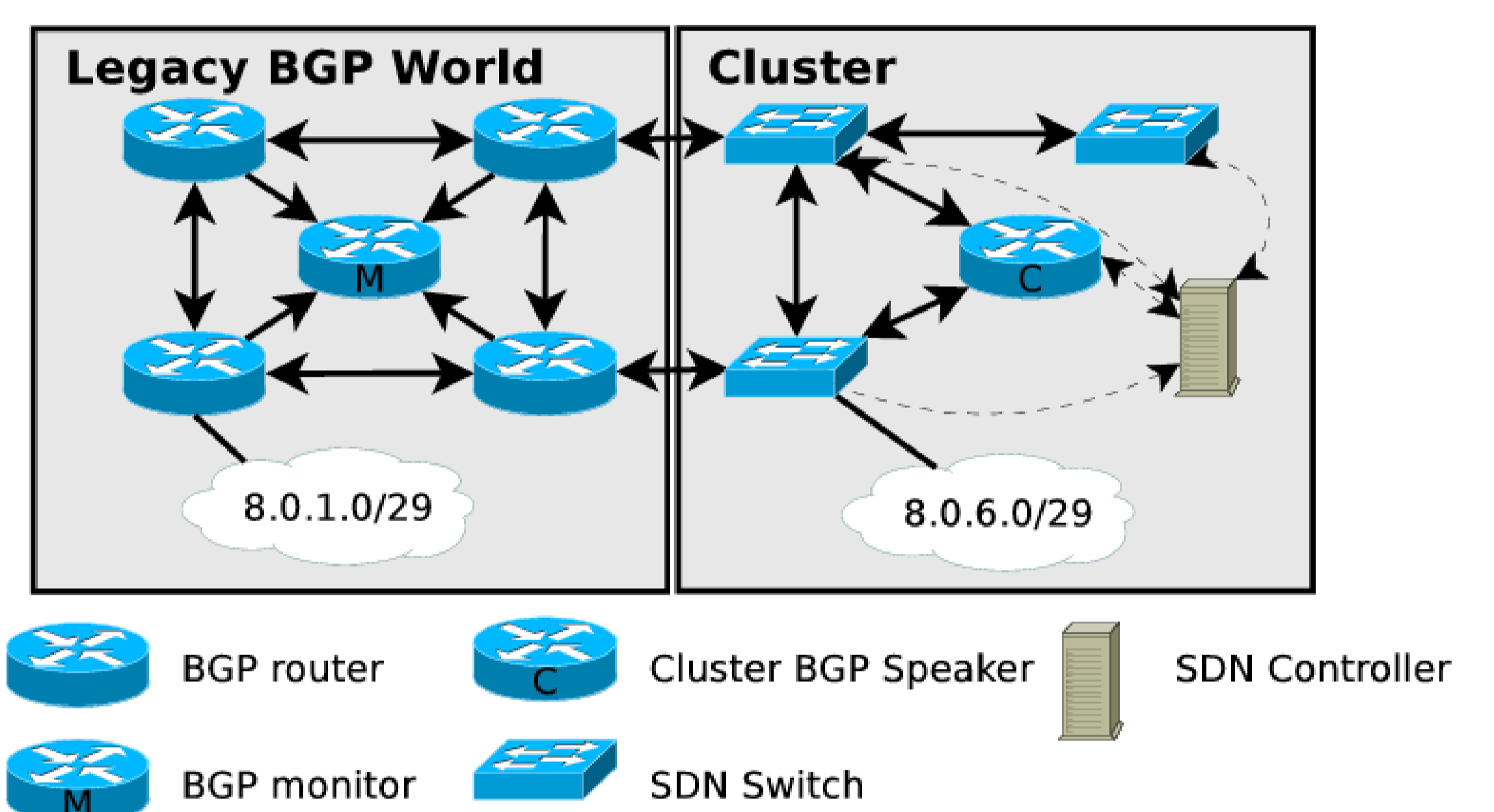
Nodes

- host (Host)
- cluster1 (sdn)
- cluster2 (bgp)

### Dashboard



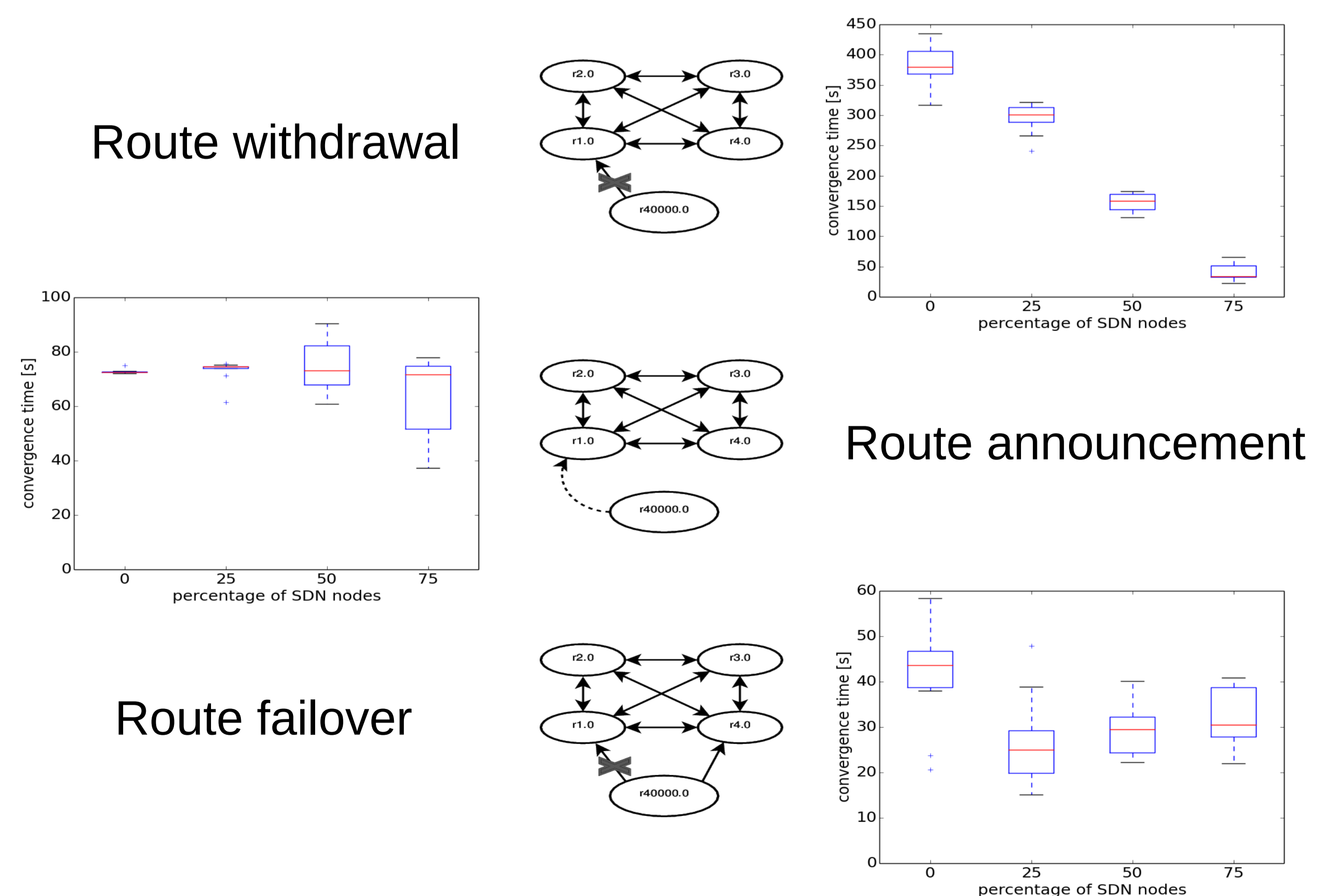
## Use-case: effect of SDN centralization on BGP convergence time



### Multi-AS cluster controller

- Centralized controller speaks BGP and OpenFlow
- Transparent to the BGP world
- Hybrid path vector / link state inter-domain routing
- Route advertisements delayed for stability

### Insight: SDN can help reduce BGP convergence time in certain cases



Download at: <https://bitbucket.org/gaadrian/siren>

### References

- [1] Kotronis, V., Dimitropoulos, X., Ager, B. Outsourcing the Routing Control Logic: Better Internet Routing Based on SDN Principles. In Proc. of ACM HotNets-XI, 2012.
- [2] Gupta, A., Vanbever, L., Shahbaz, M., Donovan, S., Schlinker, B., Feamster, N., Rexford, J., Shenker, S., Clark, R., Katz-Bassett, E. SDX: A Software Defined Internet Exchange. In Proc. of ACM SIGCOMM, 2014.