

# Experience of Using GENI in Networking Classes

(GENI in Education Panel)

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# Classes Using GENI

- Undergraduate networking classes
- Graduate networking classes
- Some special topics course on networking
  
- Most recent use: this semester (Fall 2014)
  - CS 571: Graduate networking class (24 students)
  - CS 687: Special topic class on SDN (9 students)
  
- Take home assignments

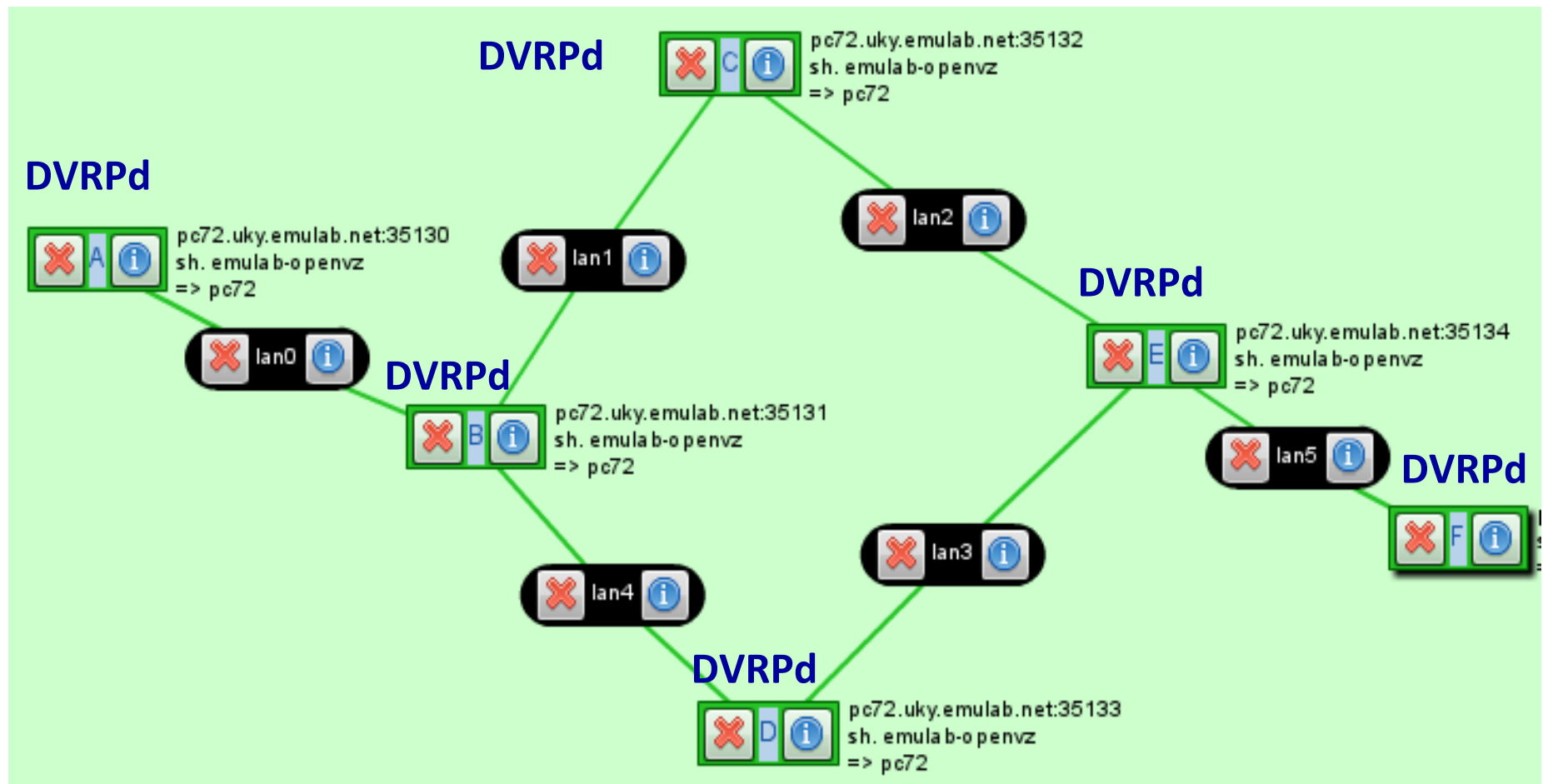
# Routing Algorithm

- We want students to write a generic routing algorithm, such as distance vector routing, or link state routing algorithm that can work with any number of nodes in the network. (scalability)
- A configuration file can be provided to each node to give some basic information. (initialization)
- We did not use the exercise from GENI web page because it contains 3 nodes.

# Distance Vector Routing Protocol

- Goals:
  - Get hands-on experience with the distance vector routing protocol
  - Understand at-scale experiments
- Steps
  - Setting up the initial experiment
  - Distance vector routing protocol daemon (DVRPd) running on each node
  - Dynamic change of link costs
  - Generating traffic and monitoring the routing path

# Setting Up the Initial Experiment



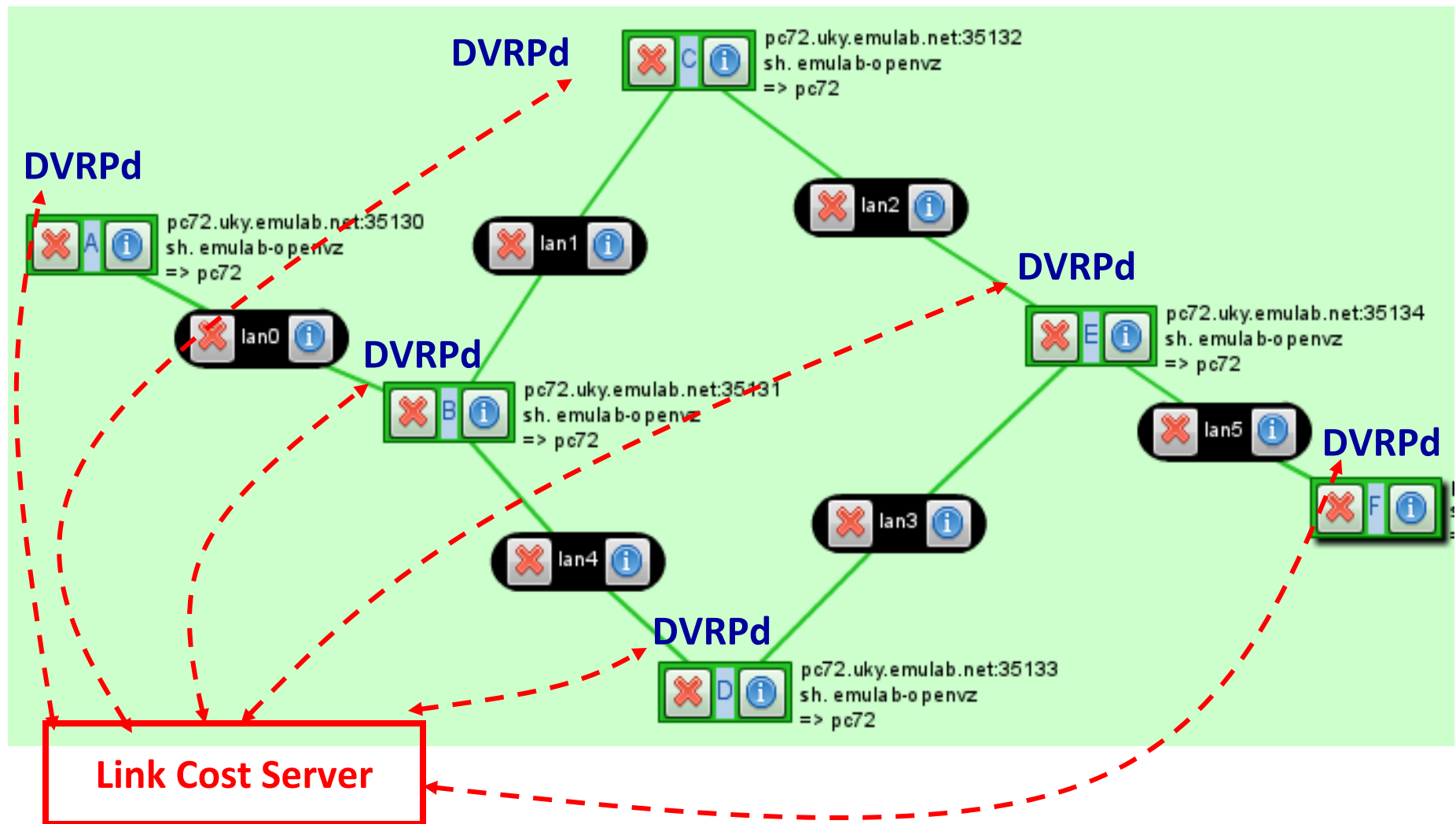
# Distance Vector Routing Protocol

- DVRP running on each node
- To simplify the implementation using UDP, we replace the initial network discovery by providing a configuration file for each node

```
name_of_this_node
neighbor_1_name    link_cost    neighbor_1_IP_addr
neighbor_2_name    link_cost    neighbor_2_IP_addr
.....
neighbor_n_name    link_cost    neighbor_n_IP_addr
```

- The IP addresses are needed for UDP programs to know where to send packets.
- Periodic updates and triggered updates
- Make changes to forwarding tables

# Dynamic Change of Link Costs



# Generating Traffic and Monitoring Routing Path

- Traffic is generated from node A to node F using iperf
- Use GENI Desktop to monitor the TCP and IP traffic at node C and D
- As the link costs change, the routing path will be changed and the effect can be observed by the instrumentation and measurement tools
- Final note: The experiment can be expanded to an arbitrarily large scale.



# Using OVS Image from GENI

- In my SDN class, we gave an assignment using mininet.
- It turns out the biggest problem is installing mininet itself.
  - Different environments
  - Virtual box problem (64bits vs 32 bits)
  - Computer configurations
  - Key
  - Path
- OVS image from GENI is a standard image that can be used to install mininet from source without a problem.
- We are considering using exercises from GENI web page.

# Challenges

- Challenges faced by instructors
  - Find/design appropriate exercises
  - Figure out the problems in the programs or configurations of students' experiments
- Challenges faced by students
  - Instructions are not comprehensive
  - Robustness of experimental systems

# Experience

- Using GENI enables us to give assignments that are almost impossible in traditional labs. Students can learn some key concepts and gain practice experience designing and implementing these experiment.
- Using GENI can make the life of the instructor easier.

# Suggestions for Helpful Tools

- A recorded video giving an introduction on how to use GENI
  - Login to GENI Portal
  - Handle ssh keys
  - Create experiments
  - Use GENI Desktop