ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ

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Simulate or Emulate?

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How do I test network stuff?

- Simulation and emulation use cases
  - How will this protocol perform?
  - How will this application perform?
  - How will this network topology perform?
- Simple answer: build it and test it!
  - Hard to do in a large scale (tens of nodes)
  - Hard to do in diverse settings (wired/wireless)
  - Requires hardware, connectivity and time

Simulation

- Discrete event simulators
  - Entities cause and respond to events
  - Events are ordered in time
  - A scheduler selects the next event
- Networking example: ns-3
  - Written in C++
  - Modules for many protocols and links
  - Simulations configured in C++ or Python

Emulation

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- System emulators
  - Real system runs in a sandbox
  - Sandboxes connected virtually
  - Scheduler runs all systems concurrently
- Networking example: mininet
  - Uses Linux process-level virtualization
  - Runs actual Linux code
  - Configurable in Python

Pros and cons (1)

- In simulation you use models
  - You do not run real code as in emulation
  - Somebody needs to write the model code
    - Especially tricky with applications
  - Models are abstract representations
    - Simpler models are faster
    - More exact models are slower
    - With less detail, higher scalability

Pros and cons (2)

- In emulation you are using the real thing
  - Actual applications and kernel code
    - But, specific kernel code (mininet uses Linux)
  - No need to write any models
    - You can even use proprietary applications
    - Anything you can run on your kernel
  - But everything is the real thing
    - Scalability is limited by system resources

Pros and cons (3)

- But, everything uses Python, right?
  - You need a language to describe the system
    - Nodes, links, protocols, applications
  - Interpreted languages are great for this
  - In NS-3 you also need Python to control entities
    - Tell an application model to send or receive
  - In mininet, you use Linux shell commands
    - You are running real applications, after all

Which is best?

- Simulation is best for scale
  - Hundreds or thousands of nodes
  - You only need to model what is relevant
    - Sometimes it is hard to say what is relevant
- Emulation is best for accuracy
  - You run actual Linux code and applications
    - Only the links between nodes are virtual
  - But you are forced to model everything