THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Development of Education and Training Resources for GENI Experimenters

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Goals

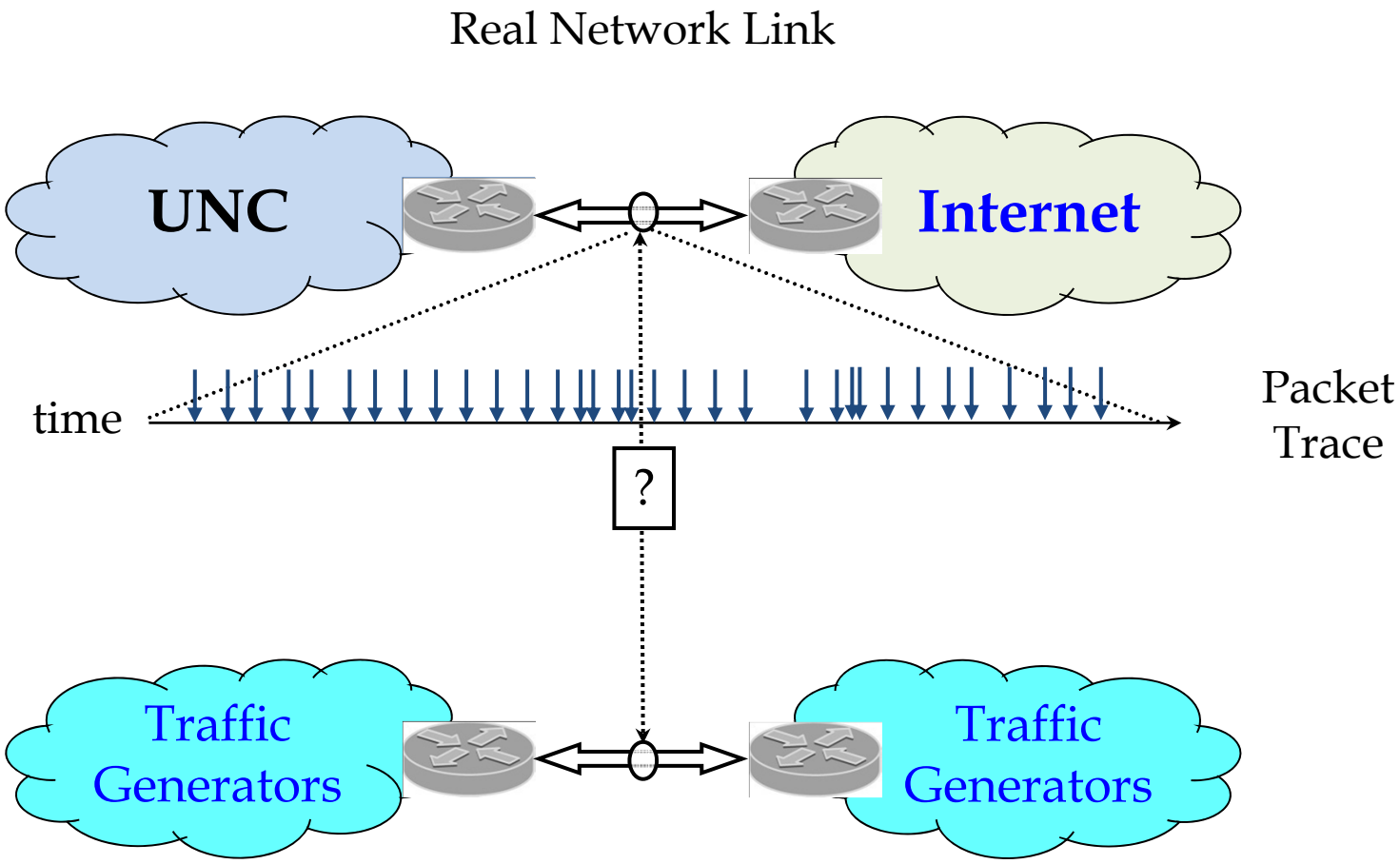
- Port a suite of tools for realistic traffic generation to GENI clusters
- Develop training material for use of these tools by GENI experimenters
- Allow experimenters to generate realistic and reproducible traffic for their experiments
- Provide pretested modules for network experimentation

Motivation

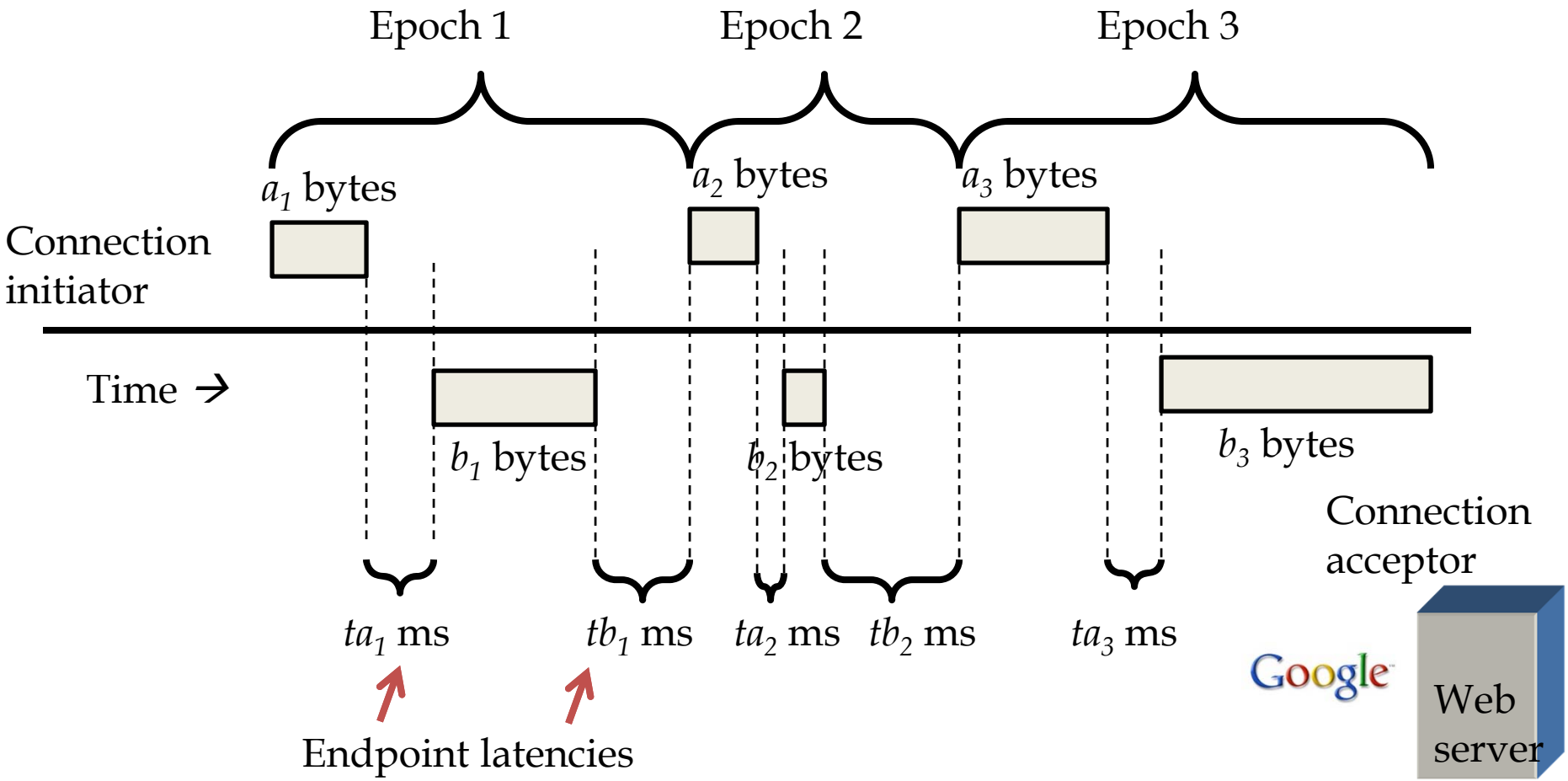
- Dissertation research:

  An Investigation of the Effects of Application Workload Modeling and Path Characteristics on Network Performance

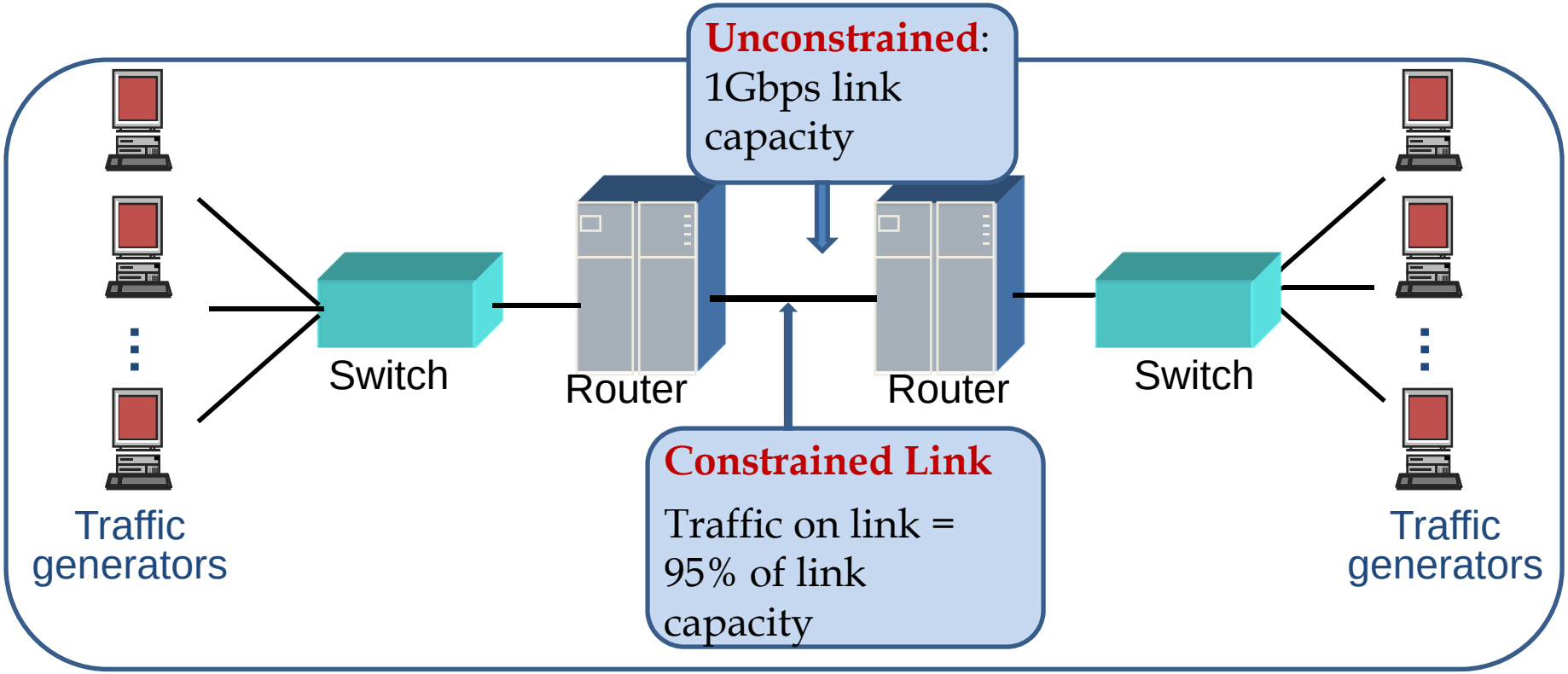
Traffic Generation



a-t-b-t Model


Epoch 1
Epoch 2
Epoch 3
a_1 bytes
a_2 bytes
a_3 bytes
Connection initiator
Time →
b_1 bytes
b_2 bytes
b_3 bytes
Connection acceptor
ta_1 ms
tb_1 ms
ta_2 ms
tb_2 ms
ta_3 ms
Google
Web server
Endpoint latencies

Network Environments



Laboratory **testbed** for experiments

Experimental Design

Different application workload models

Different Round Trip Time methods

Four performance metrics:
- Connection duration
- Response time
- Router queue length
- Active connections

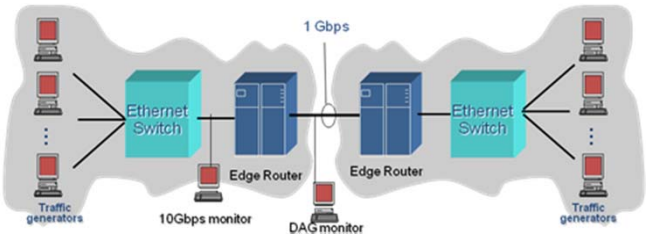
Two traffic inputs: UNC and IBM

Two network environments: unconstrained and constrained

Research → teaching

- Significant methodological advances in empirical networking research
- Large-scale collaborative research testbeds, including the GENI infrastructure
- But these resources have yet to make their way into our classrooms and textbooks

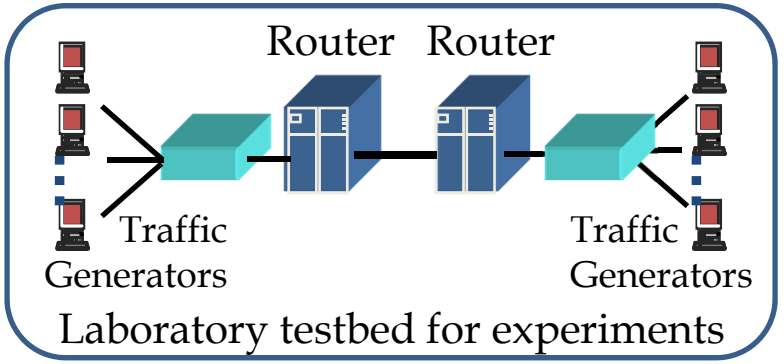
UNC lab → GENI clusters



- Laboratory experiments
  - Experiments on a testbed in a controlled environment.
- GENI experiments
  - Experiments using one or more GENI clusters

geni
Exploring Networks of the Future

Laboratory Experiments - Controlled environment



- Design experiments
- Calibrate the network
- Traffic generation
- Variables in an experiment
- Measurement methodology
- Performance metrics
- Trade-offs
- Analyses and presentation of results

GENI-based experiment – controlled or in the "wild"

- Different learning experience
- Remotely controlled: reserve, configure, program, and operate distributed systems across the GENI clusters
- Wealth of network environments and infrastructure

Broad Goals

- Tools for traffic generation
- Traffic datasets
- Manuals for GENI cluster usage
- Pretested modules for network experimentation

Goals (contd.)

- Develop "laboratory manuals" that teach GENI experimenters best practices for experimental methodology, network measurement and data analysis
- Manuals → course materials
- Tutorials/workshops at major conferences where we teach the principles and practices of experimentation on GENI clusters.

Longer-term Goal

- Textbook on methods and practices for experimental networking, with GENI experiments serving as an extensive set of case studies

Immediate Goals

- Tools and programs for realistic traffic generation in ProtoGENI
- Create draft documents (“lab manuals”) describing the cluster, the experimental setup, the input data, and the results
- Sample traffic models for use in experiments.

Educational goal – bold plan

Best practices in "**experimental methods for networking research**"

Teach such a **course** and write the **textbook** on it

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Thank you!

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