Behind the Scenes of GENI Experimentation

featuring Named Data Networking

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Tutorial Objectives

- By the end of this tutorial you should:
  - Feel comfortable running experiments on GENI
  - Have a basic understanding of how GENI works
- Later exercises in this tutorial may skip some of the basic steps to focus on new material
  - You may be given an RSpec to use rather than creating one yourself
  - You may use slices that have already been created with resources added to them

For a description of the GENI concepts covered, see:
`http://groups.geni.net/geni/wiki/GENIConcepts`

Hands-On Exercise*

- Reinforce new concepts using a Named Data Networking (NDN) based experiment*
  - New concepts: RSpecs and AM API
- Named Data Networking (NDN)
  - A Future Internet Architecture (FIA) project**

* Based on a classroom exercise developed by Sonia Fahmy, Ethan Blanton & Sriharsha Gangam of Purdue U.; Christos Papadopoulos & Susmit Shannigrahi of Colorado State U.

** http://named-data.net

Named Data Networking (NDN)
… also known as Content Centric Networking (CCN)

PRINCIPLE

Focus on **what** you need; **not on where** you find it

TODAY

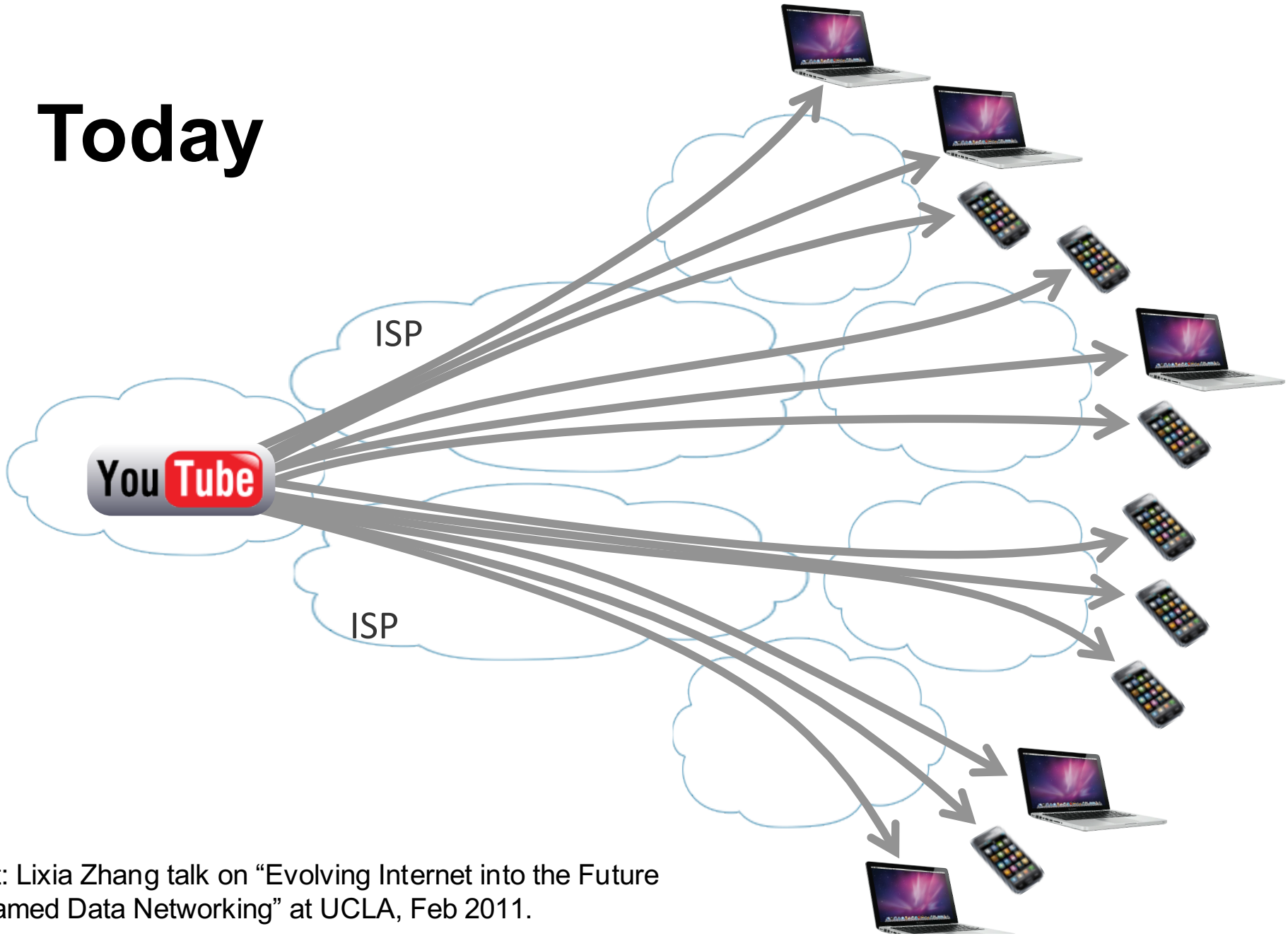
Must know the **location** of information (aka URL)

- Search engines map the *what* to the *where*
- Most Internet information look-ups start with search engines

NDN (CCN)

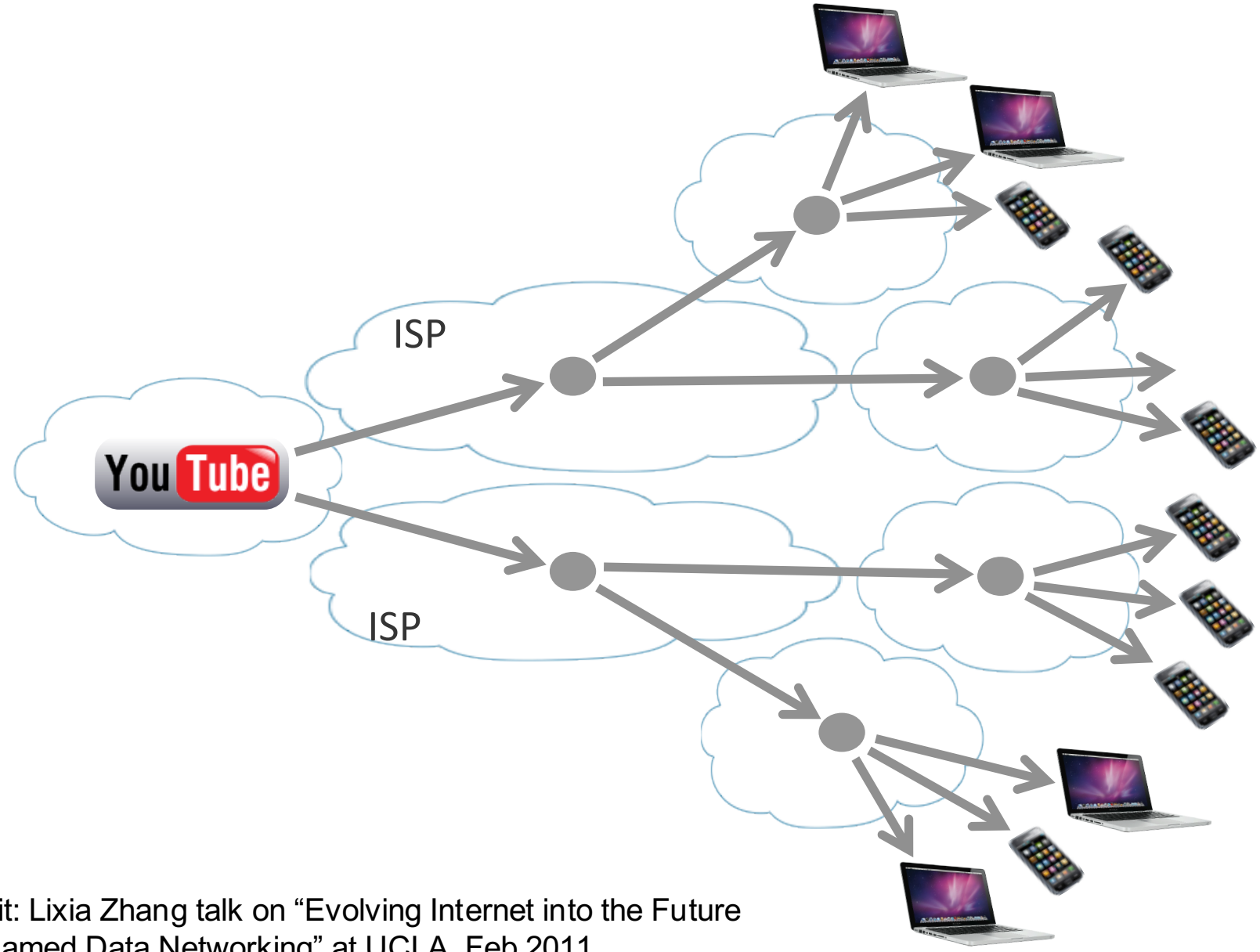
- New network architecture reflects Internet usage
- CCN protocols cache data at all network levels
  - routers, hosts

Point-to-point for data distribution



Credit: Lixia Zhang talk on “Evolving Internet into the Future via Named Data Networking” at UCLA, Feb 2011.

NDN: Scalable Data Dissemination



Credit: Lixia Zhang talk on “Evolving Internet into the Future via Named Data Networking” at UCLA, Feb 2011.

CCNx

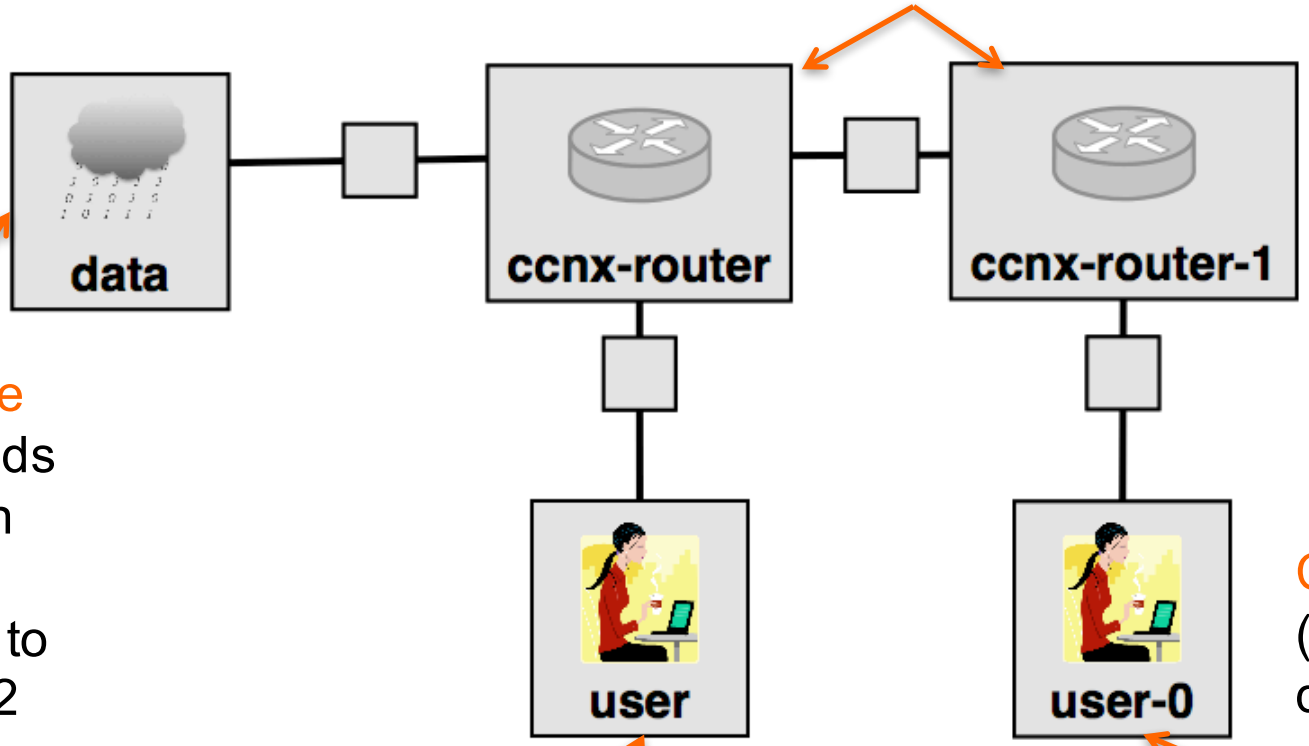
- An implementation of NDN by Xerox PARC

- Our exercise uses the CCNx software
  - Software runs on all nodes in our experiment
  - All nodes cache information that passes through them
  - When a node gets a data request it:
    - Returns data from local cache, if available
    - Passes the request to neighbor if data is not in cache
    - Caches data returned by neighbor

http://www.ccnx.org

Experiment Setup

Intermediate nodes (`ccnx-router & ccnx-router-1`). Requests not in local cache forwarded to data source



Data Source (`data`): Holds precipitation data from 1 Jan 1901 to 31 Jan 1902 (data from NOAA)

Researcher (`rsrchr`) fetches data by name (e.g. precip data from 1901/01/01 to 1901/01/02); requests not in cache forwarded to router

Collaborator (`collab`) fetches data by name; requests not in cache forwarded to intermediate nodes

Experiment Execution

- Log into the researcher node (`rsrchr`) and fetch data
  - Use a client program already installed on the node
    - Installed using an install script in the RSpec
- Note how long it takes to get data
- Fetch same data again and note time
- If time permits
  - Repeat the above at the collaborator node (`collab`)
    - Data is not in local cache but in `ccnx-router` cache
  - Fetch new data at the collaborator node (`collab`)
    - Data is not in local cache or in `ccnx-router` node cache
- Later: Use GENI Desktop/GEMINI to view graphs of traffic on links
  - Helps visualize when data comes from a local cache and when it comes from a neighbor

The Exercise

- Load an RSpec into Jacks
  - Instead of drawing the topology ourselves (saves time)
- Edit the RSpec using Flack but don't "submit"
- Save the request RSpec generated by Flack into a file
- Make GENI AM API calls to send the request RSpec, check status of resources, etc.
  - Use the Omni experimenter tool
- Run a CCN application
- (Optional) Visualize the experiment using the GENI Desktop and GEMINI instrumentation tool

Tutorial Structure

- Configure Omni (Step 2.2 of instructions)
- View and edit an RSpec using Jacks (Steps 3.2 – 3.5)
- Request resources specified in RSpec using Omni (Step 3.6)
- When resources are ready, log into a node to run the CCN application (Step 5)
- (Later) Visualize the experiment using the GENI Desktop and GEMINI
  - GENI Instrumentation and Measurement system

Tutorial Tips

- Cut-and-paste is your friend!
  - Cut-and-paste URLs, commands, etc., from instructions into text boxes, terminal windows
- If at any step you don't understand why you are doing something, ask!
- If you fall behind, let us know!
  - We will help you catch up

If you want to do the GENI Desktop exercise later

DO NOT DELETE

Tips

- Successful return from Omni `createsliver` means your RSpec was submitted to the AM
- It does not mean:
  - The RSpec was correct
  - The resources are available
- Use `readyToLogin` to monitor your resources
  - Wait until the status turns to “ready” before using

Tip

Cut-and-paste `ssh` command from `readyToLogin` into a terminal to log into the `rsrchr` node.

Example:

```
$ ssh -p 32315 -i /Users/vthomas/.ssh/geni_key_portal
vthomas@pc1.instageni.nysernet.org
```