Georgia Institute of Technology

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Software Defined Networking

In this course, you will learn about software defined networking and how it is changing the way communications networks are managed, maintained, and secured.

School of Computer Science

This Module: Control and Data Separation

- Opportunities from control and data separation
  - New routing services in the wide area
    - Maintenance
    - Egress selection
    - Security
  - Data centers
    - Cost
    - Management

Three Lessons

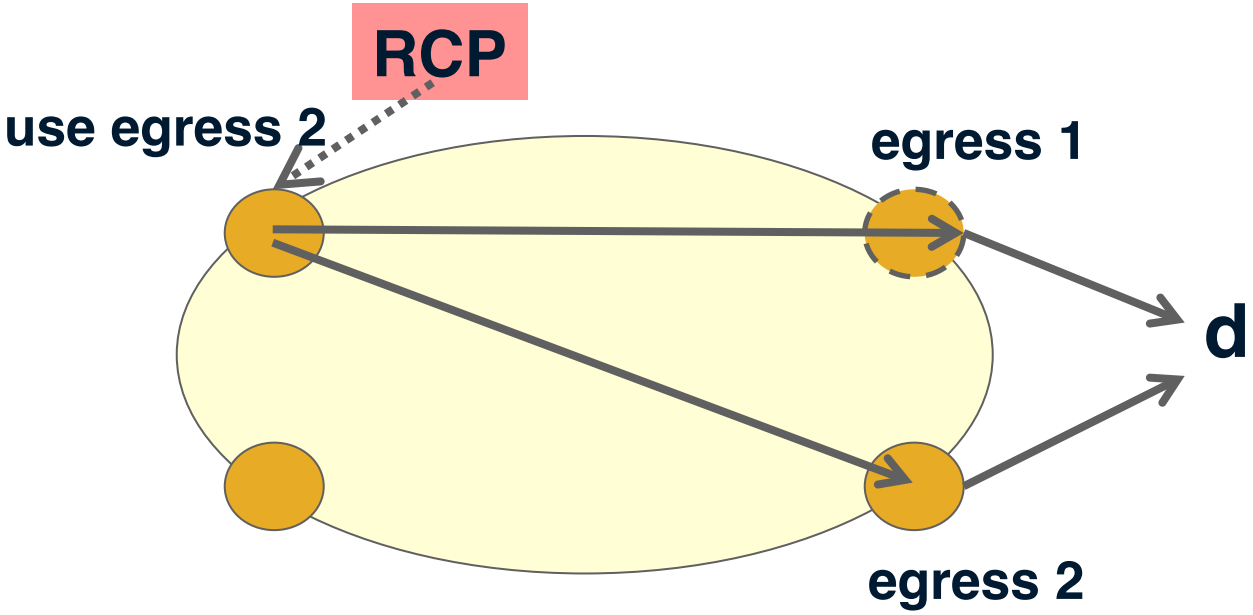
- Overview
  - What is control/data separation?
  - Why is it a good idea?
  - What are the opportunities and challenges?
- Opportunities in various domains
  - Routing, data centers, etc.
- Challenges and approaches
  - Scaling, reliability

Interdomain Routing: Constrained Policies

- Today's interdomain routing protocol, BGP, artificially constrains routes
  - Route selection is based on a fixed set of steps
  - There are limited knobs to control inbound/ outbound traffic
  - Very difficult to incorporate other information (e.g., auxiliary information, time of day)
- **Instead:** Route controller can directly update state

Example: Maintenance Dry-out

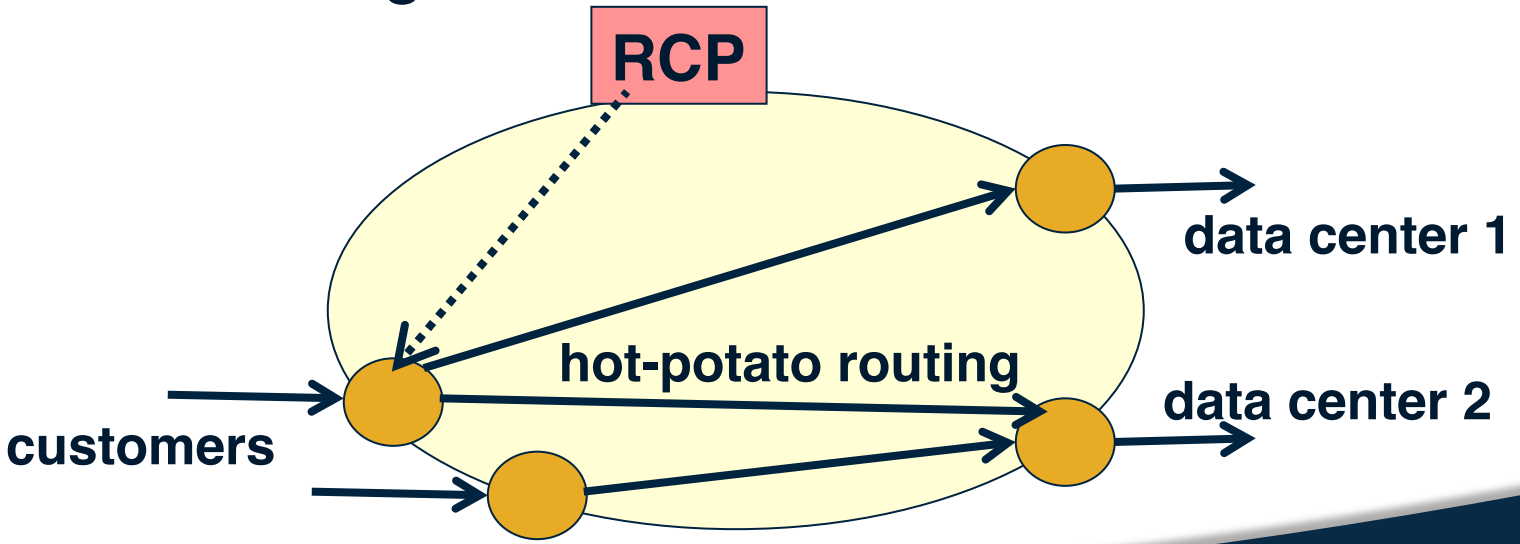
- Planned maintenance on an edge router



Source: Jennifer Rexford

Example: Egress Selection

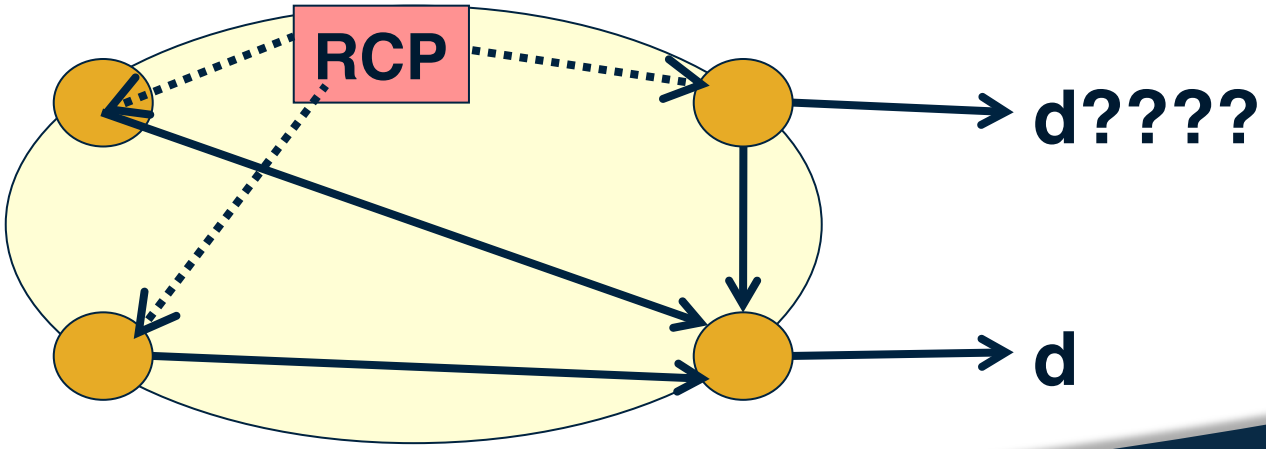
- Customer-controlled egress selection
  - Multiple ways to reach the same destination
  - Giving customers control over the decision



Source: Jennifer Rexford

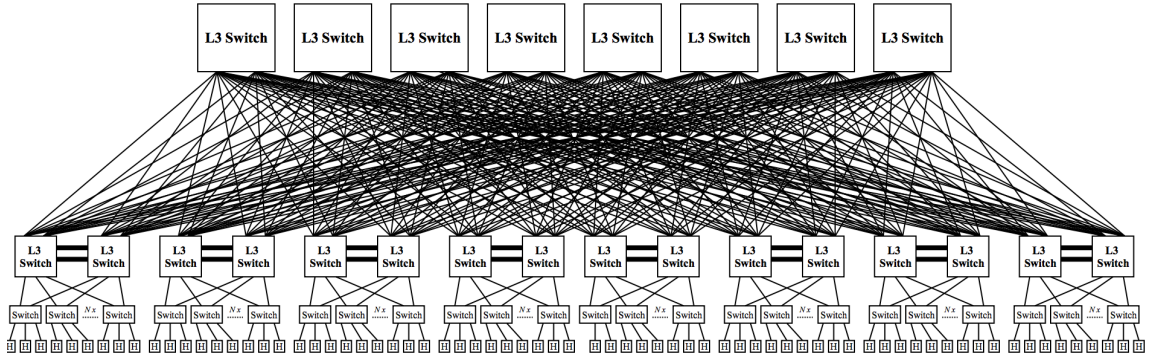
Example: Better BGP Security

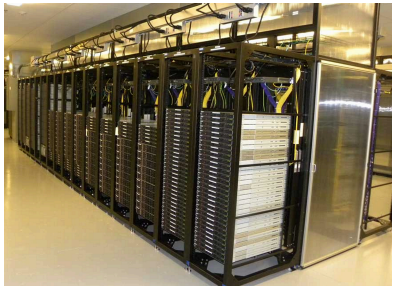
- Better interdomain routing security
  - Anomaly detection to detect bogus routes
  - Prefer "familiar" routes over unfamiliar



Source: Jennifer Rexford

Example: Data Centers (Cost)





Cost

200,000 servers

Fanout of 20 ➔ 10,000 switches

$5k vendor switch = $50M

$1k commodity switch = $10M

Savings in 10 data centers = $400M

Control

More flexible control

Tailor network for services

Quickly improve and innovate

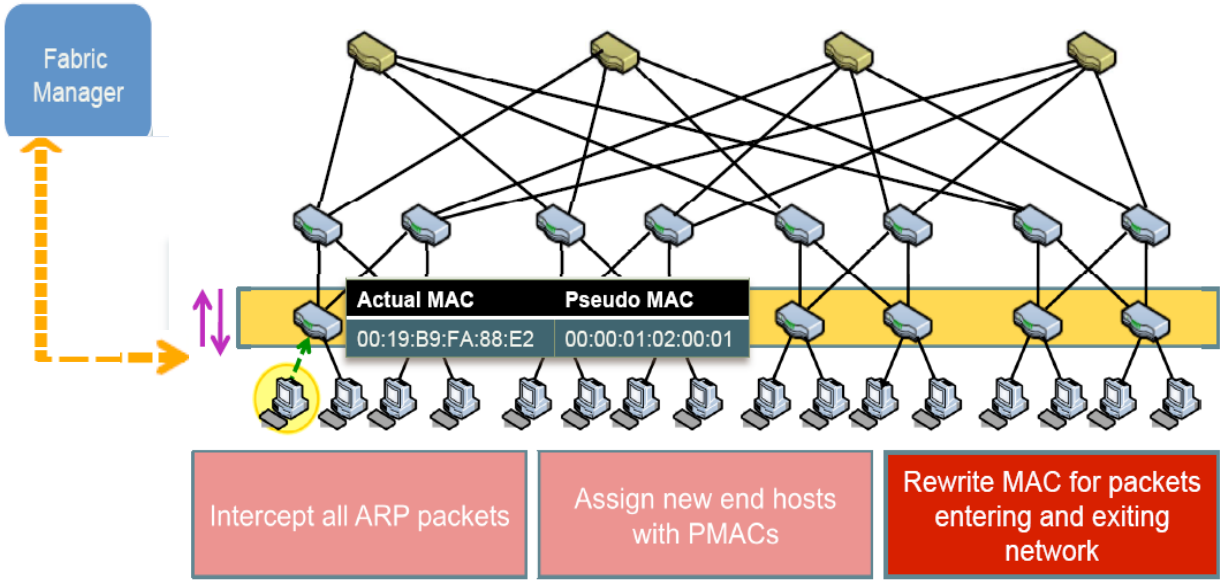
Source: Nick McKeown et al.

Example: Data Center Addressing

- How to address hosts in a data center?
  - **Layer 2:** Less configuration/administration, but bad scaling properties
  - **Layer 3:** Can use existing routing protocols, but high administration overhead
- How to get the best of both worlds?

Solution: Separate Controller

- Topology-dependent MAC addressing
- IP addressing for application compatibility



Other Opportunities

- Dynamic access control
- Seamless mobility/migration
- Server load balancing
- Network virtualization
- Using multiple wireless access points
- Energy-efficient networking
- Adaptive traffic monitoring
- Denial-of-Service attack detection

See http://www.openflow.org/videos/