

# Software Defined Networking



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



# 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

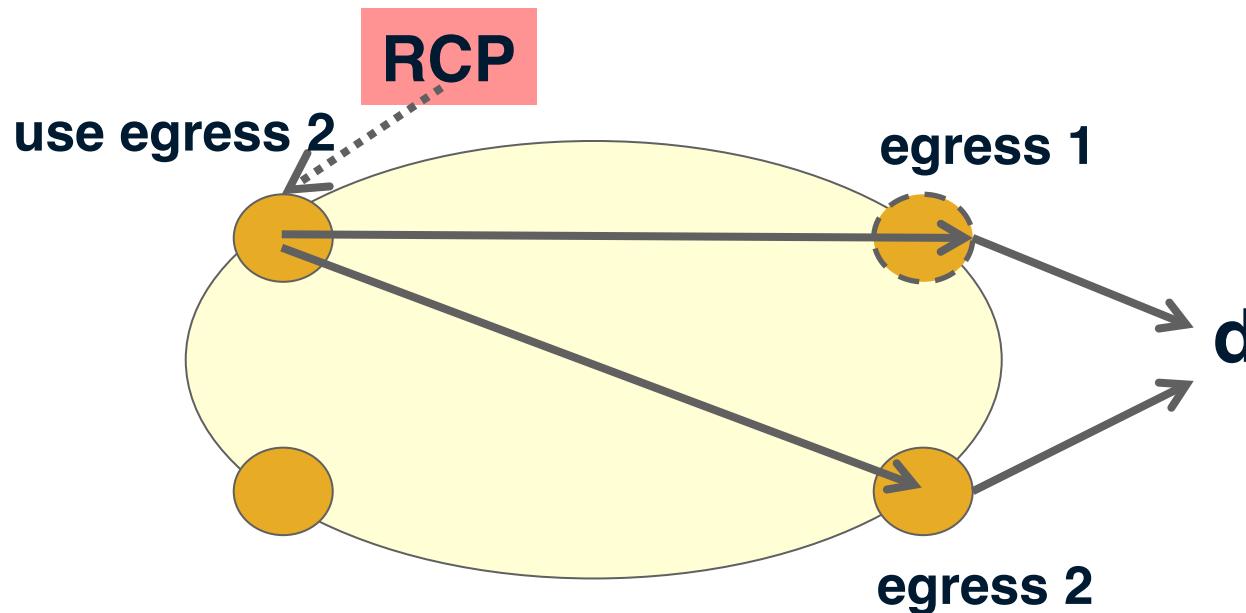
- Scaling, reliability

# 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

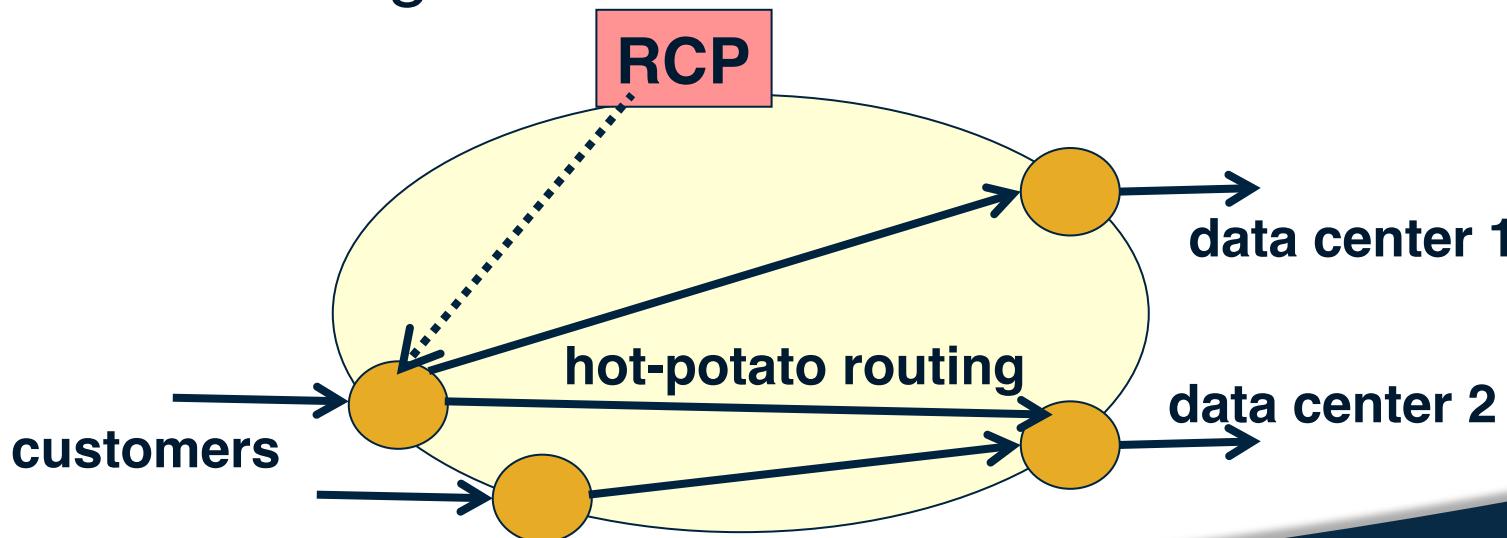
# Example: Maintenance Dry-out

- Planned maintenance on an edge router



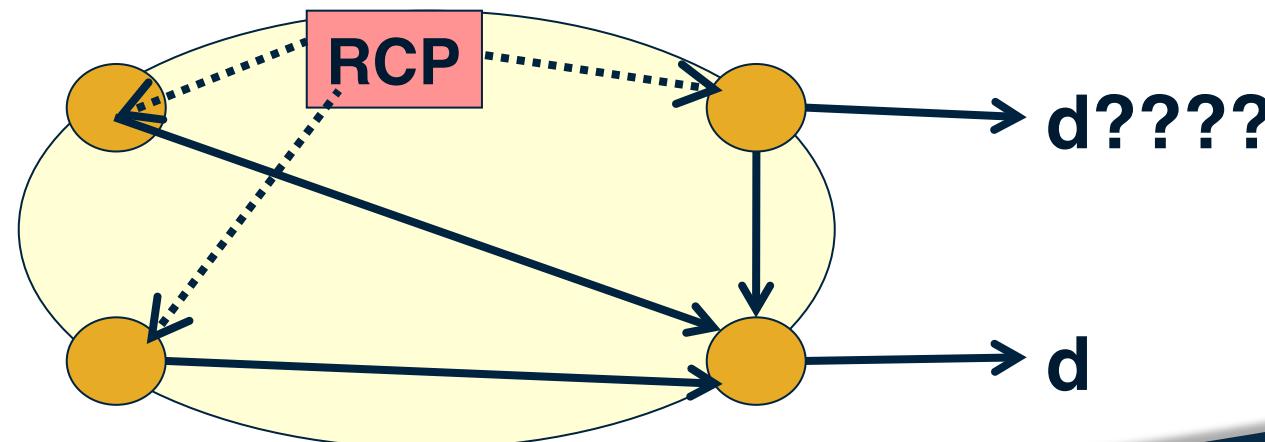
# Example: Egress Selection

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

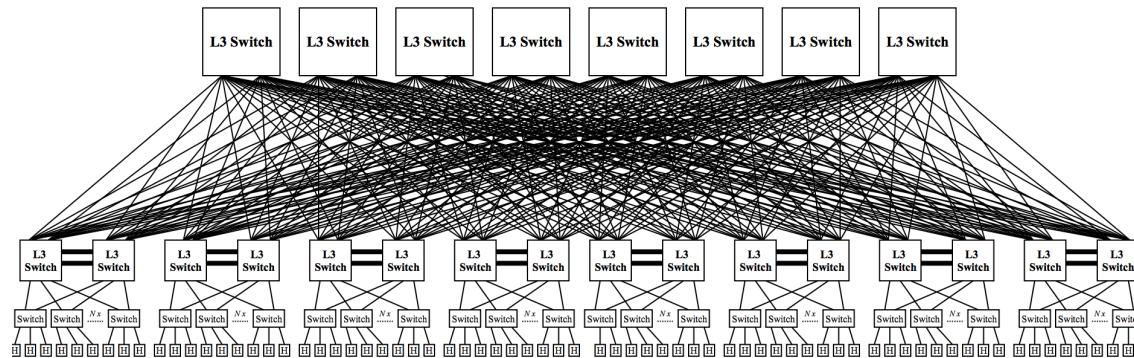


# Example: Better BGP Security

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



# 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

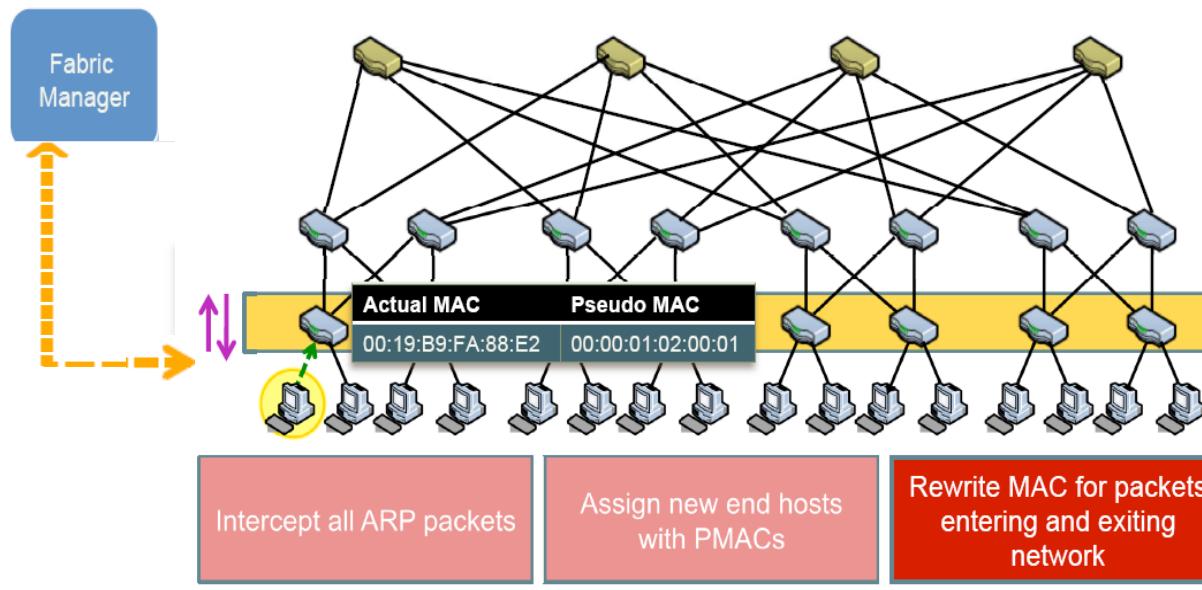
Quickly improve and innovate

# 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/>