Georgia Institute of Technology

Software Defined Networking

Dr. Nick Feamster
Associate Professor

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

Module 2: Control and Data Separation

- Learning Objectives
  - Be able to explain the difference between control and data plane.
  - What is the function of each?
    - Provide examples of functions performed by each.
    - Describe the infrastructure that supports the control plane and the data plane.
  - What are the challenges of separation?

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

What are the control and data planes?

- **Control Plane:** Logic for controlling forwarding behavior.
  - **Examples:** routing protocols, network middlebox configuration.

- **Data Plane:** Forward traffic according to control plane logic
  - **Examples:** IP forwarding, Layer 2 switching

Why Separate the Control and Data Planes?

Independent evolution and development

- The software control of the network can evolve independently of the hardware.

Control from high-level software program

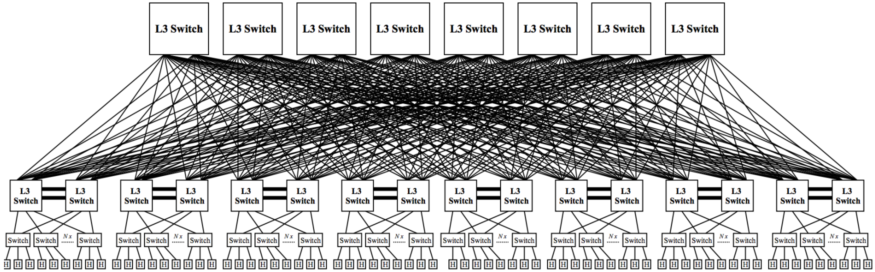
- Control behavior using higher-order programs
- Debug/check behavior more easily

Opportunities: Where Separation Helps

- **Data centers:** VM migration, Layer 2 routing
- **Routing:** More control over decision logic
- **Enterprise networks:** Security applications
- **Research networks:** Coexistence with production

Example: Data Centers (Yahoo!)

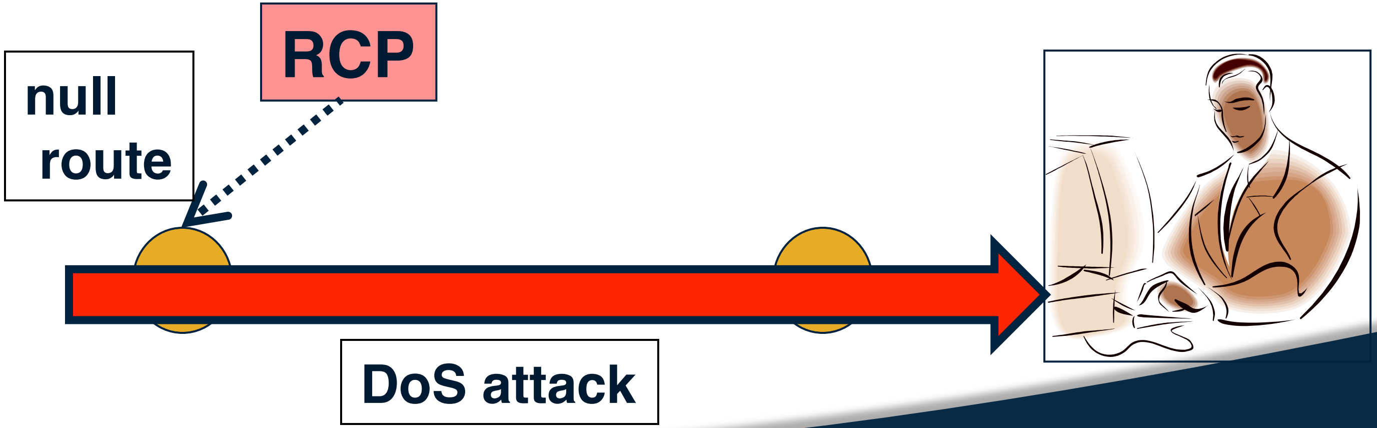
- 20,000 servers/cluster = 400,000 VMs
  - Any-to-any, 1024 distinct inter-host links
  - Sub-second migration, guaranteed consistency
- **Problem:** Keeping 20k devices in sync with 400k+ entities?
- **Solution:** Program switch from a central database.



Source: SDN in Warehouse-Scale Data Centers, Igor Gashinsky (http://goo.gl/u9bWq)

Example: AT&T IRSCP (Commercial RCP)

- Filtering attack traffic
  - Measurement system detects an attack
  - Identify entry point and victim of attack
  - Drop offending traffic at the entry point



Source: Jennifer Rexford

Two Continual Challenges

- **Scalability:** Control elements responsible for many forwarding elements (often, thousands)

- **Reliability/Security:** What happens when a controller fails or is compromised?