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.

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.

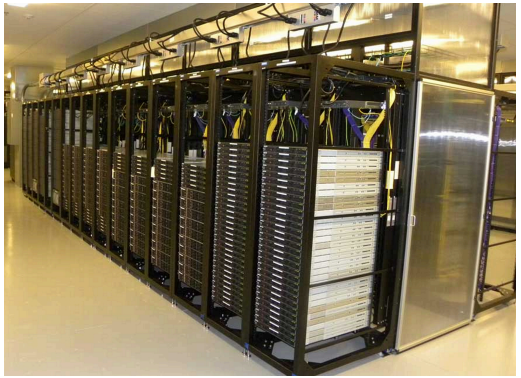
- **Control from high-level software program**
  - Control behavior using higher-order programs
  - Debug/check behavior more easily

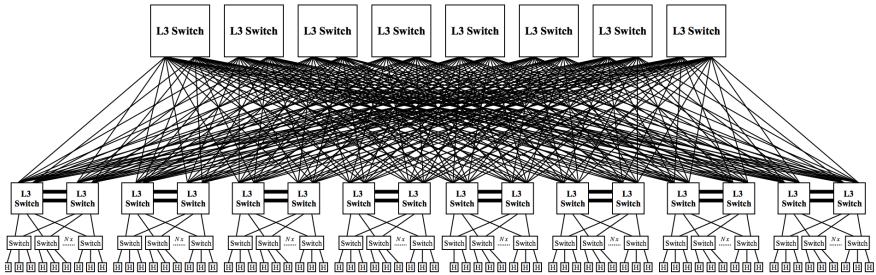
Opportunities: Where Separation Helps

- **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!)

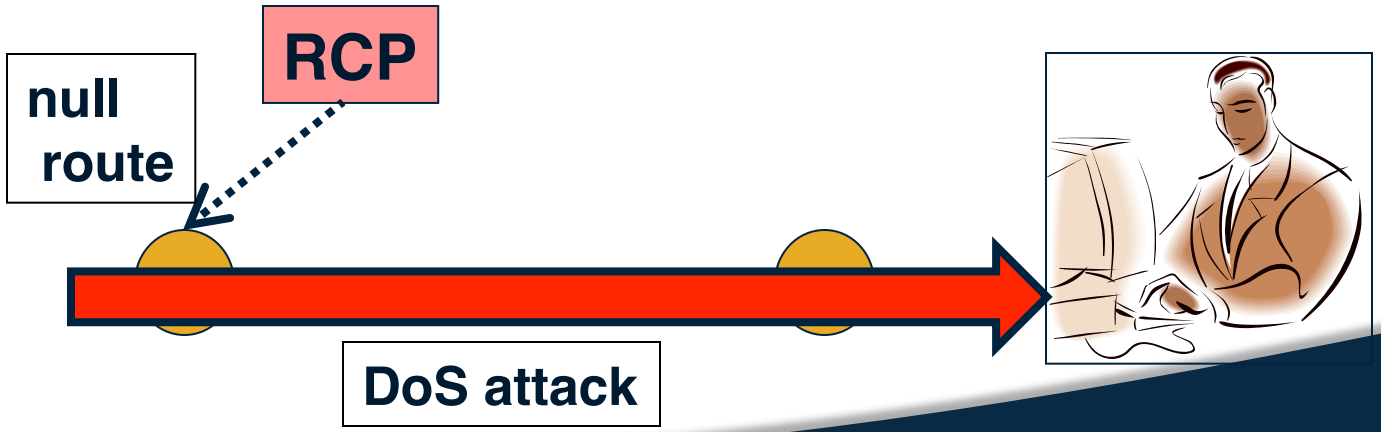
- 20,000 servers/cluster = 400,000 VMs
  - Any-to-any, 1024 distinct inter-host links
  - Sub-second migration, guaranteed consistency
- **Problem:** Keeping 20k devices in sync with 400k+ entities?
- **Solution:** Program switch from a central database.





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?