The Road to Software Defined Networking

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2013

Papers We Love, Hyderabad - 12 July 2015

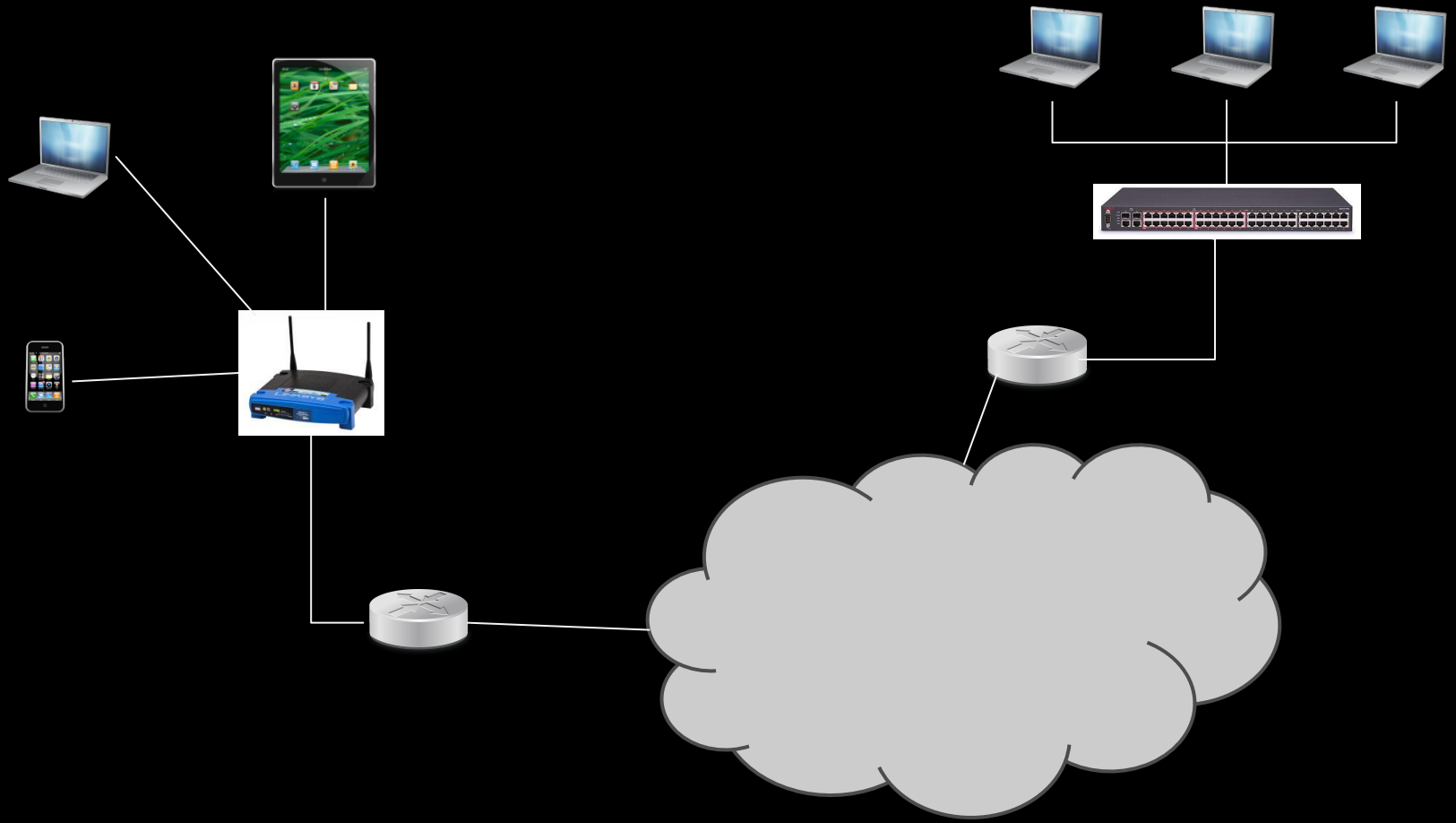
Agenda

Some Networking Basics

The Paper

Demo

Some networking basics



and a few definitions

Control Plane

Decides how to forward packets (Routing, Dropping, Firewall Rules)

Data Plane

Does the actual forwarding (or dropping, or filtering) of the data packets

The Road to SDN

Defining Characteristics

- Separation of the control and the data planes
- Control Plan Consolidation - single CP controls multiple DPs

The Roots of SDN

- Ideas in early telephone networks
- Initially used to describe Stanford’s OpenFlow project

Timeline

1995

Active Networking

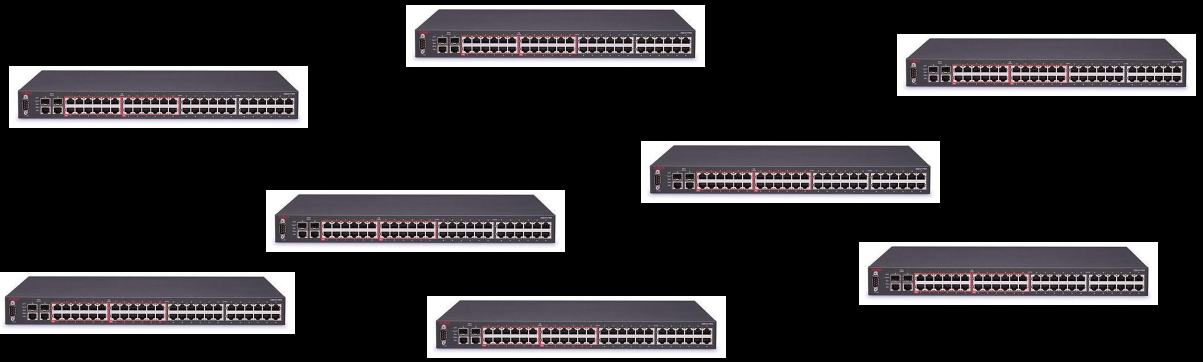
2001

Data and Control Plane Separation

2007

OpenFlow and Networking Operating System

Vision



Active Networking

Models

In-band code

Out-of-band code

Active Networking

Driving Factors

Technology - Cheaper computing, Virtual machines (sandboxes), WORA, security, a la Java

Users - Faster new service deployment, Finer control to dynamically meet app/network needs, platforms for scalable research

Legacy

Programmable functions in the network

Network virtualization

Unified architecture for "middlebox" orchestration

Active Networking

Vision

- Conventional routing protocols were primitive for traffic engineering
- Data and control planes are tightly coupled in conventional routers

Control & Data Plane Separation

Driving Factors

Technology - Vendors built packet forwarding logic in data plane hardware

Users - Increased size and complexity of service providers

Control & Data Plane Separation

Legacy

- Open interface between control and data planes (ForCES, Netlink)
- Logically centralized control of the network (RCP, SoftRouter)
- Further clean-slate architectures - 4D, Ethane (set the stage for OpenFlow)

Control & Data Plane Separation

Vision (and Reality)

- Campus networks @Stanford
- Right balance between full programmability & real world deployment
- Followed by controllers like NOX

Driving Factors

Technology - Gradual opening up of switch chipset vendor APIs, Industry demand for more network device control

Users - People getting together - Equipment vendors, chipset designers, network operators, networking researchers

OpenFlow & the NOS

And after OpenFlow

- Conceptual unification of network devices/functions
- Rise of network operating systems
- Distributed state management techniques (e.g. the Onix controller)

Myths about SDN

First packet of every traffic should go to the controller

Controller must be physically centralized (e.g. Google's WAN)

OpenFlow == SDN

Network Virtualization

Pre SDN

Packet encapsulation with custom protocols (overlay networks)

Network Virtualization

SDN Enables Network Virtualization

Network Virtualization can be used to test and evaluate SDNs

Pox SDN Controller Demo

References

The paper itself - http://queue.acm.org/detail.cfm?id=2560327

Enabling Innovation in Campus Networks - http://archive.openflow.org/documents/openflow-wp-latest.pdf

POX Controller - http://www.noxrepo.org/pox/about-pox/

OpenFlow - https://www.opennetworking.org/sdn-resources/openflow

Coursera SDN course - https://class.coursera.org/sdn1-001

An attempt to motivate and clarify Software-Defined Networking - https://www.youtube.com/watch?v=WVs7Pc99S7w

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