

Software Defined Networks (SDN)

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Cybersecurity Opportunities

- ▶ CyberPatriot
 - ▶ Cyberfed show
 - ▶ Troy High School
 - ▶ Always looking for mentors and sponsors
- ▶ Cal Cup
 - ▶ Exhibition match this coming June in Sacramento
 - ▶ Full round of competition in 2017
- ▶ Cal Poly Pomona
 - ▶ Tech Symposium
 - ▶ SWIFT, CCDC, FAST
 - ▶ Student-run Data Center
 - ▶ 2017 Conference (WTS, Women in IT, Cybersecurity, Software Development)

What is SDN?

- ▶ No one knows for sure as the definition is currently being rewritten by different stakeholders to fit their interests.
- ▶ There is a general consensus that SDN refers to the use of software to control network devices and manage network traffic.
- ▶ A few competing ideas:
 1. Open SDN - Open Networking Foundation
 1. SDN = Separation of the control plane and data plane
 2. Network devices are updated and controlled via the OpenFlow protocol
 2. SDN via API's - Cisco and other established networking companies
 1. Functionality on networking devices is exposed using a rich API
 3. SDN via Overlays - VMWare and other using SDN via overlays

Current Challenges in Network Operations

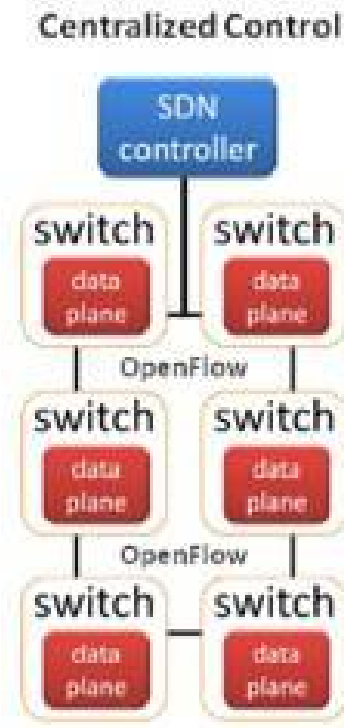
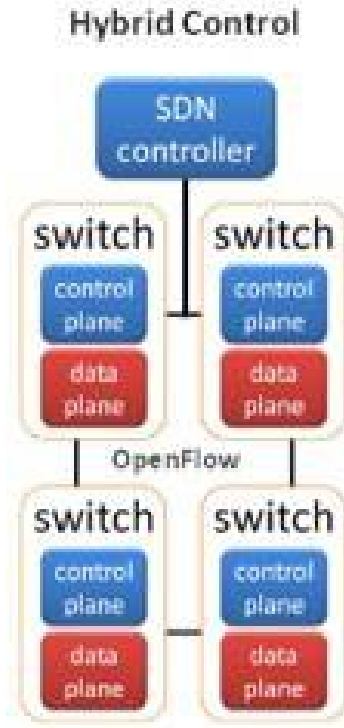
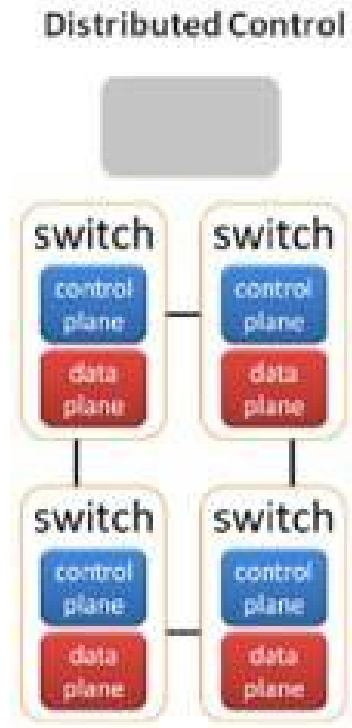
- ▶ Networks are brittle and inflexible
 - ▶ Complex interactions between devices (elections), each device keeps its own state
 - ▶ Networks are non-deterministic
- ▶ Inflexibility has led to stasis
- ▶ IPv4 addressing schemes are complex and require human intervention for both design and maintenance

Network Flexibility

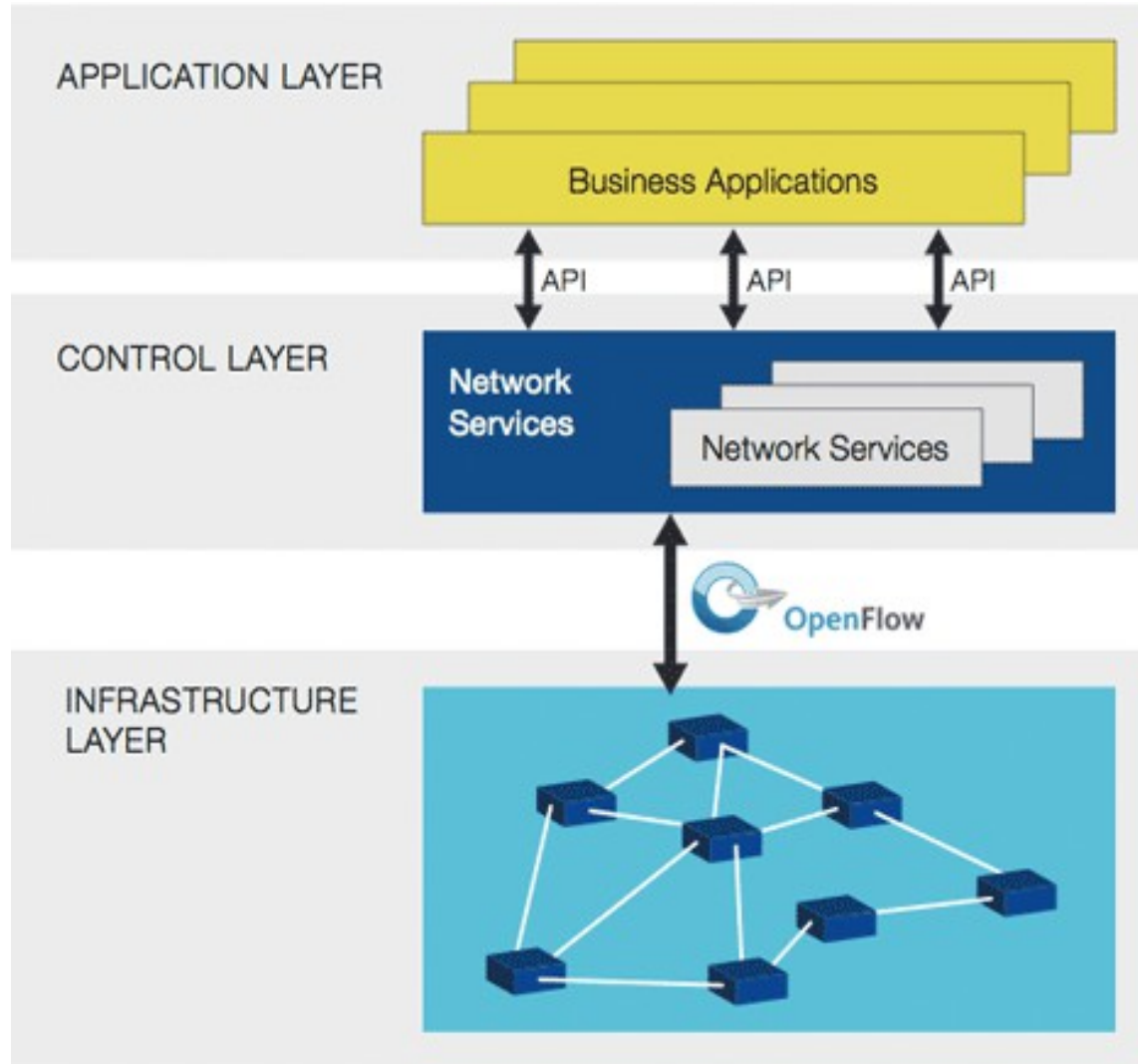
- ▶ Software Defined Networks (SDN) simplify and empower network functionality
 - ▶ No more elections and complex device interactions
 - ▶ One or more controllers provide forwarding information to network devices
 - ▶ Packets are identified and traced all the way through the network
 - ▶ Packets can be treated differently based on any number of factors
- ▶ IPv6 has adequate address space allowing network addresses to be simplified

Traditional, API and Open Networks

Software Defined Networking

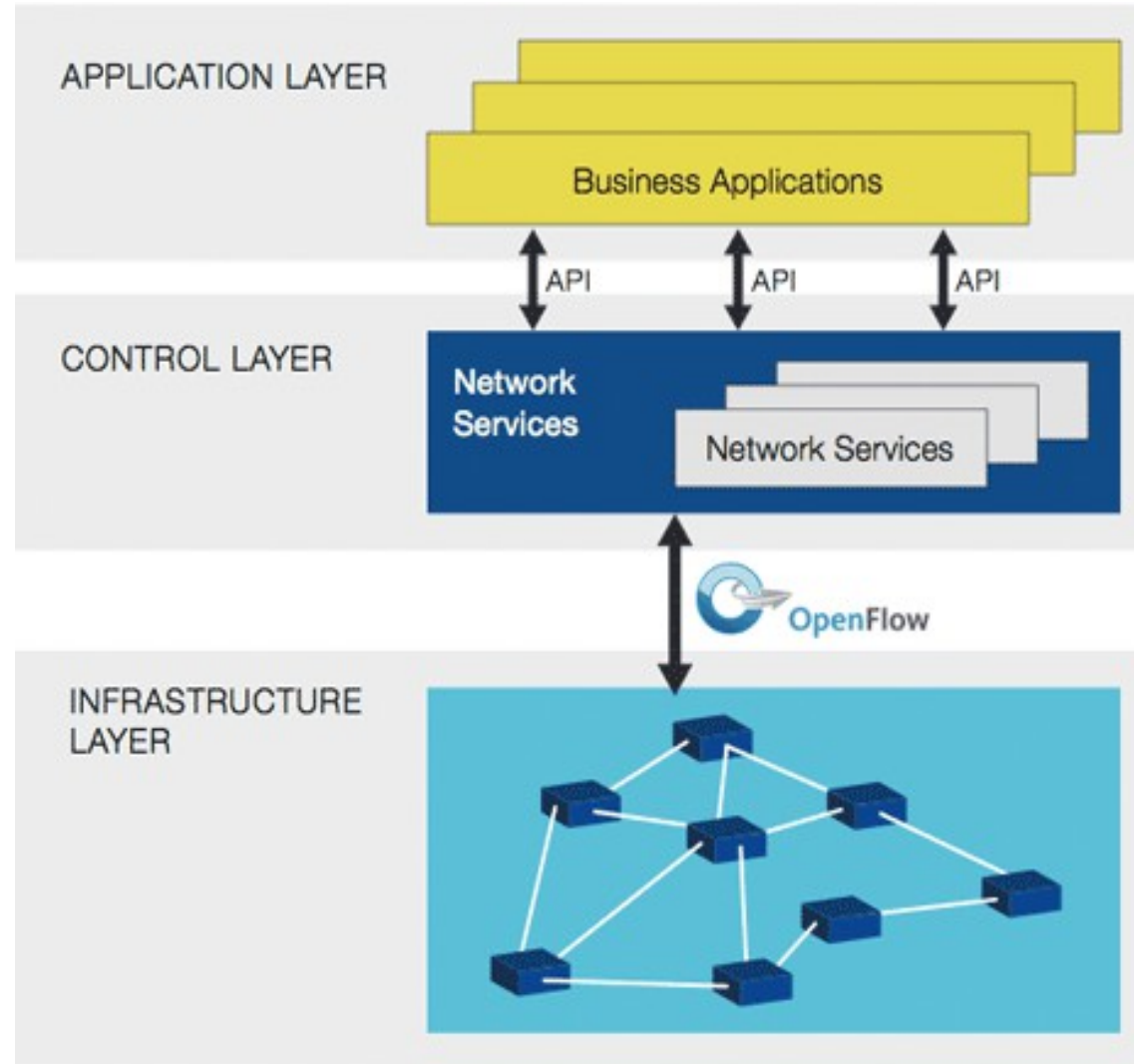


Open SDN Model



North and South Bound Interfaces

- ▶ Northbound interface has no broadly accepted protocol but relatively strong support for the use of REST or Java APIs.
- ▶ Southbound interface has a broadly accepted protocol called OpenFlow
- ▶ Anyone can now write applications to control the paths network traffic will follow.



Implications

- ▶ The Internet of Things (IoT) will cause internet connectivity to grow by an estimated 20 billion devices in the next five years.
- ▶ SDN offers new approaches and solutions to cybersecurity
- ▶ Automation of network administration - building and tearing down network in realtime on demand

IoT

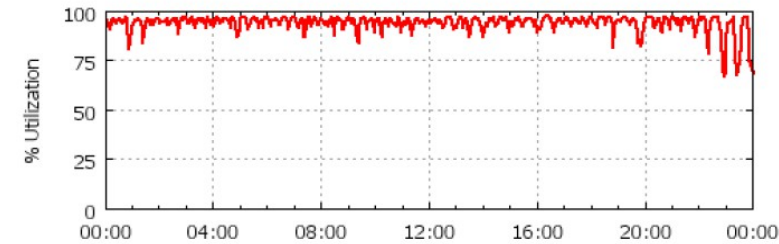
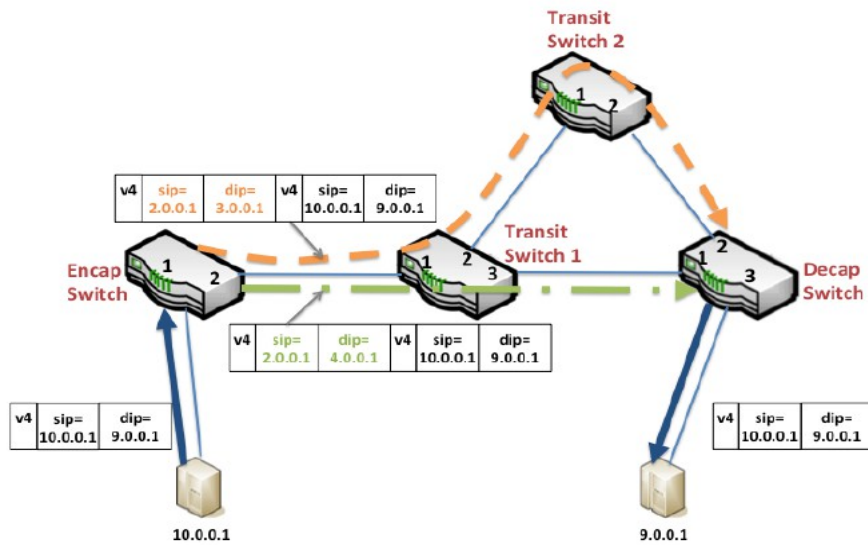
- ▶ There are more than 1 billion IoT devices already connected to the Internet including
 - ▶ Coffee pots
 - ▶ Sprinkler systems
 - ▶ Refrigerators
 - ▶ Sports and medical wearables
- ▶ An estimated 20 billion IoT devices will be added to the Internet in the next five years
- ▶ Managing the influx of devices to the Internet is a key motivation for SDN

Cybersecurity

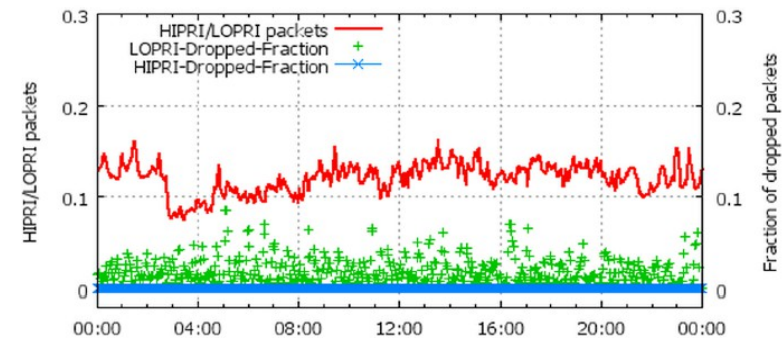
- ▶ SDN offers the ability for networks to be deterministic
 - ▶ A packet can be tracked and state can be maintained
- ▶ Virtualization may be the key to APTs (Advanced Persistent Threats)
 - ▶ Ticketmaster example
- ▶ SDN offers the ability to redirect network traffic in real time to adjust for threats

Automation of Network Administration

- ▶ Virtualization may well be the “killer app” of SDN
- ▶ Software control of networks
- ▶ IPv6 removes address scarcity impediments that required human intervention
- ▶ Network bandwidth automation



(a)



(b)

Tell Me MORE!

- ▶ Openstack - compilation of resources used by organizations to build open cloud architectures.
- ▶ Open Network Foundation - organization dedicated to the promotion and adoption of SDN.

Why is Cloudstack and SDN so Exciting!!

- ▶ CPP students are well positioned for success in this market space.
- ▶ There is a huge demand for talent which is expected to persist for more than a decade.
- ▶ These technologies are at the forefront of technology development and represent excellent opportunities for employment and entrepreneurship.