Cisco Networking Academy

What is Network Programming?

Software Defined Networking Webinar Series

Speakers: Serges Nanfack
Hostess: Kara Sullivan

19 October 2016

Welcome to the 1st session of the ***Software Defined Networking*** webinar series!

- Use the Q and A panel to ask questions.
- Use the Chat panel to communicate with attendees and panelists.
- A link to a recording of the session will be sent to all registered attendees.
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Career Advantage **Webinars**

Software Defined Networking Series

NEXT SESSION:

Intro to SDN

29 November, 2016 – 7:00 A.M. PST

Register at: bit.ly/SDNSeries

Network Programming

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What We are Going to Cover

1. Today's network
2. What is network programming?
3. Why do we need Programmable networks?
4. Technologies that enable programmable networks

Today's Network

Point-of-Sale

Taxi

Hotel

Bookstore

Print Advertising

Car

Music

Digitization Is Changing The World

Bookstore

Taxi

Music

Hotel

Print Advertising

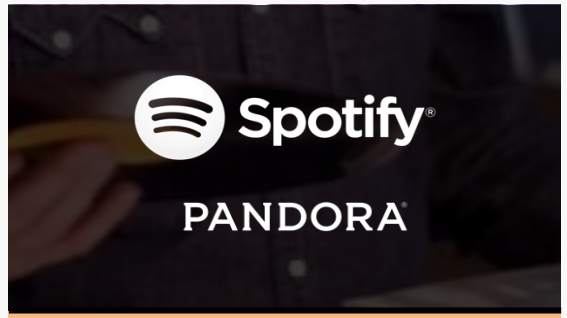
Car

Point-of-Sale

Digitization Is Changing The World

Bookstore

Taxi



Music

Hotel

Print Advertising

Car

Point-of-Sale

Digital Disruptors

Social

Mobile

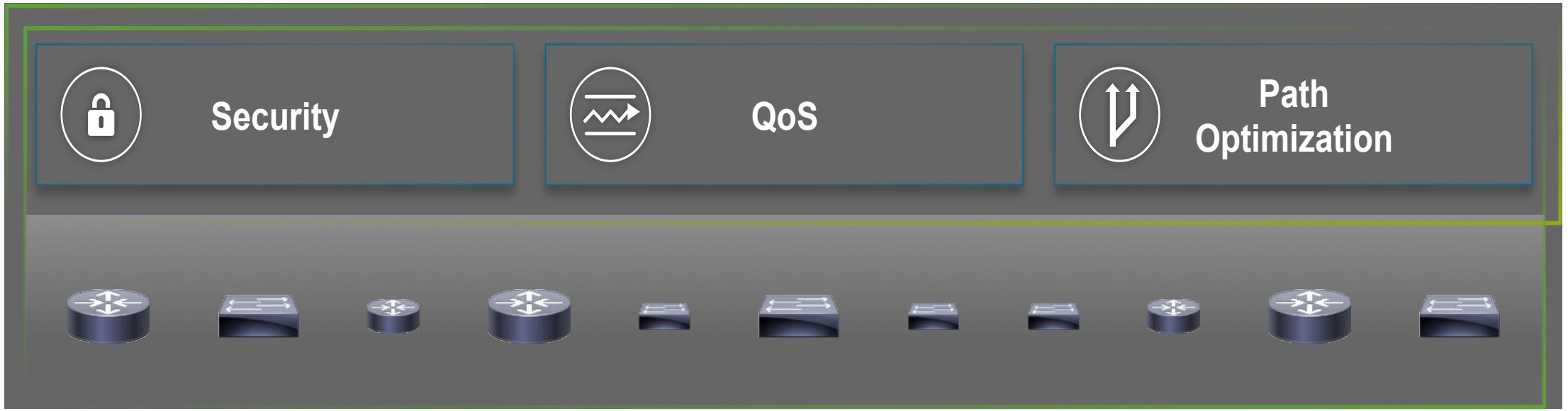
Data

Cloud

Today's IT Model – Complex, Not Fast Enough

Box by Box

Manual Configuration



Today's Passive Networks

- Dumb store-and-forward network
  - Smart end hosts implement key functions
  - Simple routers store and forward packets
  - Limited network processing (e.g., routing, forwarding, buffering, and packet scheduling)
- Packet header used in a simple way
  - Common, standardized format
  - Causes one of a small set of operations to occur
  - Packet forwarded or dropped based on those rules
  - Network (largely) ignores higher-layer headers

Enable experimentation and innovation *inside* the networks?

Evolution of the Server Configuration

1990's

+

+

or

Today

Chef

puppet labs

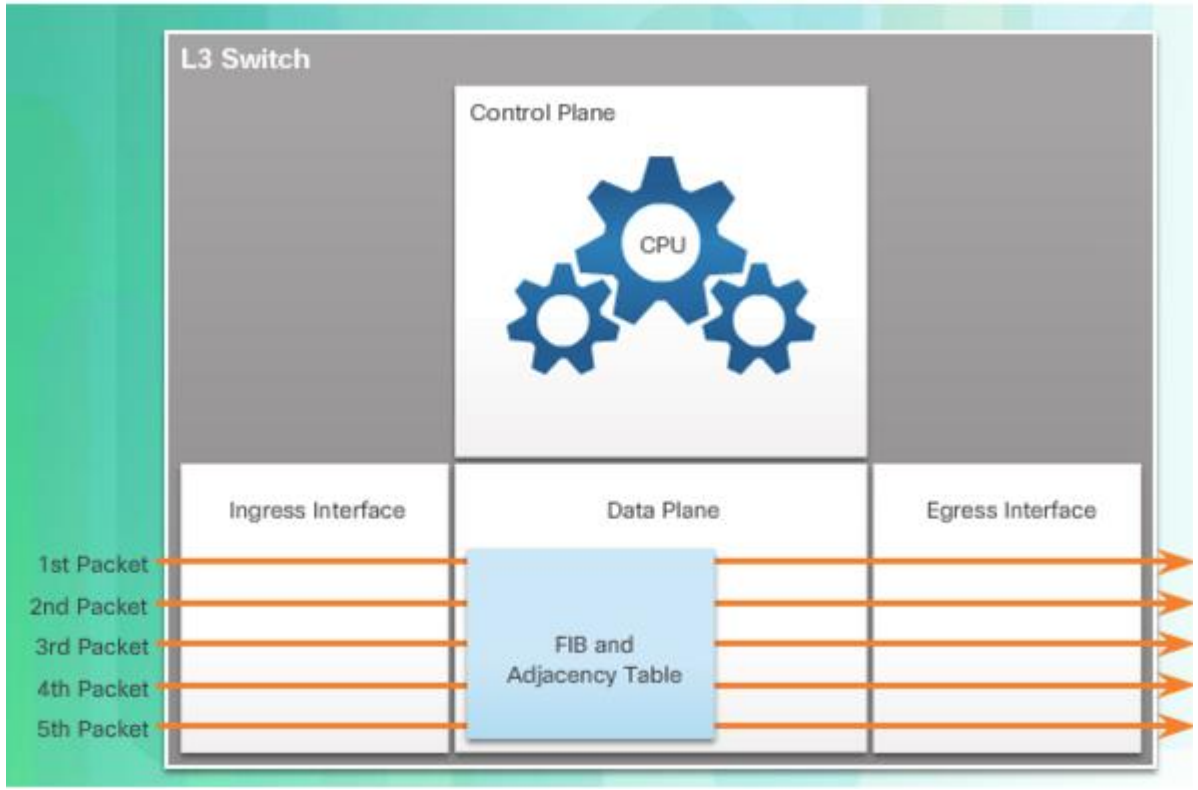
CISCO UCS Manager

openstack CLOUD SOFTWARE

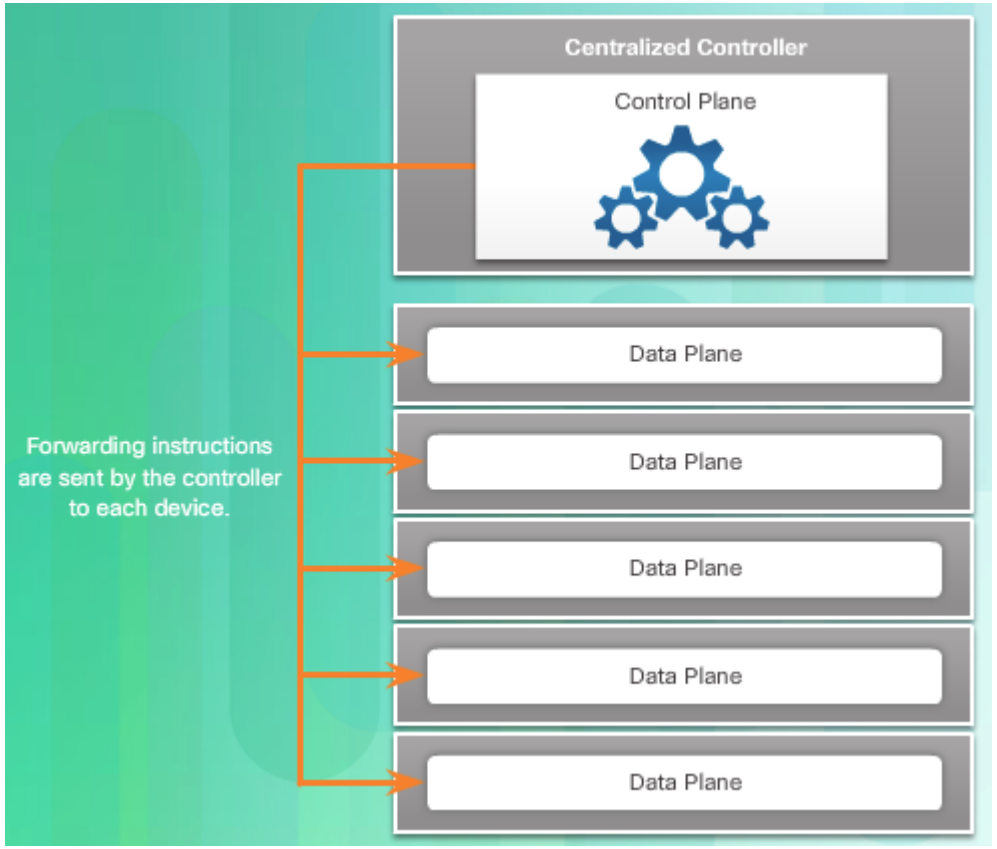
What is Network Programming?

Network Virtualization

Traditional

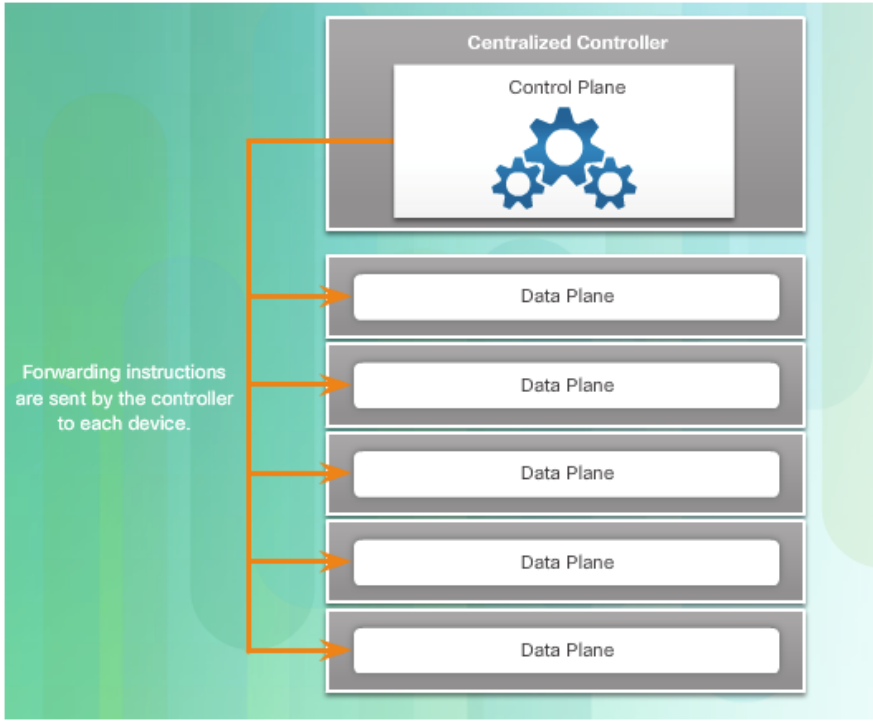


Virtualized



Control Plane and Data Plane

- A network device contains the following planes:
- **Control plane** – This is typically regarded as the brains of a device.
- Used to make forwarding decisions.
- Contains Layer 2 and Layer 3 route forwarding mechanisms, such as:
  - Routing protocol neighbor tables and topology tables
  - IPv4 and IPv6 routing tables
  - STP
  - ARP table
- **Data plane (forwarding plane)** – Typically the switch fabric connecting the various network ports on a device.
- The data plane of each device is used to forward traffic flows.



Cisco Express Forwarding (CEF) is an advanced, Layer 3 IP switching technology that enables forwarding of packets to occur at the data plane without consulting the control plane.

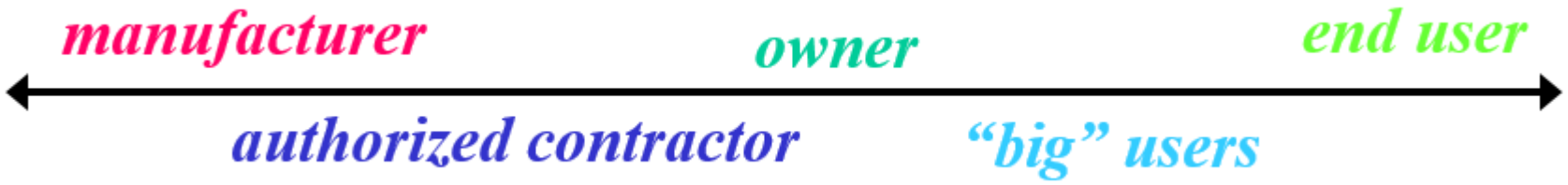
Programmable Networks

- Packet == data + code
  - Smart hosts, as before
  - Active nodes that can execute code on the data
  - Active packets that carry code to active nodes
- Postscript analogy
  - Contains both your data, and the program the printer runs to print your data
- Active networks
  - allow an individual user, or groups of users, to inject customized programs into the nodes of the network.

Programmable Routers

- What is programmable

- Who can program



Why Programmable Network?

Motivation for Programmable Networks

- High-level goal
  - Leverage computation in the network
- User pull
  - Automatically adaptive streaming
  - Data aggregation to reduce data volumes
  - Computation closer to users to reduce latency
- Industry push
  - Ad-hoc collection of middleboxes emerging
  - Replace with generic, multi-purpose active nodes
  - Otherwise, proliferation of active components will happen anyway, without any common framework

Motivation for Programmable Networks

- Big mismatch in rates of innovation
  - Applications change quickly (e.g., Web, P2P, IM)
  - The network changes slowly
- Deploying new network technology is hard
  - Delay for standardization (at the IETF)
  - Additional delays for vendors to implement and service providers to deploy the new technology
- Better to decouple services from hardware
  - Minimize the amount of global agreement
  - Load new services on demand

What Enables Network Programming?

Enabling Technologies for Programmable Networks

- Component-based software engineering
  - Building blocks for composing software
- Code mobility (e.g,. Java)
  - Previously between end hosts, not network nodes
  - Innovation in safe and efficient code mobility
- Field-programmable gate arrays (FPGAs)
  - Enabling higher speed of packet processing
- Research in programming languages
  - And PL folks' interest in networking

Two Models of Programmable Networks

- Active networks are active in two ways
  - Switches run code on data flowing through them
  - Individuals can inject programs into the network
- Programmable switches: **discrete** ANs
  - Separation of program loading and execution
  - E.g. program loading only by network operator
  - Packet is demultiplexed to the right program
- Capsules: **integrated** ANs
  - Every packet is a program, and carries its code
  - Perhaps in a restricted programming language

Three Parts to a Programmable Network

- Execution environment
  - Virtual machine with access to node resources
  - General, Turing-complete vs. restricted models
- Active applications
  - Provide an end-to-end, customized service
  - Load code on to the routers to program the VM
- Node operating system
  - Support multiple execution environments at once
  - Provide safety between execution environments

Join the Next Session : Software Defined Networking

Network Programmability concepts

SDN architecture

Type of SDNs

Open flow Protocol

Q&A

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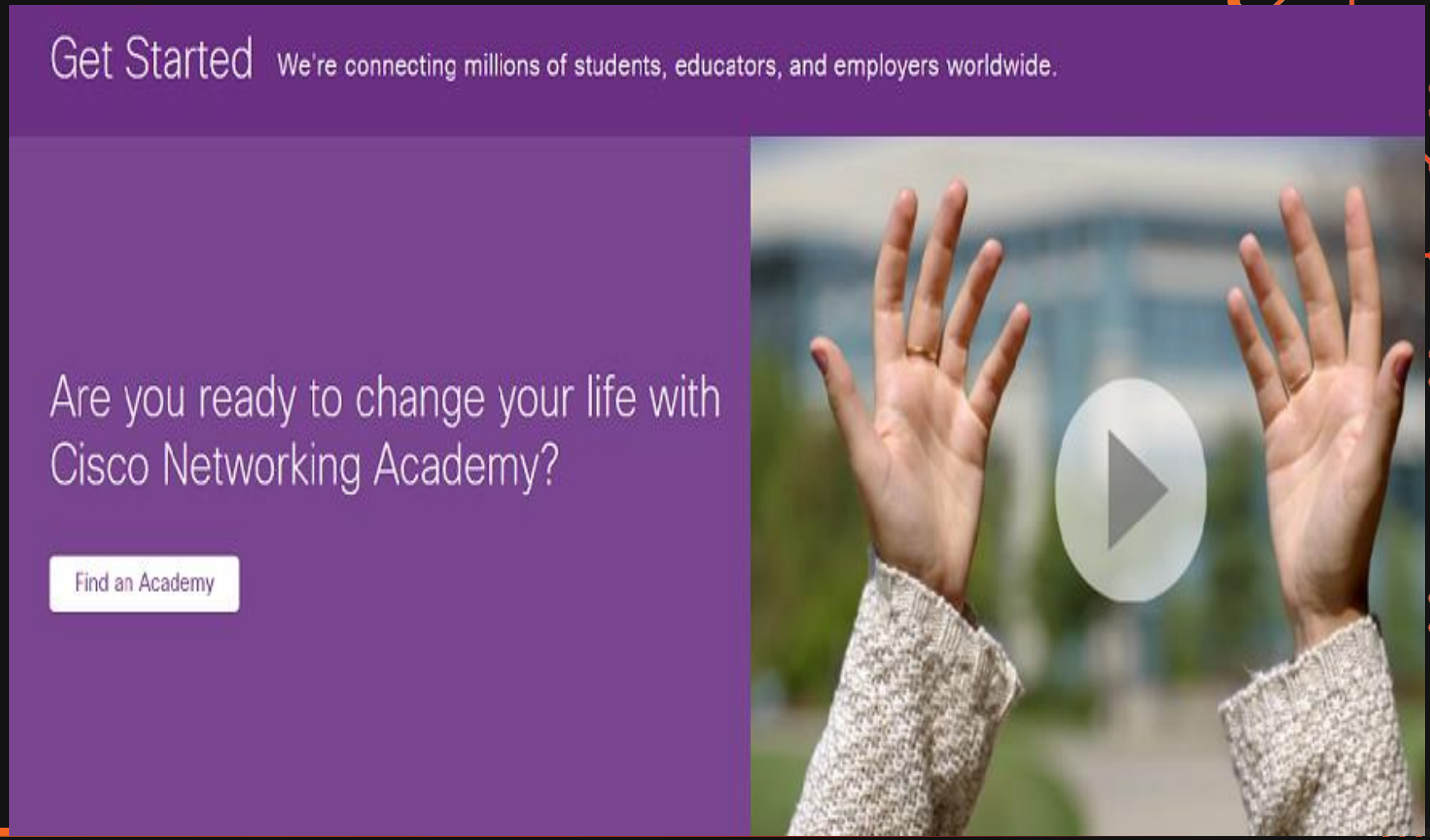

Thank you.

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Mind Wide Open