

How to be a Network Engineer in a Programmable Age

Go beyond Infrastructure as Code and Automation

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Topics to Cover

- The Network Engineer of Old
- The Four Ages of Networking
- Applying DevOps to Networking
- Today's Network Engineer
 - Certifications!

The Network Engineer Evolves



Ye ole Network Engineer



Meet Carl the Network Engineer

Programming Skills

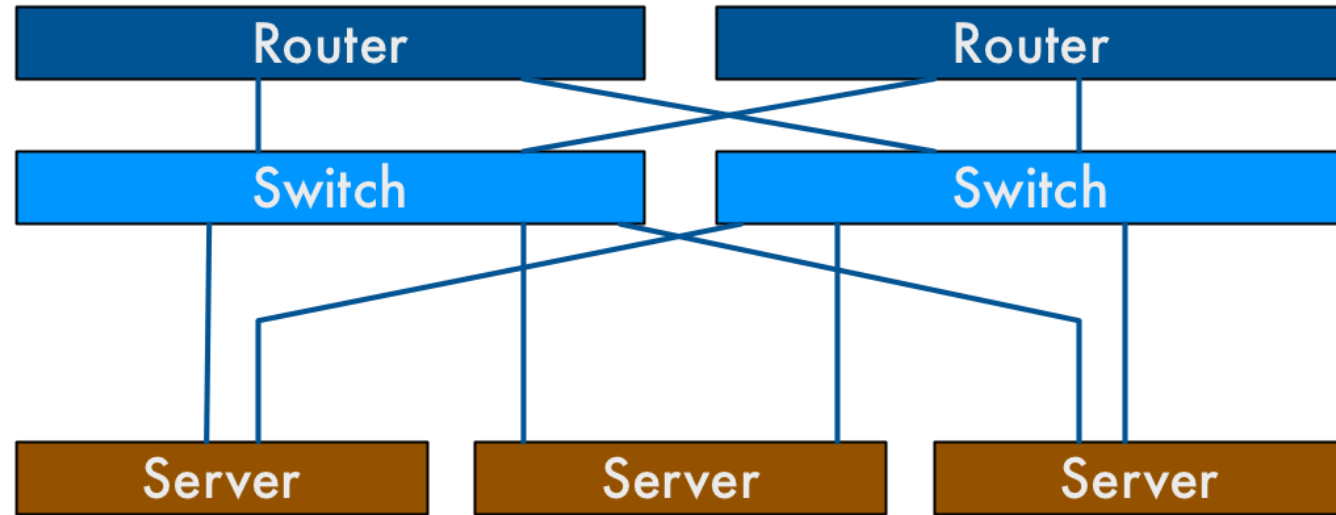
- TCL
- EEM
- Expect Scripts



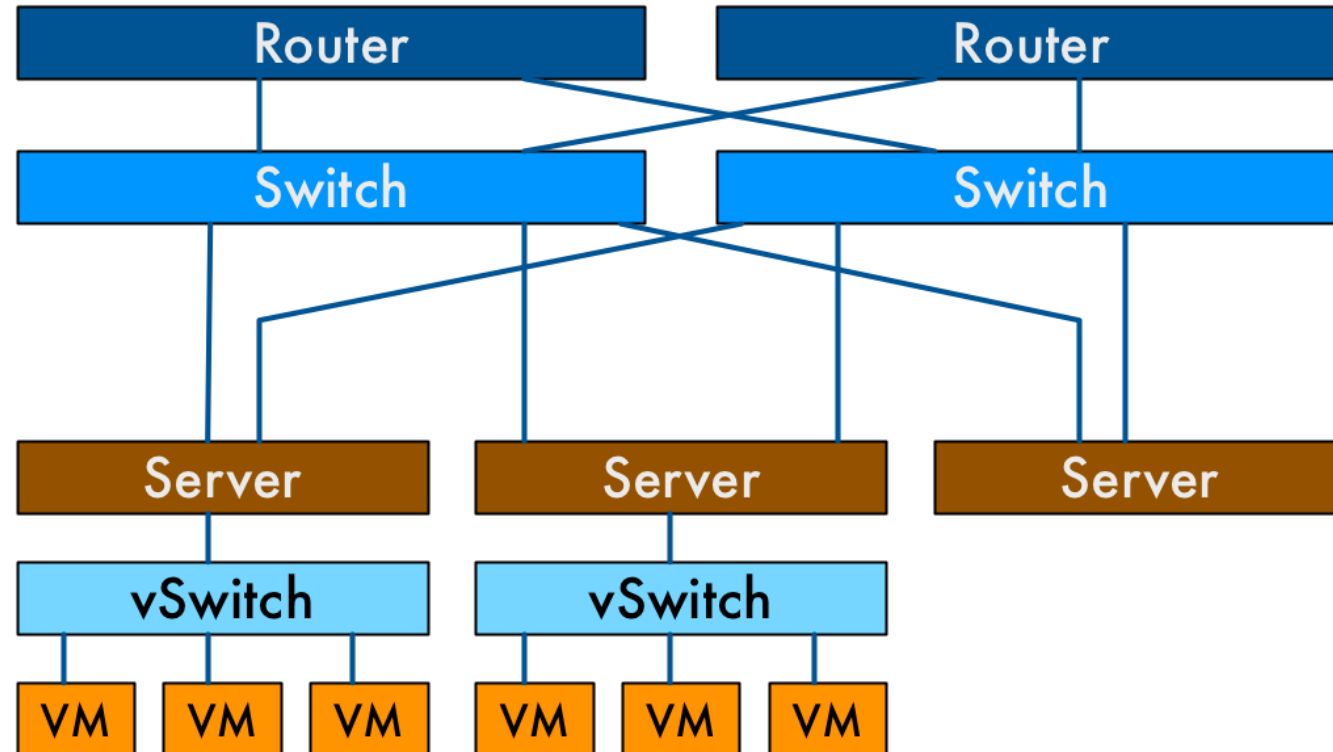
Networking Skills

- Spanning-Tree
- Routing Protocols
- QoS
- VPN Design
- Spanning-Tree
- VOIP
- Fibre Channel
- Security Policy
- MPLS
- Spanning-Tree
- Did I mention Spanning-Tree?

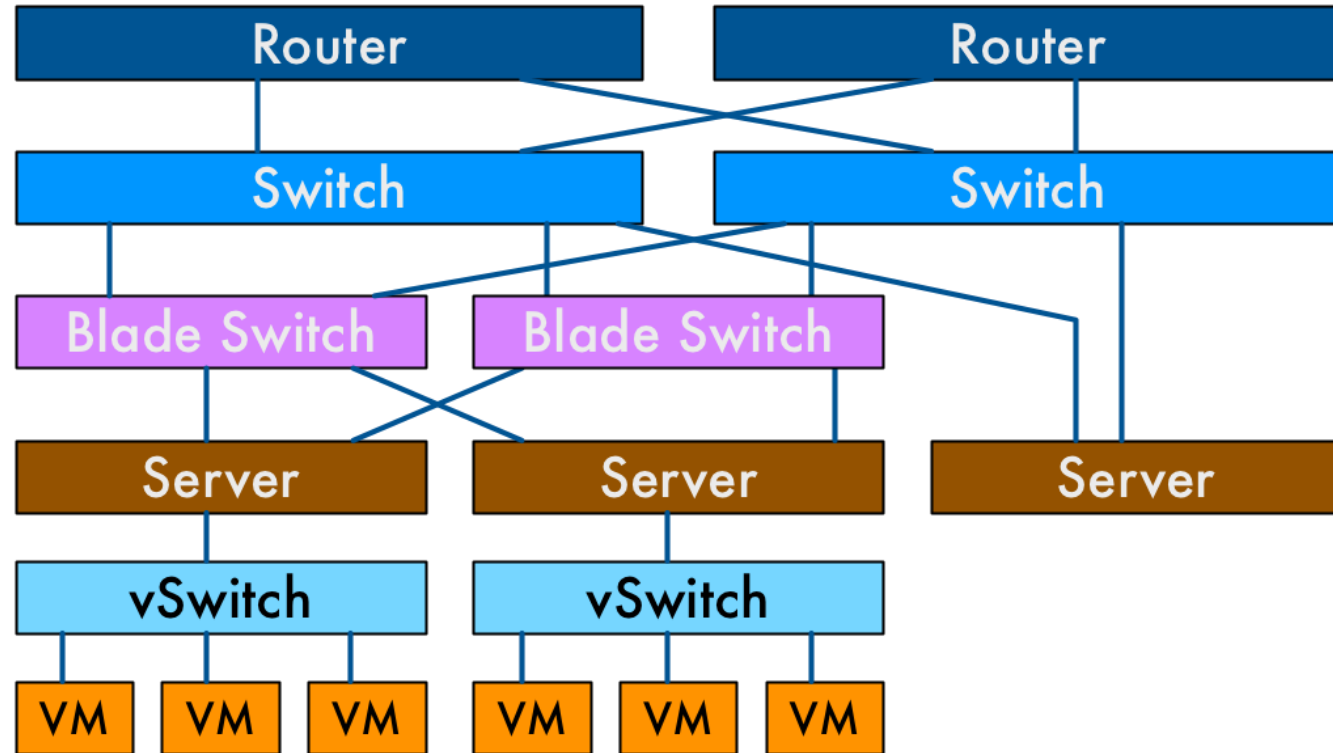
The Network...



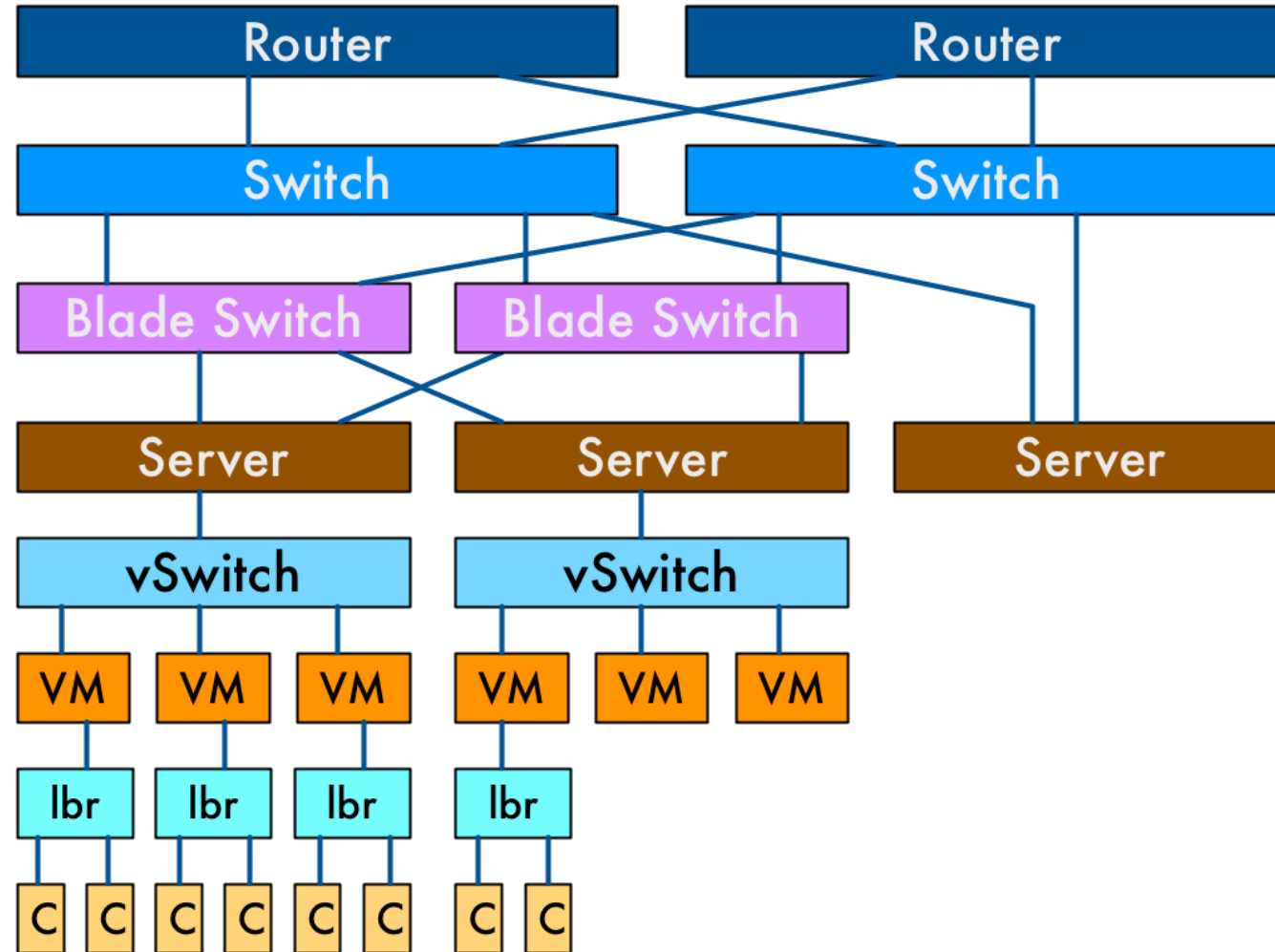
The Network...



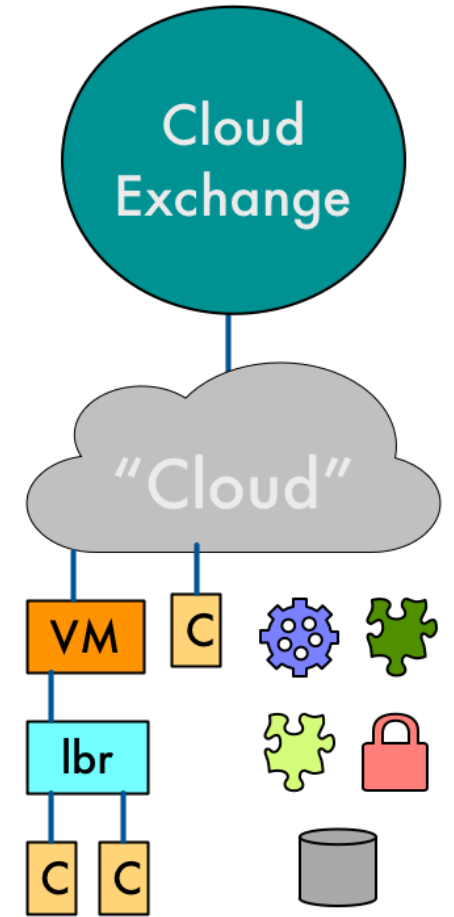
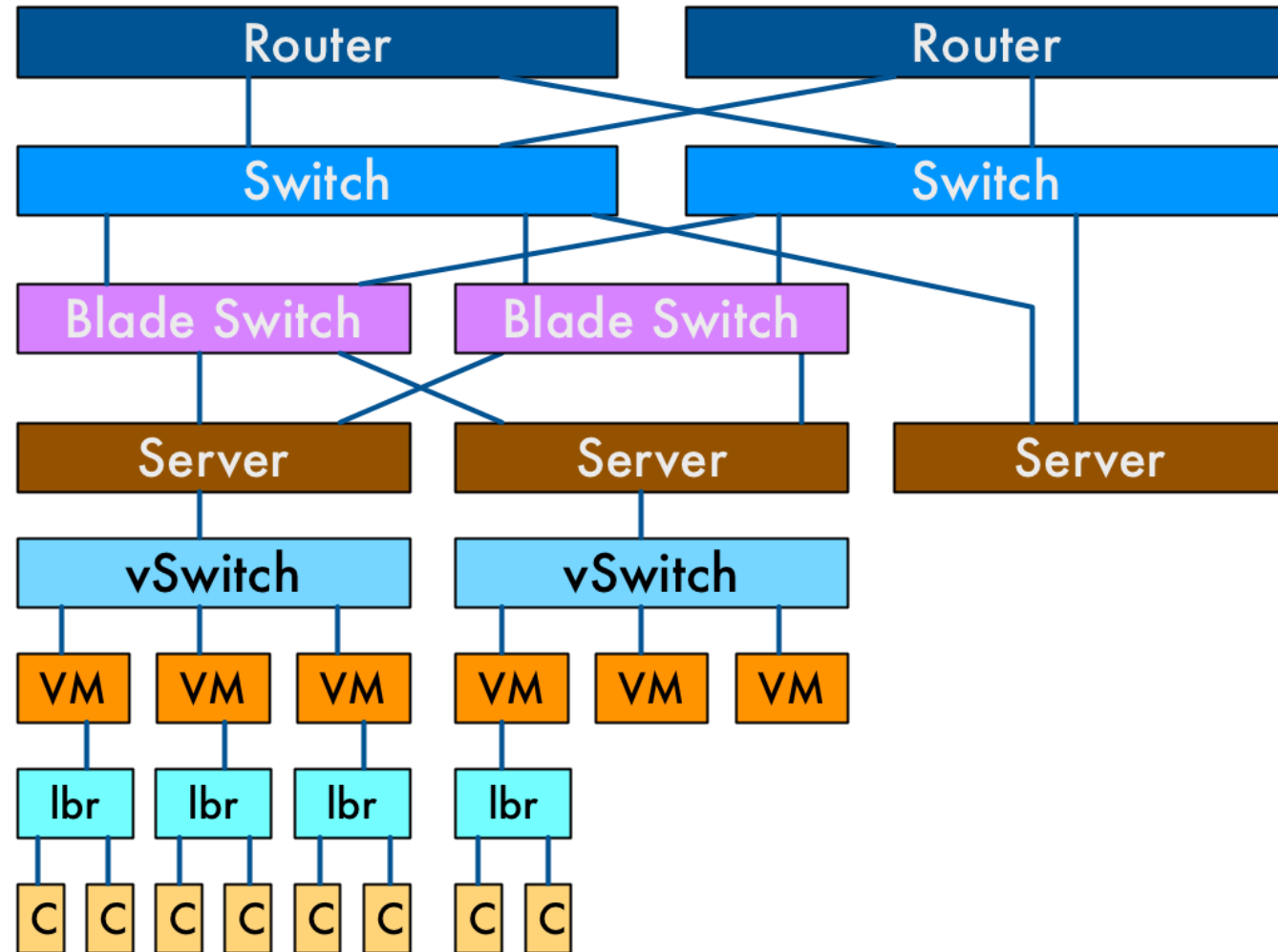
The Network...



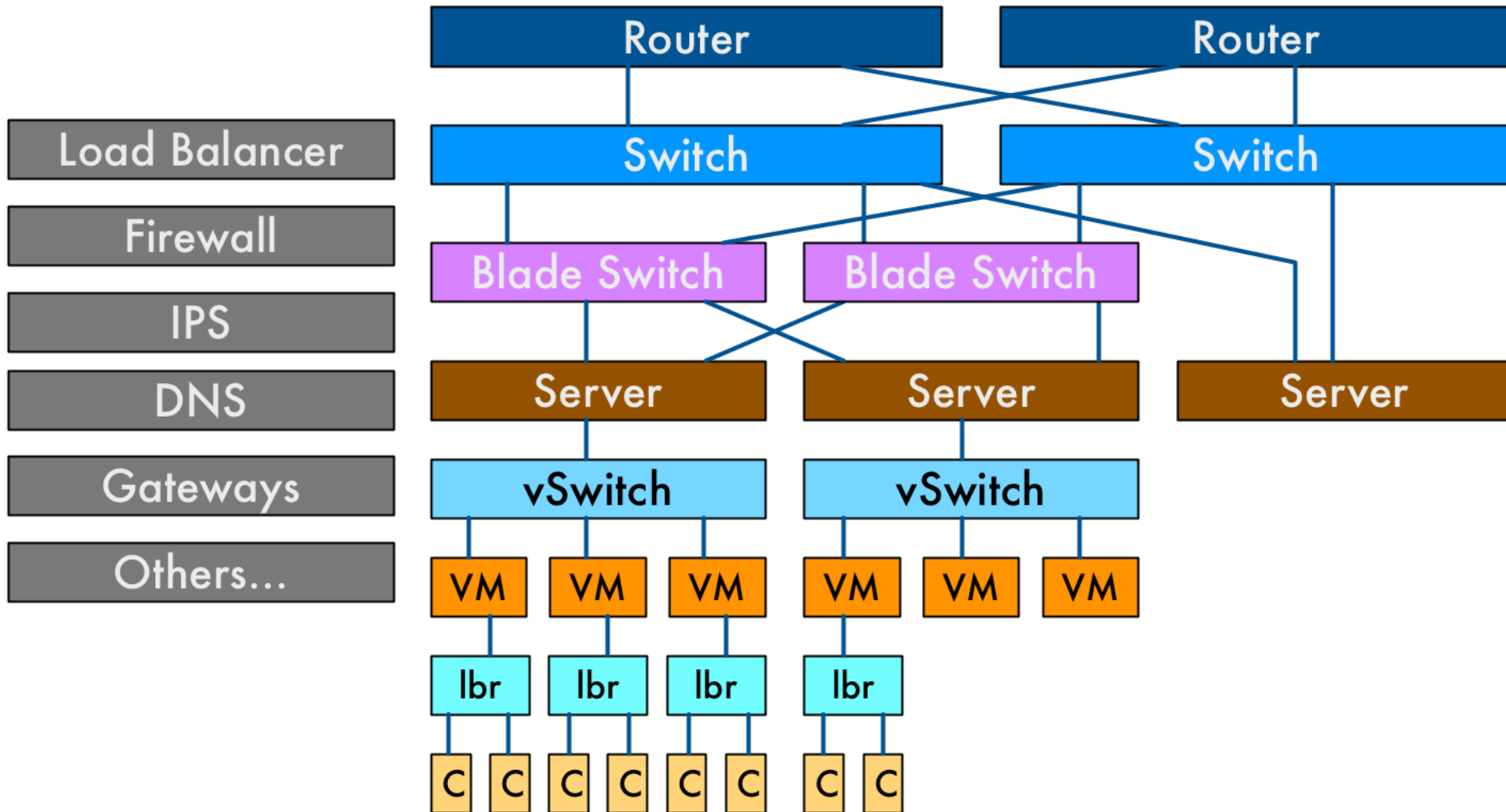
The Network...



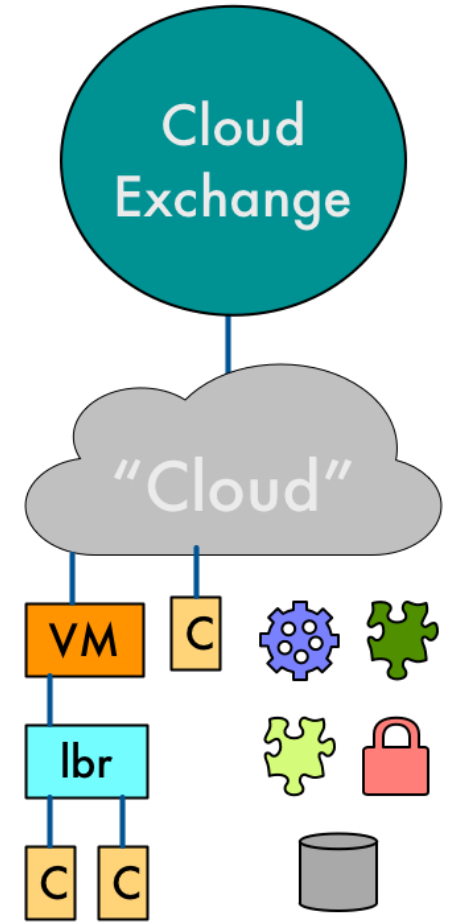
The Network...



The Network...



- Load Balancer
- Firewall
- IPS
- DNS
- Gateways
- Others...



The OSI Model of Networking...

Please don't ask about this...

L7: Application

L6: Presentation

L5: Session



L4: Transport

L3: Network

L2: Data Link

L1: Physical

Oh Yeah... We Got this

Black Magic



Today's reality...

- Functional but considered fragile
- Network configuration more “art than science”
- Tribal knowledge of key engineers



“Every time we implement a network change something goes wrong...”

“Isn’t it great, our switch hasn’t been rebooted in 6 years”

“We can’t update/change the network, our business won’t allow it”

* Paraphrased quotes from actual network operators

From: [REDACTED]
Date: [REDACTED]
To: [REDACTED]
Cc: [REDACTED]
Subject: switch uptime

```
[REDACTED]1>sh ver  
Cisco Internetwork Operating System Software  
IOS (tm) s72033_rp Software (s72033_rp-ADVENTERPRISEK9_WAN-M), Version  
12.2(18)SXF3, RELEASE SOFTWARE (fc1)  
Technical Support: http://www.cisco.com/techsupport  
Copyright (c) 1986-2006 by Cisco Systems, Inc.  
Compiled Tue 14-Feb-06 17:18 by kehsiao  
Image text-base: 0x4010140, data-base: 0x42D30000  
ROM: System Bootstrap, Version 12.2(17r)S2, RELEASE SOFTWARE (fc1)  
BOOTLDR: s72033_rp Software (s72033_rp-ADVENTERPRISEK9_WAN-M), Version  
12.2(18)SXF3, RELEASE SOFTWARE (fc1)
```

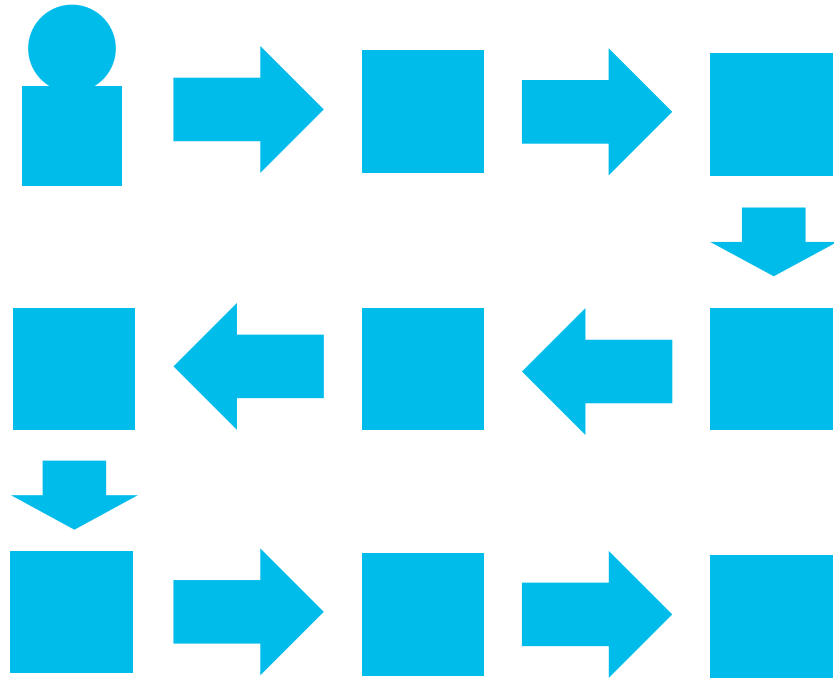
***Don't encourage this
kind of behavior!!!!***

```
[REDACTED]1 uptime is 11 years, 31 weeks, 1 day, 16 hours, 46 minutes  
Time since r-secmgtel-1 switched to active is 11 years, 31 weeks, 1 day, 17  
hours, 29 minutes
```

```
System returned to ROM by s/w reset (SP by power-on)
```

```
System restarted at 20:47:24 UTC Thu Mar 9 2006
```

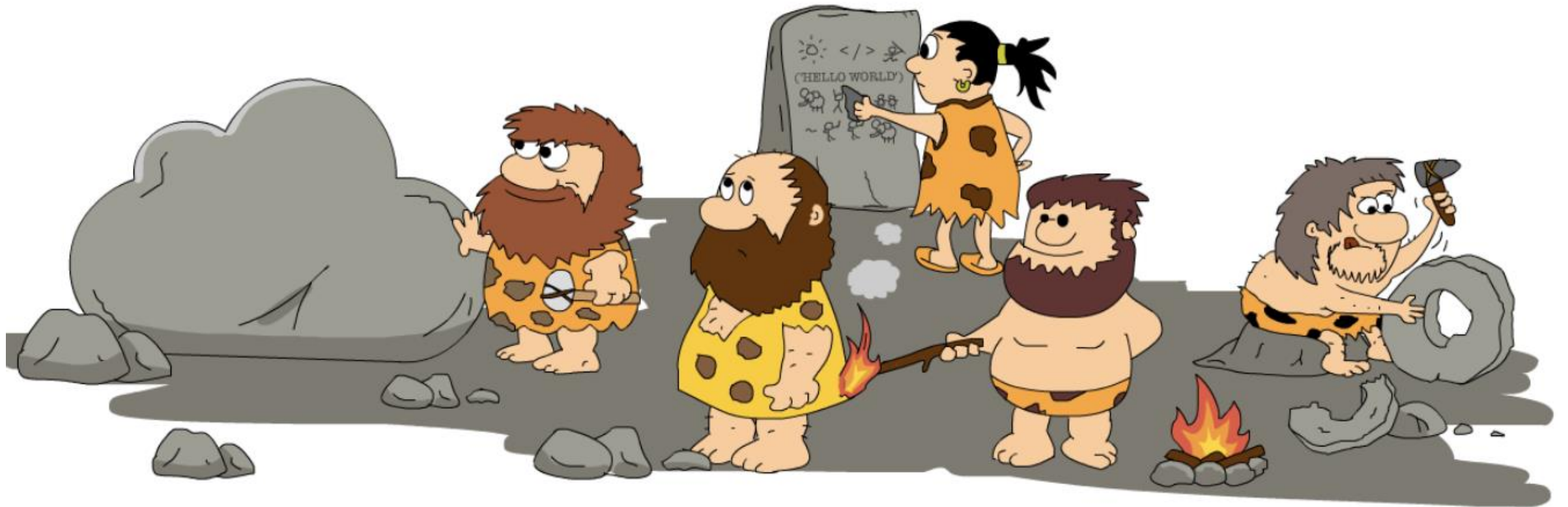
Today's Network Realities



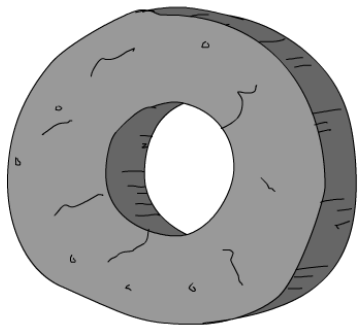
**Sequential and Manual
Infrastructure Provisioning**



**Snowflake and Time Capsules
of Configuration**



Networking through the ages...

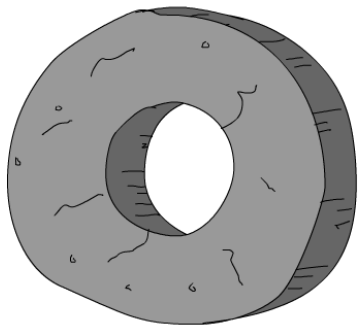


Stone Age

Spanning Tree

VLANs

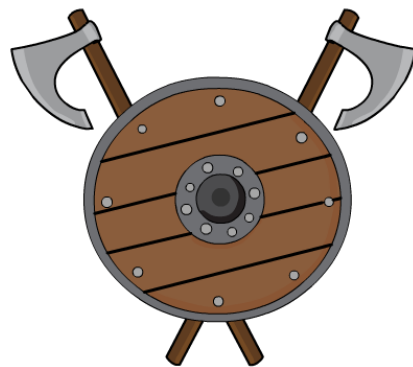
The Four Ages of Networking.....



Stone Age

Spanning Tree

VLANs



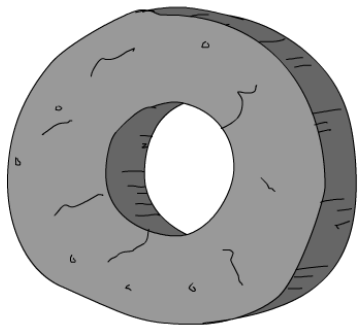
Bronze Age

Routing Protocols

WAN Design

IP-magedon

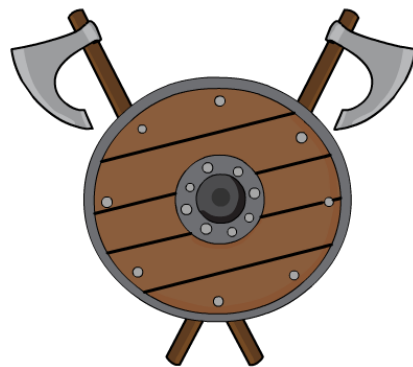
The Four Ages of Networking.....



Stone Age

Spanning Tree

VLANs



Bronze Age

Routing Protocols

WAN Design

IP-magedon



The Renaissance

SDN

OpenFlow

Controllers

Overlays

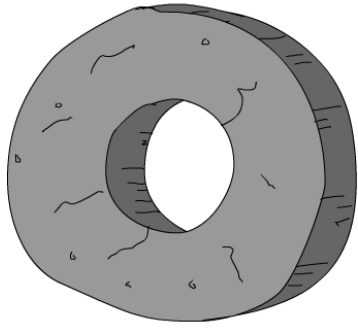
MP-BGP

VXLAN

Micro-Segmentation

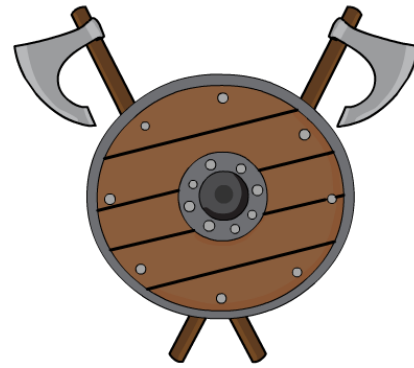
White Box

The Four Ages of Networking.....



Stone Age

Spanning Tree
VLANs



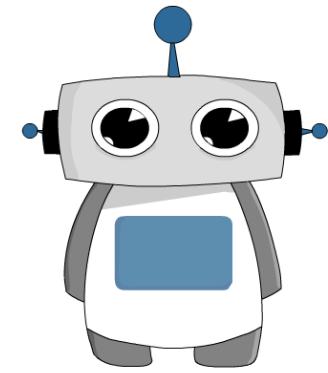
Bronze Age

Routing Protocols
WAN Design
IP-magedon



The Renaissance

SDN
OpenFlow
Controllers
Overlays
MP-BGP
VXLAN
Micro-Segmentation
White Box



Programmable Age

Cloud
Python
REST / APIs
NETCONF / YANG
“Fabrics”
Network Function
Virtualization (NFV)
Containers
DevOps
NetDevOps!

The Four Ages of Networking.....

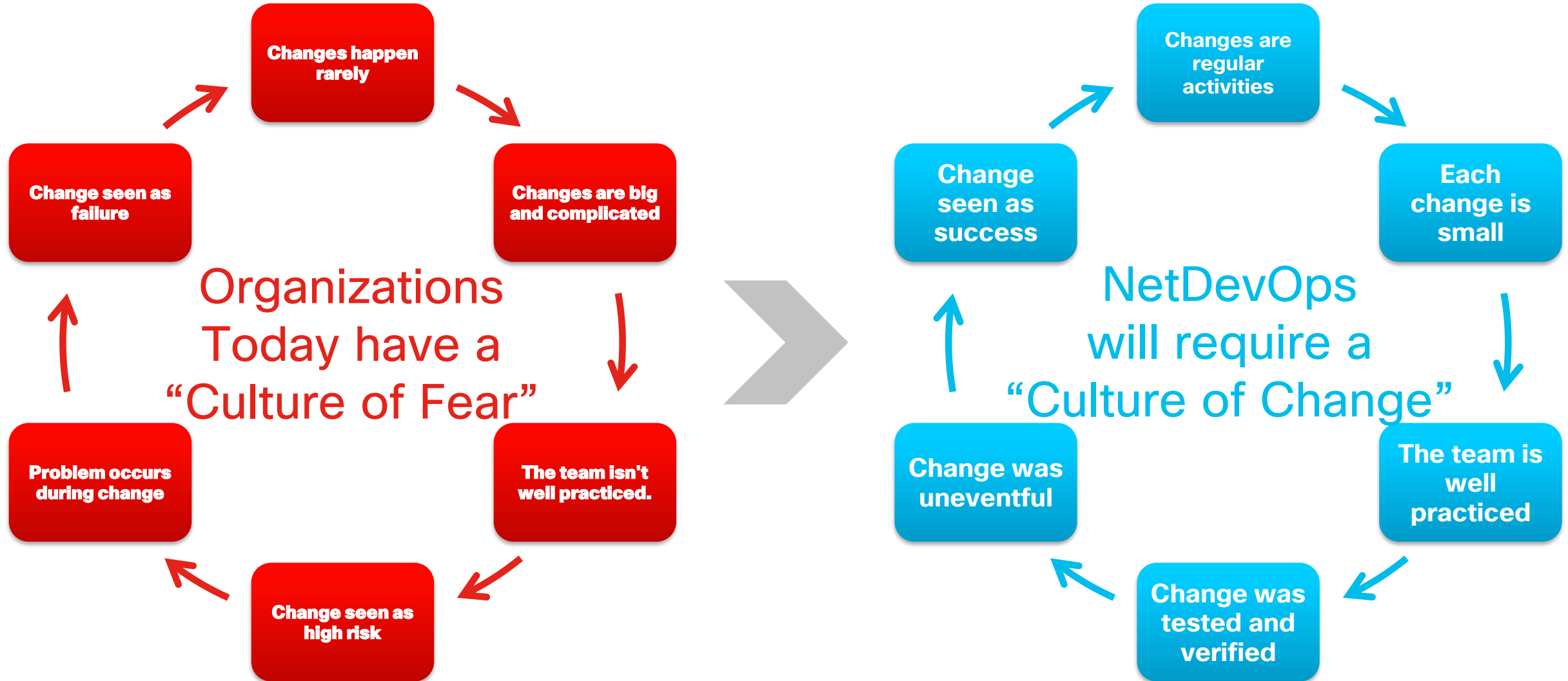
Applying DevOps to Networking



Moving to a NetDevOps Culture and Mindset

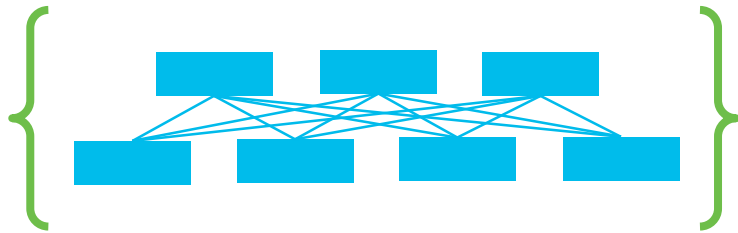


Moving to a NetDevOps Culture and Mindset



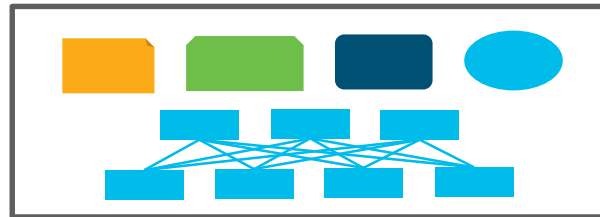
NetDevOps Operational Models

Network as Code



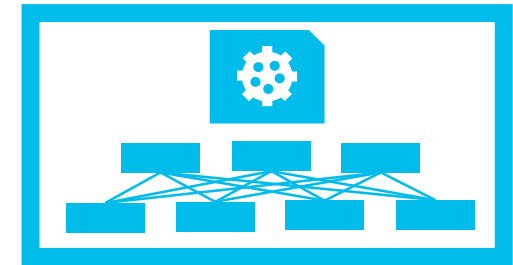
- Git based workflows
- Close alignment to software DevOps approaches
- Leverage abstractions, such as controllers, when possible

IT as a Service



- Service Catalog based workflows
- Deliver End User Self Service experience in “eStores”

Controller Driven



- Network Controller based workflows
- Evolving traditional network operation model

The NetDevOps Engineers Tool Chest

Source Control

Continuous Integration

Artifact Repository

Network Service and Configuration Management

Network Verification

Network Device Interfaces

Network Controllers

Network Virtualization / Simulation Platforms

Security Services

Infrastructure Services

Telemetry & Monitoring

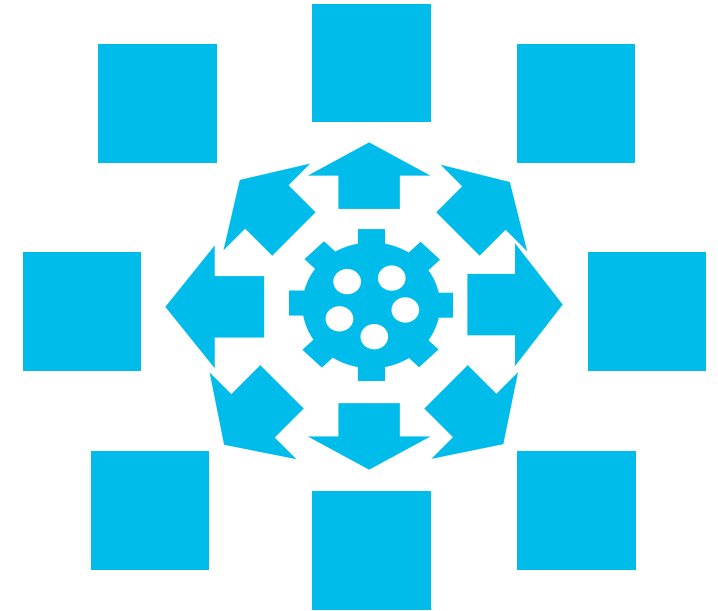
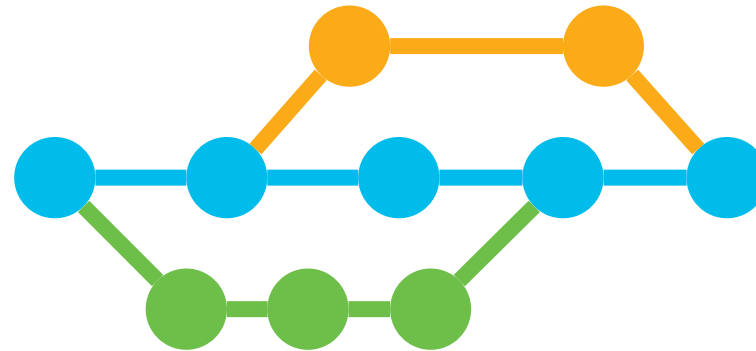
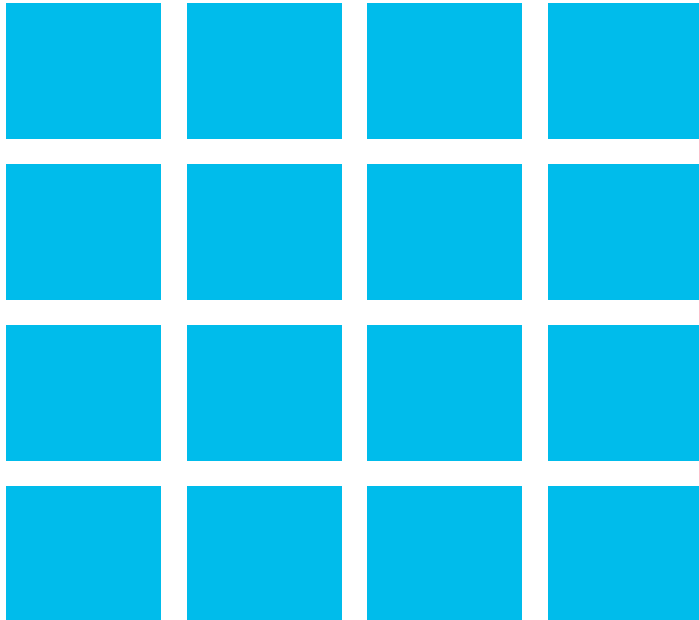
How to pick a tool? (Not in priority order)

- Commercial vs Open Source
- Programming language
- Supported integrations
- Popularity in community
- Relevant examples
- Tool Capabilities
- Used elsewhere in organization



*Often no one tool will fit,
using multiple is okay too!*

NetDevOps Will Deliver



**Consistent Version Controlled Infrastructure deployed
with Parallel & Automated Provisioning**



**IT'S
ALIVE!!!**

***Today's Network
Engineer***

A "Traditional" Network Engineer Profile



Network Skills

- Spanning-Tree
- Routing Protocols
- QoS
- VPN Design
- Spanning-Tree
- VOIP
- Fibre Channel
- Security Policy
- MPLS
- Did we mention Spanning-Tree?

Programming Skills

- TCL
- EEM
- Expect Scripts

A Profile of a NetDevOps Engineer!

Network Skills

- Layer 2 & 3 Fundamentals
- Quality of Service
- Security and Segmentation
- Linux Networking
- Container Networking
- Cloud Networking
- IOT Networking
- Model Driven Programmability
- Network Function Virtualization

Platform Skills

- Linux Administration
- Container Fundamentals
- Micro Service Platforms
- Cloud Fundamentals

Programming Skills

- Data Formats (ex: JSON, YAML, etc)
- Python and APIs (ex: REST, NETCONF, etc)
- Source Control (ex: git, GitLab, etc)
- Configuration Management (ex: NSO, Ansible, Puppet, etc)



Carl's 3 Step Approach to Network Programmability

Phase 1

- Python
- REST APIs
- JSON/XML/YAML
- git/GitHub

Phase 2

- Linux Skills
- Config Management
- Docker
- NETCONF/YANG

Phase 3

- Linux Networking
- Container Networking
- Network Function Virtualization



As Needed

- Network Controllers
- IOT Networking
- Cloud Networking
- "DevOps"





Jumpstart your Journey! Network Programmability Basics

10+ hours of FREE training on DevNet

<http://developer.cisco.com/video/net-prog-basics/>

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Learn network programmability basics

Jumpstart your journey into network programmability with this expert-led video course. We have 6 modules, each with lessons including API and code samples you can use on your computer to follow along with the videos.

Start learning now

Start your network programmability journey

MODULE 2



Programming Fundamentals

Jumpstart your journey into Network Programmability with this quick introduction to the core programming fundamental topics you'll explore.

Play module

- Data Formats: Understanding and using JSON, XML and YAML 21:21
- APIs are Everywhere... but what are they? 13:00
- REST APIs Part 1: HTTP is for more than Web Browsing 32:07

MODULE 4



Network Controllers

Explore what network controllers offer to Software Defined Networking.

Play module

- Introducing Cisco DNA Center Platform APIs and Programmability 15:44
- Got SDN? Understanding the ACI Programmability Options 28:56
- Network Control in the Cloud - Developing with Cisco Meraki 16:16

MODULE 6



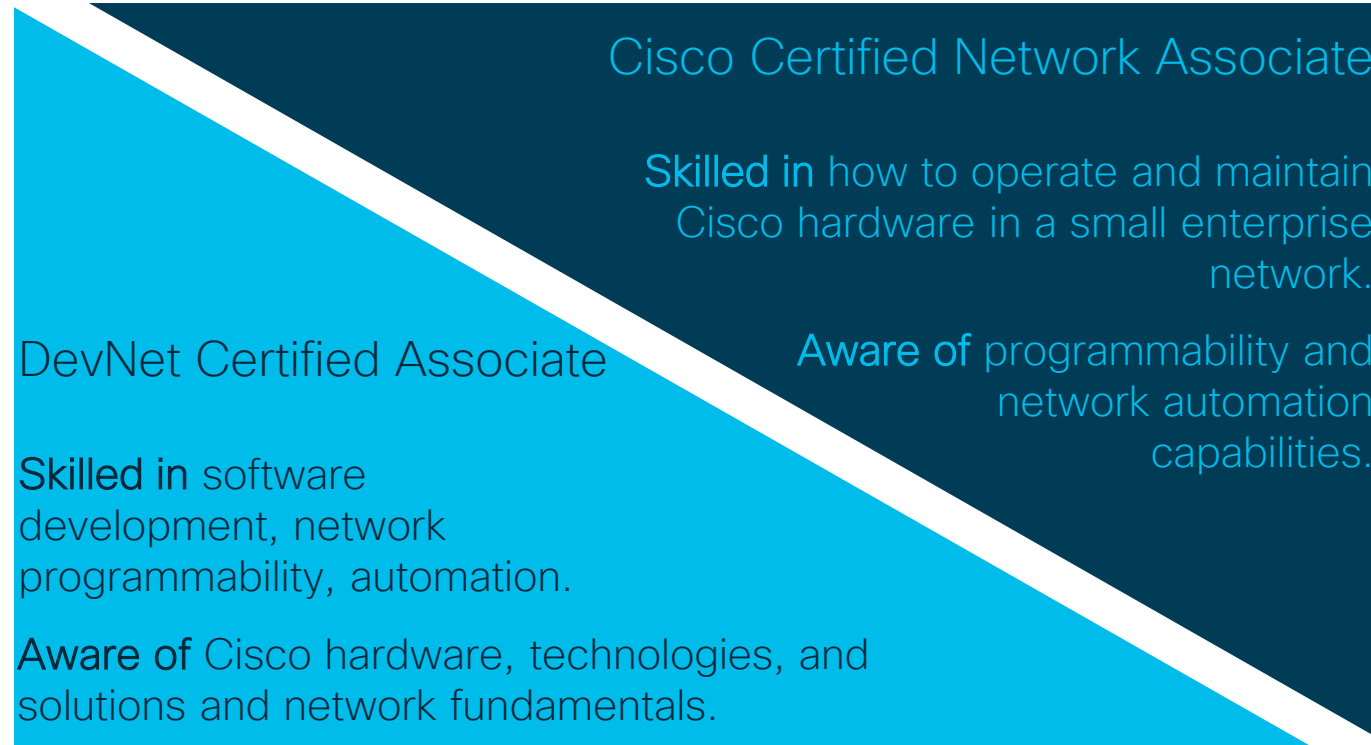
NetDevOps

NetDevOps is about bringing the culture, tools, and best practices from DevOps to networking. Get started with configuration management for the network in this module.

Play module

- Configuration Management and the Network 11:28
- Ansible Part 1: What you need to Get Started 24:27
- Ansible Part 2: Using Ansible for Network Configuration 14:21

Cisco Certifications for the Programmable Age!



Complementary balance and role alignment

DevNet Certifications Available Today



DevNet
Associate



DevNet
Professional



DevNet Specialist
Enterprise Automation



DevNet Specialist
Data Center Automation



DevNet Specialist
Service Provider Automation



DevNet Specialist
Security Automation



DevNet Specialist
Collaboration Automation



DevNet Specialist
IoT



DevNet Specialist
WebEx



DevNet Specialist
DevOps

Training for new job roles

NetDevOps Engineer

** One possible example of combining skills and training*

Professional certification

Technology concentrations



CCNP Enterprise



Cisco Specialist: Data Center

Automate data center operations



Cisco DevNet Associate

Understand software development and programmability



Cisco DevNet Specialist: Webex

Build chat bots for alerting and monitoring

Find more information on DevNet, CLN, Cisco.com

Find learning lab and sandbox offerings to start learning journey

DevNet Associate Exam v1.0 (200-901)

DevNet Associate Exam v1.0 (DEVASC 200-901) is a 120-minute exam associated with the DevNet Associate - Developer Certification. This exam tests a candidate's knowledge of at the associate level in software development and design, understanding and using APIs, application deployment and security, and infrastructure and automation on Cisco platforms. The course, Developing Applications and Automating Workflows using Cisco Core Platforms, helps candidates to prepare for this exam.

[Sign up for updates](#)

Exam overview

15% 1.0 Software Development and Design

Exam Topics

- 1.1 Compare data formats (XML, JSON, YAML)
- 1.2 Describe parsing of common data format (XML, JSON, YAML) to Python data structures
- 1.3 Describe the concepts of test-driven development
- 1.5 Explain the benefits of organizing code into methods/ functions, classes,
- 1.5 Explain the benefits of organizing code into methods/ functions, classes, and modules
- 1.6 Identify the advantages of common design patterns (MVC and Observer)
- 1.7 Explain the advantages of version control
- 1.8 Utilize common version control operations with Git:
 - 1.8.a Clone
 - 1.8.b Add/remove
 - 1.8.c Commit

Study Material

These resources are meant to supplement your learning experience and exam preparation. They are NOT designed to serve as a complete self-study program, but intended only as a suggested starting point. Login to access these materials.

- [Setting up your Linux \(Ubuntu\) workstation as a development environment](#)
- [Setting up your Windows workstation as a development environment](#)
- [Setting up your macOS workstation as a development environment](#)
- [What is a Development Environment and why do you need one?](#)
- [A brief introduction to Git](#)
- [Intro to Python Part 1](#)
- [Intro to Python Part 2](#)
- [Introduction to CI/CD](#)
- [Coding 202: Parsing JSON using Python](#)
- [Introduction to XML](#)
- [Introduction to the Guest Shell](#)

[Chat with Us!](#)

Exam Topics →

Learning Labs ←

developer.cisco.com/certification

cisco.com/nextlevel

Exchange > Explore

Discover code repositories related to Cisco technologies

Discover, learn, build, and collaborate on curated GitHub projects to jumpstart your work with Cisco platforms, products, APIs, and SDKs

What listing are you looking for?

Or find repos by product categories

- Cisco DNA Center
- Cisco Webex
- Cisco Kinetic
- Cisco Meraki



DevNet Learning Labs

The DevNet Learning Labs will help you dive deeper into Cisco and Cisco Partner technologies, including Enterprise Networks, Data Center, Collaboration, Cloud, SDN, and IoT. If you're just getting started or need a programming refresher, the Learning Labs will help you get started with tutorials covering REST APIs, Python, JavaScript, and other programming technologies and concepts.

Springboards are now Tracks.

DevNet Tracks and Modules now make it easier for you to learn. Tracks and Modules are designed to guide you through learning labs that are conceptually related.

Get Started →

- Coding**
Get started using REST APIs with Python and JavaScript using...
- Collaboration**
Learn how to use Slack, Jabber, and other collaboration tools to work together and make your life easier.



DEVNET

Course introduction

- Module Overview
- Welcome to DevNet Associate Fundamentals
- Introduction to Cisco DevNet
- Exploring DevNet online resources
- Finding and attending DevNet events
- Resources for further study
- Quiz for course and DevNet introduction
- Module Summary

Course introduction summary

1 hour 20 minutes 8 submodules

Now that you've been introduced to Cisco DevNet and know you should be able to identify online resources, the DevNet Sandbox and Learning Labs are your next step.



Introduction to DevNet Interfaces (NETCONF/YANG)

Understand model-driven programmability and how NETCONF, YANG, and RESTCONF are the next generation of standard device-level interfaces.

1 Hour 15 Minutes

- Introduction to Standard Device Interfaces**
Understanding how NETCONF/YANG fits into Network Management technologies.
- Introduction to YANG Data Modeling**
Understand what a Data Model is and what YANG provides for Network Management.
- Introduction to the NETCONF Protocol**
Explore the key elements of the NETCONF Protocol and how to use it.
- Introduction to the RESTCONF Protocol**
Explore the key elements of the RESTCONF Protocol and how to use it.

EXPLORE DEVNETSANDBOX

Login to Start Module

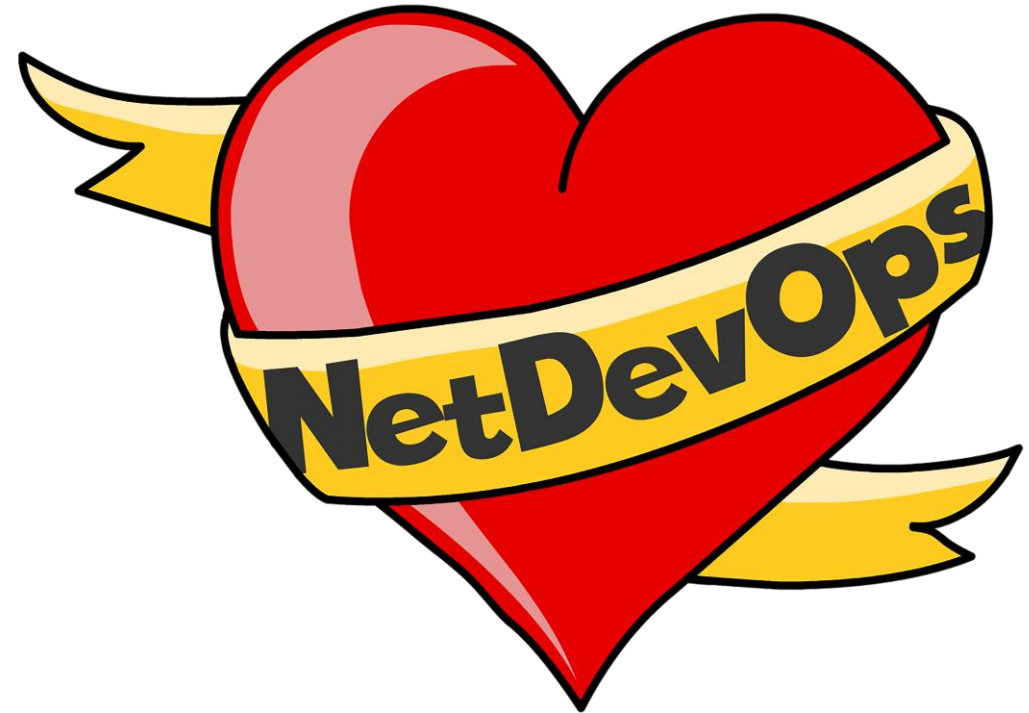


TRUST the `</>` AUTOMATION

Summing up

Review

- We looked back on the history of the network and network engineering
- Traveled through the Four Ages of Networking
- Explored how NetDevOps will change Networking
- Considered the skills a network engineer needs today



What do do next?

- [Certification Information](#)
- NetDevOps Readings
 - [Embrace NetDevOps, Say Goodbye to a "Culture of Fear"](#)
 - [NetDevOps Goes Beyond Infrastructure as Code](#)
 - [What does "Network as Code" Mean?](#)
 - [A Network Engineers Journey in Programmability](#)
 - [NetDevOps and the Rise of the Programmable Network](#)
- NetDevOps Learning Resources
 - [Network Programmability Basics Video Course](#)
 - [NetDevOps Learning Labs](#)
 - [NetDevOps Live!](#)
- NetDevOps Videos
 - [How to be a Network Engineer in a Programmable Age](#)
 - [Network as Code in Action](#)
 - [Benefits of Configuration Management](#)

Got more questions? Stay in touch!



Hank Preston

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 <http://github.com/hpreston>



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 <http://github.com/CiscoDevNet>



EXPLORE

DEVNETSANDBOX

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