CISCO GLOBAL LEARNING PARTNER OF THE YEAR 2014

NIL LEARNING

Cisco Learning Specialized Partner

Cisco Learning Business Partner

SDN, OPENFLOW AND NFV WORKSHOP

In partnership with Ivan Pepelnjak

OpenFlow, Software Defined Networks (SDN) and Network Function Virtualization (NFV) technologies fuel the latest hype bubble in the networking industry and service provider environments.

Based on vendor and industry press promises, well-published OpenFlow deployment with Google's internal network, and numerous other industry initiatives, these technologies became an unavoidable boardroom discussion as service providers and enterprises try to seek new revenue streams or optimize their costs.

On the other hand, many engineers are left wondering what's really going on behind the scenes and how useful these technologies might be in real-life networks.

This workshop describes the technology fundamentals of Software Defined Networking (SDN), OpenFlow and Network Function Virtualization (NFV), their advantages and pitfalls, and the potential use cases including a brief overview of some existing deployments. The focus of the presentation is on real-life deployment scenarios and design discussions.

Topics Covered

- The need for Software Defined Networking (SDN)
- SDN Explained
- Introduction to OpenFlow
- OpenFlow scalability challenges
- Benefits of Network Function Virtualization (NFV)
- BGP-based SDN solutions
- Software Defined WAN (SD-WAN)
- Network programmability with NETCONF and YANG
- Network automation with Ansible
- SDN and controller-based networking deployment considerations
- Real-life SDN use cases

Workshop Contents

The Need for Software Defined Networking

While the whole IT industry has been moving toward highly automated solutions in the last decade, networking has remained stuck – most networking engineers are still manually configuring individual devices.

There's high time we change the deployment and operational processes and reduce the amount of time spent doing repetitive manual tasks; this part of the workshop will give you some high-level guidelines.

The first part of the workshop focuses on technologies underlying SDN and NFV – OpenFlow, NETCONF, APIs, virtualization and virtual appliances.

Software Defined Networking Explained

Software-defined networking is not a new technology – we've been using the concepts of programmable networks for decades.

This section describes the motivations behind the SDN movement, its principles and perfect use cases, and numerous technologies you can use to program the network devices. It will also try to answer the fundamental questions: When, Why and How should you program your network.

NIL LEARNING ©2015 All rights reserved.

Introduction to OpenFlow

This section describes the concepts of OpenFlow, a new protocol used to decouple control plane (topology discovery, path calculation…) from data plane (packet forwarding). It covers the following topics:

- Traditional forwarding with distributed routing protocols
- Controller-based forwarding
- Basics of OpenFlow protocol
- Benefits and drawbacks of OpenFlow

OpenFlow Deep Dive (New in version 2.0)

After the introduction to OpenFlow concepts, the workshop includes a deep dive into the details of OpenFlow protocol, including:

- OpenFlow forwarding model;
- OpenFlow ports, classifiers, and actions;
- OpenFlow groups and multi-table support;
- QoS in OpenFlow networks;
- OpenFlow protocol details;
- Simple OpenFlow use cases, from controller-based topology discovery and learning bridges to distributed routing and control-plane protocols;
- OpenFlow deployment models and real-life implementations.

OpenFlow Scalability Challenges (Extended in version 2.0)

OpenFlow concepts are not new and share scalability challenges with similar technologies and architectures including Frame Relay, ATM, ForCES and MPLS-TP. This section discusses the major OpenFlow scalability challenges:

- Hardware limitations
- Proactive and reactive forwarding table setup
- Hop-by-hop and path-based forwarding
- Control-plane scalability and lack of shared fate

Benefits Of Network Function Virtualization

If you open a firewall, load balancer, WAN accelerator or almost any other network services appliance, you'll find one or more x86 processors,

NIL LEARNING ©2015 All rights reserved.

standard GE/10GE NICs and some custom packet handling logic. Is there any reason we have to be tied to physical hardware? Wouldn't it be better to deploy the same services in virtual machine format and make them flexible? That's the fundamental concept of Network Function Virtualization.

Does it really make sense to replace physical network services appliances with virtual machines? What are the benefits and drawbacks of NFV approach? This section will give you the answers you need to start evaluating applicability of NFV in your environment.

BGP-based SDN (New in version 2.0)

Numerous SDN solutions use BGP as the controller-to-device communication protocol. This section explains the basics of BGP-based SDN, documents several typical use cases and gives practical deployment guidelines, including sample open-source-based controller implementation.

Network Programmability With NETCONF and YANG (New in Version 2.0)

NETCONF is a protocol widely used to configure networking devices (it's supported by Brocade, Cisco, Juniper and other vendors). This section describes NETCONF and YANG (the data model description language used by NETCONF), their benefits and shortcomings, and the vendor-specific implementation details. It includes the following topics:

- What is NETCONF and YANG
- Why are SNMP, CLI and REST not good enough?
- Where did NETCONF and YANG come from?
- How does NETCONF work over XML?
- How does YANG work?
- Why would you write a YANG module? Is it useful?
- I want to deploy a service like MPLS/VPN - are NETCONF and YANG useful?
- Tools you can use to test your NETCONF code
- Differences in NETCONF implementations
- Deployment examples

©2015 All rights reserved.

Network Automation With Chef, Puppet And Ansible (New in Version 2.0)

Chef, Puppet, and Ansible are the most popular server configuration management tools, and all of them get used in network automation solutions.

This section describes the fundamentals of all three tools, their typical implementation on network devices, and the potential benefits and drawbacks of using them. It then focuses on Ansible is one of, which is commonly the tool-of-choice due to its agentless design.

SDN and Controller-Based Networking Deployment Considerations

Networking solutions with centralized network intelligence or control plane have existed for almost half a century (IBM SNA, ATM, Frame Relay, Ipsilon Flow Management Protocols).

Not surprisingly, novel SDN architectures using centralized controller clusters exhibit similar challenges:

- Single points of failure;
- Impact of network partitions;
- Balance between tightly- and loosely-coupled elements;
- Control plane and controller security;
- Impact of data plane activity on control-plane performance (punting to control plane);
- Control plane denial of service (DoS) attacks.

This section describes typical SDN deployment considerations, ranging from architectural and design challenges to security and operational considerations.

Real-Life SDN Use Cases (Extended in Version 2.0)

Service providers and enterprises are already deploying SDN, using NETCONF, BGP or OpenFlow as the implementation technology. This section describes numerous use cases based on real-life deployments:

- Data center fabrics (Arista XMPP, Juniper QFabric, NEC ProgrammableFlow, Plexxi controller)
- Forwarding optimizations and exception routing with BGP (Microsoft)

©2015 All rights reserved.

- Optimized WAN edge forwarding (Spotify/Arista)
- Centralized traffic engineering with OpenFlow (Google)
- Programmable network taps and tap aggregation networks (Arista, NEC, Big Switch, Cisco)
- Network monitoring (Plexxi Control, HP SDN VAN controller)
- Network services insertion (NEC ProgrammableFlow, segment routing, virtualization solutions)
- Software-defined WAN
- Scale-out load balancing (NEC/Riverbed) and firewalling (Arista/Palo Alto)
- Scale-out intrusion detection system (University of Indiana)
- DoS mitigation tools (Remote-triggered black holes, BGP Flowspec, NEC/Radware)
- Edge policy enforcement

Course Duration

SDN, OpenFlow and NFV workshop is a **2-day intensive instructor-led workshop**.

Audience

Network architects, designers and implementation engineers working in environments that are evaluating the viability or plan to deploy SDN solutions based on OpenFlow, BGP, NFV or other related technologies.

NIL LEARNING ©2015 All rights reserved.

About the Author

Ivan Pepelnjak, CCIE#1354 (Emeritus), has been designing and implementing large-scale service provider and enterprise networks using advanced and emerging technologies since 1990.

Ivan started analyzing OpenFlow-based solutions and writing about OpenFlow technology and SDN concepts in early 2011. He was moderating the first-ever OpenFlow symposium in Silicon Valley in September 2011, had SDN presentations at RIPE and other regional ISP meetings, ran full-day SDN workshops at Interop and Troopers, and created OpenFlow/SDN webinars for NEC, VMware and Nuage Networks.

Ivan published two books on SDN and OpenFlow in 2014, and helped large multinational organizations and equipment vendors familiarize themselves with SDN concepts, evaluate their SDN strategies, and plan and design SDN pilots. He's also the author of several Cisco Press books, prolific blogger at blog.ipspace.net and author of a series of highly successful webinars.

More @ ipspace.net

NIL LEARNING ©2015 All rights reserved.

NIL – More Than Just a Training Company

NIL Learning delivers the leading-edge Cisco training to IT professionals and companies around the globe. Through field-proven experts — each both active engineer and instructor — NIL Learning enhances the standard learning curriculum with real-life experience and helps clients to maximize their training investment.

NIL Learning is part of NIL, a leading global IT solutions provider. Since 1992, NIL has been at the forefront of advanced contributors to strategic partner Cisco's technologies, learning curriculum and value-added solutions deployed to clients around the globe. Today, NIL has earned the highest certifications offered by Cisco, VMware, EMC, HP, IBM, Microsoft, F5, MobileIron, RSA, VCE and others. Their portfolio of solutions consists of managed services, professional services and learning services.

NIL is headquartered in Slovenia, with regional offices in Croatia, Serbia, Saudi Arabia, the U.S., South Africa, Morocco, Nigeria, Kenya and Botswana.

Why learn at NIL LEARNING?

- All NIL LEARNING instructors are **field-proven experts** - each both active engineer and instructor.
- 75% of NIL LEARNING engineers hold CCSI certifications, and 20 have already achieved the respected CCIE rank.
- NIL LEARNING enhances the standard learning curriculum with real-life experience and helps clients to maximize their training investment:
    - SDN instructors have **hands-on experience with Tail-F NCS and a few other SDN tools**
    - SDDC instructor **designed and implemented a production VMware NSX and Cisco ACI deployment**
    - **IPv6 instructor helped large global organizations roll out IPv6**
- NIL has been a Cisco Training Partner since 1993; today NIL holds **Cisco Learning Specialized** status and **Cisco Business Learning Partner** status.

©2015 All rights reserved.

- NIL was awarded the Cisco Most Business Relevant Learning Partner in MEA in 2010 and the most innova- tive learning partner in MEA.
- NIL received the **Innovation Award** for its Technology Led Training and its extensive contribution to Cisco learning solutions at the Cisco EMEAR Learning Partner Summit in 2012.
- NIL received the **Innovation Award** for its Technology Led Training and Advanced Engineer Program at the Cisco Global Learning Partner Summit in 2013.
- NIL LEARNING runs a centralized training schedule across the whole EMEAR region.
- NIL received **Cisco Global Learning Partner of the Year Award** in 2014

NIL LEARNING ©2015 All rights reserved.

More Info

Slovenia

T: +386 1 4746 500

E: sales-support@nil.com

Botswana

T: +267 318 1684

E: training@it-iq.bw

Croatia

T: +385 (0)51 583 255

E: info-nilcroatia@nil.com

Kenya

T: +254 773 145 680

E: mea_sales@nil.com

Morocco

T: +212(0) 660 808 394

E: info-nilmorocco@nil.com

Nigeria

T: +234 1 903 53 47

E: mea_sales@nil.com

Saudi Arabia

T: +966 1 465 4641

E: info.nilme@nil.com

Serbia

T: +381 11 2420 388

E: info-nilserbia@nil.co.rs

South Africa

T: +27 (0)11 575 4637

E: mea_sales@nil.com

Turkey

T: +386 1 474 6 500

E: sales-support@nil.com

USA

T: +1 651 888 6598

E: info-nilusa@nil.com

learning.nil.com

©2015 All rights reserved.