Hewlett Packard Enterprise

Developing SDN Applications H4C86S (00863055)

HPE course number	H4C86S
Course length	4 days
Delivery mode	ILT
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Why HPE Education Services?

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Developing SDN Applications is an introductory course to SDN (Software-defined Networking) and development of SDN applications. The course provides an in-depth overview of SDN and guides the learner through how to develop applications that can dynamically control network behavior for advanced value and to make deploying new solutions more efficient and less time consuming.

Course description

In this course you will learn how, based on OpenFlow as the open standard transport mechanism, SDN is used in networking environments. You will also learn how SDN separates the control and data plane, enabling you take advantage of the significant benefits of this technology.

Using general application basics, SDN solution design, and hands-on labs, you will also learn vendor-independent techniques for developing applications or the SDN environment. Learners will apply their knowledge during the course to write an application for the HPE Virtual Application Networks (VAN) SDN Controller API's (REST and Java API's).

Once you complete the course, you will have a solid understanding of what SDN is and how to develop SDN applications. This course is approximately 50 percent lecture and 50 percent learning activities. The Developing SDN Applications course prepares candidates for the HPE ASE—SDN Application Developer V1 within the HPE ExpertOne program.

Audience

The Developing SDN Applications course is suitable for:

- ISVs—Application developers focused on creating SDN applications for sale in the HPE SDN App Store
- Network Engineers with some application expertise who want to develop a specific application for their own company to solve a specific networking problem

What is new?

The Developing SDN Applications is a new course within the HPE Networking technical certification curriculum.

*Realize Technology Value with Training, IDC Infographic 2037, Sponsored by HPE, January 2016

Prerequisites

None, however basic networking and basic software development knowledge (Java) is highly recommended.

HPE does recommend for those who want to learn more about general networking technologies such as IP addressing, VLANs, spanning tree and IP routing to view the following HPE Networking Fundamentals videos:

- HPE Networking Fundamentals Video Series—OSI Model, Rev. 13.3 (course ID 00764936)
- HPE Networking Fundamentals Video Series—Binary, Rev. 13.31 (course ID 00764942)
- HPE Networking Fundamentals Video Series—Data Flows, Rev. 13.31 (course ID 00765397)
- HPE Networking Fundamentals Video Series—IP Addressing, Rev. 13.31 (course ID 00766100)
- HPE Networking Fundamentals Video Series—IP Subnetting, Rev. 13.31 (course ID 00764933)
- HPE Networking Fundamentals Video Series—TCP/UDP, Rev. 13.31 (course ID 00765415)
- HPE Networking Fundamentals Video Series—VLANs, Rev. 13.31 (course ID 00764953)
- HPE Networking Fundamentals Video Series—Routing, Rev. 13.31 (course ID 00764946)
- HPE Networking Fundamentals Video Series—Spanning Tree, Rev. 13.31 (course ID 00764948)

Course objectives

The Developing SDN Applications course covers the important topics an application developer or network specialist needs to know when designing Software-defined Network based applications. After completing this course, you will be able to:

- Explain what SDN means, from a technical and business perspective
- Understand SDN use cases
- Explain and understand how OpenFlow is the open-standard transport mechanism used to make SDN possible
- Understand how OpenFlow enables the separation of the control and data planes
- Understand and configure the HPE VAN SDN controller
- Understand the basics of building an SDN application, including issues related to devices, controllers, and application types
- Understand how to design an SDN application, including decisions about application type, process of design creation, and examples of successful SDN application designs
- Understand the available APIs for developing applications and the modules that constitute an SDN application, and in-depth walkthroughs of actual SDN applications
- Understand the unique attributes of the HPE VAN SDN Controller, and the common attributes shared with other controllers
- Learners will design and develop an SDN application for the HPE VAN SDN Controller

Certification(s)

HPE ASE—SDN Application Developer V1

Exam(s)

HPE0-Y48—Developing HPE SDN Applications

Detailed course outline

Module 1: Application History

- Overview
- Welcome to HPE's Developing SDN Applications Course
- SDN Backstory
- A Brief History of Networking
- Networking Today
- Network Change: ForCES
- Network Change: Clean Slate
- First SDN Application: Ethane
- OpenFlow is Born
- OpenFlow Interest: Initially
- Networking is a Closed System
- Why is a Closed System a Bad Thing?
- What Caused Interest in SDN to Increase?
- MAC Address Table Issue
- Spanning Tree Issue
- VLAN Issue
- Traffic Engineering Issue
- Agility and Automation Issue
- Cost Issue
- OpenFlow Interest: after Data Center
- Using Management to Address DC Issues
- Orchestration Solutions
- VM Plug-in Solutions
- RADIUS Solutions
- Using Tunnels to Address DC Issues
- Tunnels: VXLAN
- Tunnels: NVGRE
- Tunnels: Stateless Transport Tunneling
- Using Protocols to Address DC Issues
- Protocols: Trill
- Protocols: Shortest Path Bridging (VLAN)
- Protocols: Shortest Path Bridging (MAC-in-MAC)
- SDN Definitions: What is SDN anyway?
- SDN: It Depends on Who You Ask
- Open SDN: Separate Control & Forwarding
- Open SDN: OpenFlow Protocol
- Open SDN: The Big Picture
- Open SDN: Today's Devices
- Open SDN: Devices with OpenFlow
- Open SDN: Summary
- SDN via APIs: Review of Open SDN / Separation of Forwarding and Control Planes
- SDN via APIs: Programmability / no Separation
- SDN via APIs: Review of Open SDN / OpenFlow SDN via APIs: Proprietary Protocol
- SDN via APIs: Today's Devices
- SDN via APIs: A Better API
- SDN via APIs: Summary
- SDN via Overlays: Virtualized Networks
- SDN via Overlays: Doesn't Touch Devices
- SDN via Overlays: MAC-in-IP Tunnels
- SDN via Overlays: Tunneling Operation
- SDN via Overlays: Summary
- A Closer Look at SDN
- Anatomy of an SDN Hardware Device
- Anatomy of an SDN Software Device
- SDN Device Hybrid Modes
- SDN Controller APIs
- SDN Controller: Northbound API
- SDN Controller Applications
- SDN Controller Considerations
- OpenFlow Overview
- OpenFlow Match Fields
- OpenFlow Flow Entries
- OpenFlow Flow Tables
- OpenFlow Flow Entry Types
- OpenFlow Ports
- OpenFlow Flow Entry Examples (1)
- OpenFlow Flow Entry Examples (2)
- OpenFlow 1.1 Changes
- OpenFlow 1.2 Changes
- OpenFlow 1.3 Changes
- Environments for SDN Applications
- SDN Application Environments: Data Centers
- SDN Application Environments: WANs
- Google WAN Implementation
- SDN App Environments: Routed Networks
- SDN App Environments: Carrier/Provider
- SDN App Environments: Load Balancing
- SDN App Environments: Firewalls
- SDN App Environments: Campus/Enterprise
- Summary

Module 2: SDN Application Basics

- Objectives
- SDN Applications: Two Types
- SDN App Type: Reactive
- SDN App Type: Proactive
- Reactive Application
- Reactive Application: Basics
- Reactive Application: Java
- Reactive Application: Java APIs
- Reactive Application: Java API Objects
- Reactive Application: Components
- Reactive Application: Listeners
- Reactive Application: Packet Handlers
- Reactive Application: Packet Actions
- Reactive Application: Flow Management
- Proactive Application
- Proactive Application: REST Basics
- Proactive Application: REST Basics examples
- Proactive Application: REST Resources
- Proactive Application: Flow Management
- Proactive Application: Similar to Network Management, with a Major Difference Summary

Module 3: SDN Application Design

- Objectives
- Designing SDN Solutions
- Why SDN Solutions May Be Harder?
- Steps for Designing an SDN Application
- Step #0: Define the Problem
- Step #1: Choose Application Design Type
- Step #2: Draw Initial Diagram
- Sample Diagram: Reactive Application
- Sample Diagram: Proactive Application
- Step #3: Define Initial (Default) Flows
- Step #4: Define Operation of System
- Step #5: Perform Complete Walkthrough(s)
- Blacklist App Design: Step 2 Diagram
- Blacklist App Design: Step 3 (Initial Flows)
- Blacklist App Design: Step 4 (Operation)
- Blacklist App Design: Step 5 (ARP)
- Blacklist App Design: Step 5 (DNS Request)
- Blacklist App Design: Step 5 (IP packet)
- Blacklist App Design: Step 5 (non-IP packet)
- Blacklist App Design: Final Diagram
- SDN Application Design Labs
- Lab 3-1: Patch Panel
- Debrief for Lab
- Lab 3-2: Learning Switch
  - Debrief for Lab
- Lab 3-3: Firewall
  - Debrief for Lab
- Lab 3-4: Load Balancer
  - Debrief for Lab
- Lab 3-5: WAN Router
  - Debrief for Lab
- Lab 3-6: Overlay
  - Debrief for Lab
- Lab 3-7: Offload
  - Debrief for Lab
- Example: Blacklist (DNS operation)
- Example: Blacklist (IP)
- Example: Data Center Tunneling
- Example: Data Center Offload
- Example: Network Access Control (Edge)
- Example: Network Access Control (Campus)
- Example: Traffic Engineering (Proactive)
- Example: Traffic Engineering (Reactive)
- Summary

Module 4: SDN Application Integration

- Objectives
- SDN Application Development Environment
- Environment: Overview
- Ubuntu Basics
- Environmental Lab 4-1: Ubuntu
  - Debrief for Lab
- Eclipse Basics
- Environmental Lab 4-2: Eclipse
  - Debrief for Lab
- Mininet: Overview
- Mininet: Installation
- Mininet: Options
- Environmental Lab 4-3: Mininet
  - Debrief for Lab
- Wireshark (OpenFlow Dissector)
- Environmental Lab 4-4: Wireshark
  - Debrief for Lab
- OVS-OFCTL (for examining switch state)
- Environmental Lab 4-5: OVS-OFCTL
  - Debrief for Lab
- Reactive Application Review (from module 02)
- Reactive Application Components
- Listeners: Switch | Datapath
- Listeners: Switch | Datapath—example
- Listeners: Message | Packet
- Listeners: Message | Packet—example
- Listeners: Device | Node | Host
- Listeners: Device | Node | Host—example
- Packet Handler: Packet-In
- Packet Handler: Packet-In (example)
- Packet Handler: Packet-Out
- Packet Handler: Packet-Out (example)
- Packet Actions
- Packet Actions—example
- Packet Matches
- Packet Matches—examples
- Flow Modifications
- Flow Modifications—example
- Packet Handling Precedence
- Coding Lab 4-6: Learning Switch
  - Debrief for Lab
- Coding Lab 4-7: Learning Switch w/Loops
  - Debrief for Lab
- Coding Lab 4-8: Learning Switch w/OF1.3
  - Debrief for Lab
- Coding Lab 4-9: Overlays
  - Debrief for Lab
- Device Limitations
- Application Coordination
- Performance and Scale
- High Availability and redundancy
- High Availability
- Security
- Summary

Course data sheet

Module 5: Applications on the HPE VAN SDN Controller

- Objectives
- HPE VAN SDN Controller Installation
- Eclipse Basics
- Maven Basics
- OSGi Basics
- Keystone Basics
- Cassandra Basics
- Java Basics
- Javadocs
- HPE Controller: Java API Overview
- HPE Controller: Application Overview
- Factory Example
- DataPath Listeners
- DataPathListener Example
- Message Listeners
- Node Listeners
- Sequenced Packet Listeners
- Sequenced Packet Listener Example
- Message Context
- Incoming Packets: OfmPacketIn Object
- OfmPacketIn Example
- Packet Contents
- Outgoing Packets: PacketOut Interface
- PacketOut Example
- Outgoing Packets: Ofm[Mutable]PacketOut
- Factories in the HPE Controller
- Match Object
- MatchField Object
- Match and MatchField Example
- Actions
- Actions Example
- Flow Modifications: OfmFlowMod Object
- OfmFlowMod Example
- Sending the Flow Modification Message
- Sending Flow Mod Message Example
- Mutable and Immutable
- Mutability Example
- Lab 5-3: Default Application
  - Debrief for Lab
- Lab 5-4: Structure, Initialization, Debug
  - Debrief for Lab
- Lab 5-5: Switch Listener
  - Debrief for Lab
- Lab 5-6: Packet Listener
  - Debrief for Lab
- Lab 5-7: Packet Handler
  - Debrief for Lab
- Lab 5-8: Action List
  - Debrief for Lab
- Lab 5-9: Flow Modification Message
  - Debrief for Lab
- Lab 5-10: Match Object and Match Fields
  - Debrief for Lab
- Lab 5-11: Flow Modification Completion
  - Debrief for Lab
- HA Overview: Primitives, Synchronization
- HPE Controller Teaming
- Controller Teaming Example
- High Availability Services
- Distributed Bus Example
- Regions and Role Orchestration
- Distributed Persistence
- Metrics Overview
- Summary

Learn more at
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