Hewlett Packard Enterprise

Architecting Open Standards HPE Network Solutions H3K70S (00683606)

HPE course number	H3K70S
Course length	5 days
Delivery mode	ILT
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The Architecting Open Standards HPE Network Solutions course provides you with the knowledge and skills to successfully architect and design complex enterprise level networks based on open networking industry standards. This course focuses on designing a future ready network capable of endless IT innovations, including cloud services, security, OpenFlow and Bring Your Own Device (BYOD) with integrated wired and wireless solutions for seamless access.

Course description

In today's network designs the boundaries are not as clear as several years ago. Cloud and Converged Infrastructure architectures have redefined the way IT assets are deployed and consumed which dramatically affects the way networks are architected and managed. This course includes both traditional network designs such as how to make a routed, redundant and secure networks, as well as how to integrate these traditional designs into a flatter, simpler network to support the bandwidth-intensive, delay-sensitive, server-to-server traffic flows that accompany cloud or converged environments. The Architecting Open Standards HPE Network Solutions course prepares you to design comprehensive future proof networks including networking elements such as switches, routers and wireless products, as well as servers and storage network related components such as Network Attached Storage (NAS) and HPE Virtual Connect. With the Architecting Open Standards HPE Network Solutions course, you learn how to validate customer requirements and how to translate those requirements into highly scalable, customized, and secure network solution design.

What is new?

The Architecting Open Standards HPE Network Solutions course is a brand new course, part of the HPE ASE—Networking Architect certification track. It includes designs based on HPE Networking's FlexNetwork architecture, which is the industry's only unified architecture for the data center, campus and branch enabling enterprises to fully harness the power of media-rich content, virtualization, mobility, and cloud computing.

Audience

IT professionals with three or more years of experience in designing and architecting complex enterprise level networks. Recommended, but not required, experience with server and storage network related technologies.

Certifications and related examinations

- HPE ASE—Architect V1
- HP0-Y45

Prerequisites

• HPE AIS—Network Infrastructure (2011)

• Successfully passed the exam HP0-Y43, Implementing HPE Network

Course objectives

After completing this course, you will be able to:

• Explain how open standards and the HPE FlexNetwork architecture addresses modern networking's bandwidth-intensive, delay-sensitive, mobility and BYOD demands

• Design a more simplified, flatter physical topology that can handle an enterprise's traffic volume and traffic patterns, including intensive server-to-server patterns anticipated for cloud and converged infrastructures

• Design efficient routing and multicast routing solutions for various enterprise needs

• Describe best practices for designing solutions from the Physical Layer to the Network Layer, by providing basic connectivity with some resiliency and good performance ensured by the proper bandwidth provisioning and topology design

• Describe HPE rack and blade server solutions and explain some advantages of the HPE blade enclosures

• Explain how HPE Virtual Connect (VC) modules help to simplify and optimize connections between servers and the data center LAN and SAN

• Design secure, integrated wired and wireless network solutions for seamless mobile access

• Develop a plan for implementing an HPE networking solution into either a greenfield or an existing network

• Obtain the data and documentation required to understand a company's general connectivity, availability, security, and application requirements based on information provided by the company's key decision makers

• Design data center solutions including network, server, and storage virtualization and explain how virtualization and cloud computing are changing the data center environment

Detailed course outline

Course Introduction	• Course overview: Introduction	• Day 3 agenda: Introduction
	• Course objectives: Introduction	• Day 4 agenda: Introduction
	• Day 1 agenda: Introduction	• Day 5 agenda: Introduction
	• Day 2 agenda: Introduction	• HPE ASE—Network Architect V1 certification: Introduction
Module 1: Networking Trends and the HPE FlexNetwork Architecture	• Objectives	• Cloud computing
	• HPE Networking Architect	• Infrastructure convergence
	• Discussion topics	• Large-scale data center consolidation
	• Campus LAN trends	• Need for "virtualization-aware" security
	• Network resource consolidation	• Need for new management models
	• Rich media communications and UC&C	• Network Virtualization—OpenFlow and SDN
	• Mobility	• Discussion topics
	• BYOD	• HPE FlexNetwork
	• Branch office trends	• HPE FlexCampus
	• Resource consolidation	– Supplemental information on IRF and meshed stacking
	• IT staff centralization	• HPE FlexBranch
	• Data center trends	• HPE FlexFabric
	• Benefits of server virtualization	• HPE FlexManagement
	• Challenges of server virtualization	• Summary
	• Increasing east-west traffic	• Learning check
Module 2: Gathering Customer Requirements	• Objectives	– Benefits of endpoint integrity
	• Discussion topics	– Costs of endpoint integrity
	• Identify key stakeholders	– BYOD Challenges and VDI
	– Maintain awareness of political climates	• Assess the need for data security
	• Understand the scope and constraints of the design	• Sample ACL worksheets
	• Focus on business needs	• Assess firewall and IDS/IPS requirements
	• Create effective requirements statements	• Discussion topics
	– Ask the right level of questions to assess requirements	• QoS overview
	– Translate information into requirement statements	– Background information on QoS protocols
	• Discussion topics	• Classify network traffic
	• Understand the existing network	– Reasons applications require different handling
	– Sample questions	– Common traffic classes
	• Activity	• Sample application requirements worksheets
	• Determine basic connectivity requirements	• Discussion topics
	– Datacenter versus Campus LAN	• Identify operational requirements
	• Discussion topics	• Identify relevant regulations
	• Assess the costs of downtime	• Activity
	• Activity	• ITSM
	• Quantify availability	• Assess existing network management tools
	• Determine availability requirements	• Document network management policies
	– Identify critical applications and services and assess the level of criticality	• Consider traffic analysis tools
	– Identify components related to critical applications	– Ensure your proposal works with the customers' tools
	• Understand how redundancy and resiliency promote availability	– Obtain information about traffic patterns and traffic flow
	– Redundancy beyond layers 1, 2, and 3	• Sample operational requirements worksheets
	• Sample availability worksheets	• Discussion topics
	• Discussion topics	• Final analysis of customer requirements
	• Assess the costs of network insecurity	– Consolidate data and verify the integrity of requirements statements

- Assess vulnerability to threats
- Assess the need for various security mechanisms
- Assess the need for access control
  - Benefits of network access control
  - Costs of network access control
- Sample access control worksheets
- Assess the need for endpoint integrity

- Review statements with key company representatives
- Document the approval of requirements
- Design activity 2
- Activity debrief
- Summary
- Learning check

Module 3: Designing and Selecting Products for HPE FlexCampus and HPE FlexBranch Solutions

- Objectives
- Discussion topics
- HPE FlexCampus reference architectures
- Choose the architecture
- Activity—Examine the scalability of a two-tier design
- Discussion topics
- Choose the type of access layer switch
- Determine the type of edge ports
- Plan oversubscription for access layer uplinks
- Approach 1—Assess the success of current oversubscription
- Approach 1—Predict success in the future
- Approach 1—Address detected issues directly
  - Good idea of peak requirements
  - More information about traffic patterns required
  - Supplement: Moving from 10/100 edge ports to Gigabit edge ports
- Approach 2
  - Use rules of thumb
  - Plan for heavy users
- Plan non-stacked access layer switch uplinks
- Plan IRF or meshed stacking uplinks
  - Plan the group
  - Plan the uplinks
- Plan IRF or meshed stacking uplinks (Cont.)
- Best practices for access layer IRF or meshed stacking
  - Supplemental information on MAD
- Use basic requirements to select access layer switches
  - Choose a switch series and model
- Determine additional requirements for access layer switches
  - Determine Layer 3 requirements
  - Determine security requirements
  - Determine QoS requirements
- Determine high availability requirements for access layer switches
  - Hardware redundancy solutions
  - Link redundancy
  - Other redundancy services
- Select modules and transceivers
  - Gigabit fiber connections
  - 10G fiber connections

- Design the core layer
  - Determine the number and type of physical ports
  - Determine performance requirements
  - Supplement on CLOS versus cross-bar architecture
- Determine other requirements for campus LAN core and distribution switches
  - Determine Layer 3 requirements
  - Determine security requirements
  - Determine QoS requirements
  - Determine redundancy requirements
  - Summary of recommendations
- Guidelines for core and distribution layer IRF
- Example design 1
- Example design 2
- Discussion topics
- Assess connection needs at the core
- Determine core router requirements
  - Choose between core routers and 10G routing switches
  - Choose a core router
- Determine branch router requirements
  - Select type
  - Physical connections and performance
  - Layer 3 services
  - High availability features
  - Security features
  - Management features
- Background on WAN connections
- Leased lines
- Traditional shared lines
- Virtual dedicated lines
- Discussion topics
- Select wireless products
  - Controlled AP or autonomous AP solution
  - General characteristics
  - Radio type
  - Wireless security role
  - Summary of recommendations
  - Supplement on 802.11ac
- Select management solutions
  - Simple management
  - Centralized enterprise management

- Plan the PoE power budget
- Discussion topics
- Design the distribution layer
  - Select models and modules based on port count
  - Determine performance requirements

- Business optimization
- HPE management solutions
- Design Activity 3
- Activity debrief
- Summary
- Learning check

Module 4: Designing VLANs and Routing for HPE Network Solutions		

- Objectives
- Discussion topics
- Design VLANs
- Create access categories for security purposes
- Create access categories for devices that need special treatment
- Limit the broadcast domain
- Example design for core routing
- Example design for core routing (Cont.)
- Assign logical VLAN IDs
- Choose appropriate network sizes
- Choose logical network addresses
- Assign contiguous network addresses
- Preparing for route summarization
  - Preparing for ACLs
  - Using contiguous blocks
  - Optional activity
- Example design for access layer routing
- Activity: Comparing routing options
- Core routing in a two-tier design
- Access layer routing in a two-tier design
  - Option 1
  - Option 2
- Core routing with IRF
- Access layer routing with IRF
- Activity summary
- Discussion topics
- Assigning users to different VLANs
- VLAN assignment strategies
  - Static
  - Dynamic
- Dynamic VLANs with core routing
- Activity: Plan a large dynamic VLAN
- Discussion topics

- Plan VLANs and IP addressing across multiple sites
- Design IPv6 addressing
- Activity: Review strategies for migrating to IPv6
- Design Activity 4.1
- Activity 4.1 debrief
- Discussion topics
- Design the OSPF areas
  - Activity
- Design router IDs
  - Optional Activity
- Enabling OSPF on networks
  - Interfaces that connect to other OSPF routers
  - VLAN interfaces that support endpoints
- Ensure logical intra-area OSPF costs
- Design area summaries
  - ASBR summaries
- Use BGP to connect to a service provider
- Design Activity 4.2
- Activity 4.2 debrief
- Discussion topics
- Evaluate multicast traffic flow
  - Supplement on IGMP
- Design multicast routing
  - PIM-DM advantages
  - PIM-DM disadvantages
  - PIM-SM advantages
  - PIM-SM disadvantages
- Design PIM-SM
- Limit multicast scope
- Optional Design Activity 4.3
- Optional Design Activity 4.3 debrief
- Summary
- Learning check

Module 5: Designing Additional Features for HPE Network Solutions

- Objectives
- Discussion topics
- Design the RF coverage
- Identify devices and their requirements
  - Bring Your Own Devices (BYOD)
  - 802.11 standards
- Identify users and their requirements
  - Where and when users will access the network
  - User and device density
  - Users' applications and usage patterns
  - Information about existing wireless networks
  - Future plans
  - Documentation
- Site survey basics
  - Site survey kit
  - Site survey practices
- Bill of materials and finalizing the product plan
  - Example
- Plan wireless bridges
- Plan WLANs
  - Examples
- Plan WLAN security for employees and controlled devices
- Plan how wireless traffic enters the LAN
- VLAN assignment plan
- Traffic distribution plan
  - Distributed
  - Centralized
- Wireless distribution in a core routing environment—Static VLANs and fewer clients per-site
- Wireless distribution in a core routing environment—Static VLANs and many concurrent clients per-site
- Wireless distribution in a core routing environment—Dynamic VLANs
- Non-seamless roaming with access or distribution layer routing
- Seamless roaming with access or distribution layer routing
- Additional uses for wireless mobility tunnels (MTM)
  - Centralized solutions
  - Hybrid solutions (some distributed and some centralized)
- Activity: Compare wireless distribution options
- Discussion topics
- Port-based access control
  - Activity
- Plan for no or minimal security
- Plan 802.1X authentication—Authentication server
  - A company with a Windows® domain
  - Other companies
- Plan 802.1X authentication—Entities and credentials
  - Windows computer authentication
  - Password versus certificate authentication

- Plan support for endpoint integrity
  - Reference materials
- Plan for data security
- Options for protecting data
- Guidelines for server- and application-based data security
- Secure management access and communications
- Guidelines for SSH
- Guidelines for HTTPS
- Options for manager authentication
  - Local advantages
  - Local disadvantages
  - RADIUS advantages
  - RADIUS disadvantages
  - TACACS+ advantages
  - TACACS+ disadvantages
- Ensure physical security
  - Recommendations for physical security
  - Recommendations for physically insecure devices
- Design Activity 5.1
- Activity 5.1 debrief
- Discussion topics
- Review traffic classification
- Example QoS solution
- Place traffic in the proper queue—Example solution
  - Optional activity
- Configure appropriate scheduling—Example QoS solution
- More on planning minimum guaranteed bandwidths
- Classify traffic—Alternative solution
- Example QoS policy
- Example QoS results
- Consider interaction between the wireless and wired QoS
- Example QoS solution for physical VoIP phones
- Implement other QoS features
- Discussion topics
- Review device and link redundancy
  - Device redundancy
  - Redundant components
  - Plan link redundancy
- Design spanning tree
- Design VRRP
- Compare IRF and VRRP as default router redundancy options
  - IRF
  - VRRP
- Plan for routing resiliency
- Supplemental information on OSPF graceful restart
- Plan for routing resiliency (Cont.)
- Activity—Plan for routing resiliency
- Plan for service resiliency at branches
- Plan for ISP resiliency

	• Plan 802.1X authentication—Policies	• Design Activity 5.2
	• Guest solutions	• Activity 5.2 debrief
	• Guest solution 1	• Summary
	• Guest solution 2	• Learning check
	– Alternatives	
Module 6: Evolving Data Centers	• Objectives	• Brief history of storage virtualization
	• Discussion topics	• Directly Attached Storage (DAS)
	• Data center use models	• SAN
	• What is a cloud?	• FC
	• Discussion topics	• FC and WWNs for VMs
	• Virtualization	• FC communications
	• Hypervisor	• FC standard
	• Connect a VM to the data center LAN	• Evolving SAN requirements
	• Support multiple virtual NICs on a virtual switch	• iSCSI
	• Supplemental information about port groups	• FCoE
	• Create virtual switch NIC teams	• DCB
	• Load balance with NIC teaming	• Congestion Notification (CN)
	• Virtual switch NIC teaming—Physical switch perspective	• 802.1qaz
	• Implement VLANs with a virtual switch	• Transition to FCoE—Phase 1
	• Virtual Switch Tagging	• Transition to FCoE—Benefits of phase 1 implementation
	• Virtual Guest Tagging	• Transition to FCoE—Phase 2
	• Virtual server VLANs—Physical switch perspective	• Other storage technologies
	• Multiple vNICs on the same VM	• FC over IP (FCIP)
	• Summary of rules for virtual switches	• Internet Fibre Channel Protocol (iFCP)
	• VM kernel connection	• Network Attached Storage (NAS)
	• Review virtual network connections	• Activity: Review storage technologies
	• Microsoft Hyper-V virtual switch	• Discussion topics
	• vMotion—Cloud computing focus	• Abstracting connectivity from the underlying infrastructure
	• Distributed virtual switches—Cloud computing focus	• OpenFlow
	• Supplemental information: Other benefits of VMWare	• SDN
	• virtual distributed switch	• Summary
	• Discussion topics	• Learning check
Module 7: Planning Servers and Storage for HPE FlexFabric Solutions	• Objectives	• Connect servers on uplinks that support one VLAN
	• Discussion topics	• Connect servers on uplinks that support multiple VLANs— Physical view
	• Example design for a traditional data center	• Connect servers on multiple VLANs without control
	• Example virtualized data center	• Connect servers on multiple VLANs with flexibility and control
	• Focus on the virtualized server edge	• Enhance redundancy and simplify management with VC domains
	• Discussion topics	• Redundant VC solution-Physical view
	• HPE rack and modular servers	• Using multiple uplinks on networks and SUSs
	• HPE server families	• Redundant VC solution with multiple active uplinks
	• HPE BladeSystem	• Add SAN support with VC FC modules
	• Choose between HPE rack and modular servers	• FlexFabric and Flex-10 solutions
	• Reasons to use rack servers	• Configuring the FlexFabric and Flex-10 solutions
	• Reasons to use blade servers	• Use VC to ease server changes
	• Summary	• Expand with multiple enclosure domains and VCEM
	• Select servers	• Design Activity 7.1
	• Tools	• Activity 7.1 debrief
	• Select storage—Local	
	• Select storage—Remote	

	• Select FC SAN switches and routers	• Discussion topics
	• Discussion topics	• Efficiency benchmarks
	• BladeSystem connections	• Support data center productivity
	• Blade enclosure backplane paths	• HPE Thermal Logic
	• Half-height blades	• Server efficiency
	• Full-height blades	• Intelligent Power Discovery
	• BladeSystem interconnect modules	• HPE Insight Control
	• Activity	• Dynamic power capping
	• Pass-thru modules	• HPE Data Center Smart Grid
	• Switch modules	• Design Activity 7.2
	• Advantages and disadvantages of switch modules	• Activity 7.2 debrief
	• VC modules	• Summary
	• Overview of VC components	• Learning check
	• Connect servers on uplinks that support a single VLAN— Physical view	
Module 8: Designing HPE FlexFabric Solutions	• Objectives	• Where to connect storage devices
	• Discussion topics	• Fan-in ratio between edge and core switches
	• High-level data center architecture	• Availability level
	• Facility requirements driving device location	• Additional FC SAN options
	• Physical topologies	• Zones
	• Top of rack (ToR)	• Partitioned fabrics
	• EoR or MoR for the access layer	• Routing between fabrics
	• ToR (or MoR) compared to EoR and cabling recommendations	• Design FCoE solutions
	• Optional activity	• FCoE servers attached to a SAN through the FCoE switch
	• Creating large Layer 2 networks—Three-tier	• FCoE servers and FCoE storage attached to the same
	• Enhancing support with flattened topologies	• switch
	• Discussion topics	• Design direct attach for VC FlexFabric solutions
	• Plan server connections	• Consider needs for data protection and disaster recovery
	• Select data center access layer switches	• Data protection
	• Select management solutions for data centers	• Continuous data backup and automated recovery
	• Design the storage components	• Complete disaster recovery plan
	• Follow best practices for iSCSI networks	• Design Activity 8
	• Design best practice FC SANs—Small FC storage networks	• Activity debrief
	• Design best practice FC SANs—Core-edge fabrics	• Summary
		• Learning check
Module 9: Integrating and Finalizing the HPE Network Solution	• Objectives	• Design Activity 9.1
	• Discussion topics	• Design Activity 9.1 debrief
	• Consider integration when expanding the edge	• Discussion topics
	• Consider integration when adding sites	• Fill gaps with HPE alliance partner solutions
	• Discussion topics	• Enhance the FlexFabric solution with F5 Networks—HPE Alliance example 1
	• Ensure interoperability with network infrastructure devices	• Deliver an end-to-end UC&C solution—HPE Alliance example 2
	• Assess the impact	• Evaluate the plan
	• Plan how to deal with proprietary protocols	• Assess the customer operational capabilities
	• Example Layer 2 interoperability	• Design Activity 9.2
	• Case 1	• Design Activity 9.2 debrief
	• Case 2	• Summary
	• Example Layer 3 interoperability	• Learning check
	• Support non-IP devices	

Module 10: Implementing HPE Network Solutions

- Objectives
- Discussion topics
- Work within the customer's operational and governance frameworks
- Consider scenarios
- Evaluate the impact of the implementation
- Divide the project into phases
- Example of a phased migration
- Discussion topics
- Assign roles and tasks
- Conduct proof of concept and other pre-tests
- Demonstrations
- Pre-tests of the design
- Create a rollback plan
- Consider the implementation strategy
- Plan tests for the implementation
- Schedule an outage
- Prepare for the installation
- Complete physical work
- Create and load router and switch configurations
- Ready VMs and physical servers
- Manage physical constraints
- Discussion topics
- Documentation checklists
- Conduct UATs
- Identify ongoing opportunities
- Design Activity 10
- Activity debrief
- Summary
- Learning check
- Appendix A: Answers
- Appendix B: Supplemental Materials

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