Hewlett Packard Enterprise

HPE Networking BGP and MPLS technology training HL046S (00429577)

The HPE Networking BGP and MPLS technology training provides networking professionals the knowledge necessary for designing, implementing and deploying enterprise level networks based on the Border Gateway Protocol (BGP) and Multiprotocol Label Switching (MPLS) technologies.

HPE course number	HL046S
Course length	5 days
Delivery mode	ILT
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Why HPE Education Services?

- IDC MarketScape leader 4 years running for IT education and training*
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*Realize Technology Value with Training, IDC Infographic 2037, Sponsored by HPE, January 2016

Additional course description

This course provides networking professionals an excellent foundational knowledge on BGP and MPLS technologies, including many hands-on lab activities. The HPE Networking BGP and MPLS technology training does not require any knowledge on BGP and MPLS for you to successfully complete the training. This training starts with a thorough introduction to BGP and moves quickly into more complex features and implementation of this enterprise technology. For example, the labs include building redundant Internet connectivity to several ISPs using BGP and learning the preferred methods of adjusting BGP attributes to achieve outbound and inbound load-balancing, internal stability, and iBGP scalability. Finally, this training introduces the fundamental concepts and technologies of MPLS. The course offers a thorough introduction to the concepts and operation of MPLS labels, Label Distribution Protocol (LDP), Penultimate Hop Popping (PHP), and Forwarding Equivalence Classes (FEC). Students will build a single-label MPLS provider network and learn to understand the output from numerous display commands in a functioning MPLS network. The major focus of this course is the operation and configuration of BGP in an enterprise environment. This class also includes a thorough introduction to the basic operation of MPLS in an MPLS provider environment.

The HPE Networking BGP and MPLS technology training is not part of a certification track. However you will find this training very useful in preparation for the Master ASE Network Infrastructure certification.

Audience

Professionals who design implement enterprise solutions based on HPE products and technologies, including HPE Reseller Design and Solution Architects, HPE pre-sales Solution Architects and post-sales engineers.

Certifications and related examinations

- HPE Master ASE—Network Infrastructure (2011)
- HP0-Y37—Migrating and Troubleshooting Enterprise Networks

Prerequisites

The HPE Networking BGP and MPLS technology course does not require any prerequisites, but we recommend that learners signing up for this course have a strong knowledge of dynamic routing protocols such as RIP and OSPF and at least basic knowledge of the IS-IS routing protocol. Certifications such as HPE ASE Network Infrastructure or CCNP are recommended.

Course objectives

After completing this course, you should be able to:

- Understand the technical foundation of the enterprise technology BGP
- Implement and understand BGP technologies
- Implement and understand BGP attributes
- Implement and understand BGP configuration tools
- Implement and understand the technical fundamentals of MPLS

Benefits to you

The HPE Networking BGP and MPLS technology training provides networking professionals the knowledge necessary for designing, implementing and deploying enterprise level networks based on the Border Gateway Protocol (BGP) and Multiprotocol Label Switching (MPLS) technologies.

Detailed course outline

Module 0: Course Introduction	• Objective • BGP/MPLS course agenda	• Course Symbols
Module 1: What is BGP?	• Objectives • What is BGP? • BGP is an exterior gateway protocol • How is BGP used? • BGP compared to current IGPs • BGP uses TCP for transport	• BGP can scale to hundreds of thousands of prefixes • BGP peers are configured manually • BGP carries attributes • BGP attributes are the ?magic? of BGP • IGP and BGP best path choice • Lab #1
Module 2: Primary BGP Concepts	• Objectives • Autonomous Systems • Autonomous System Numbers • AS Path attribute	• HPE Networking BGP and MPLS technology training • BGP table • BGP puts the best routes in the routing table • BGP prefixes in the routing table
Module 3: Basic BGP Configuration	• Objectives • Basic BGP configuration	• Status of BGP peers • Display BGP table
Module 4: Advertising BGP Prefixes	• Objectives • Advertising a default route into IGP • Lab # 2 • Originating prefixes into BGP • BGP attributes	• AS Path attribute • The Origin attribute • Lab # 3 • Lab # 4
Module 5: Introduction to iBGP	• Objectives • External and internal BGP • Transit Autonomous System	• External BGP • Internal BGP
Module 6: Loop Free BGP and Multi-homing	• Objectives • External BGP • eBGP shared with iBGP • eBGP loop free behavior • AS Path provides loop free behavior	• eBGP is loop free • Multi-homed organization • Single-homed organization • Multi-homed organization: one ISP • Types of Autonomous Systems
Module 7: BGP Best Path Selection	• Objectives • Multi-homed organizations use BGP • BGP puts the best routes in the routing table • BGP path selection • BGP path choice • BGP table • BGP maintains multiple paths • BGP table • Basic BGP operation	• Types of BGP messages • Reset and refresh BGP peer • Lab # 5 • Methods of originating prefixes into BGP • Originating prefixes: network command • Originating prefixes: import static • Originating prefixes: import OSPF • Originating prefixes into BGP • Lab # 6
Module 8: Filtering BGP Prefixes	• Objectives • Filtering BGP advertisements • Filtering advertised prefixes • Filtering BGP prefixes • Filtering received prefixes • Using ACLs to filter prefixes • IP Prefix Lists • HPE Networking BGP and MPLS technology training	• IP Prefix Lists • Display IP Prefix Lists • Using IP Prefix Lists • BGP Description • BGP peer ignore command • BGP router ID • Display BGP router ID • Lab # 7

Module 9: Route Policies	• Objectives • Route policies • Display advertised prefixes	• Route policies applied to a BGP peer • Lab # 8
Module 10: Internal BGP	• Objectives • iBGP peer configuration • Display BGP peer • iBGP connection is logical • iBGP may be multiple hops • iBGP resiliency	• BGP table • Reading the BGP table • Lab #9 • iBGP loop free behavior • Advertise best paths only • Lab #10
Module 11: Next Hop Attribute	• Objectives • Next Hop attribute • BGP sets the Next Hop attribute • Next Hop attribute default behavior • Benefits of the Next Hop attribute • Next Hop default behavior • Next Hop indicates the ?best exit? • Next Hop attribute default behavior • Next Hop reachability • Next Hop attribute is unreachable	• Setting the Next Hop attribute • Changing the Next Hop attribute to iBGP peers • Next Hop local • Make the Next Hop attribute reachable • Lab # 11 • BGP attributes • BGP decision process • Influence the BGP decision process • Lab # 12
Module 12: Controlling BGP Prefixes and AS numbers	• Objectives • BGP aggregation • Display BGP aggregate prefix • Atomic Aggregate attribute • Aggregator attribute	• HPE Networking BGP and MPLS technology training • Lab # 13 • Private Autonomous System numbers • Remove private AS numbers • Lab # 14
Module 13: Outbound Traffic Management, Local Preference	• Objectives • BGP best path review • BGP path choice review • BGP decision process review • BGP ?politics? • Outbound traffic management • Local Preference attribute • Outbound traffic policy for AS-100	• Set Local Preference attribute • Outbound traffic management • Local Preference versus AS Path • BGP decision process review • Set Local Preference attribute • Display BGP routing table details • BGP decision process • Lab # 15
Module 14: Inbound Traffic Management, Prepend	• Objectives • BGP attributes • Outbound and inbound traffic management • Review current traffic flow • Change inbound traffic by filtering? • AS path prepending	• Lab # 16 • Example of AS path prepending • Multi-homed enterprise inbound policy • Apply inbound traffic policy • Lab # 17
Module 15: Inbound Traffic Management, MED	• Objectives • Multi-Exit Discriminator attribute • Multi-Exit Discriminator—lowest MED wins • Multi-Exit Discriminator—load balancing • Multi-Exit Discriminator versus Local Preference	• BGP decision process • MED—influence a single neighboring AS • Multi-Exit Discriminator • Lab # 18

Module 16: BGP Scalability Tools	• Objectives • Many similar iBGP peers • Many repetitive BGP peer commands • BGP peer group • Peer group configuration • Peer groups—eBGP peers	• Traffic management review • Identifying prefixes review • AS path access lists • AS path access list configuration • Lab # 19
Module 17: BGP Scalability Features	• Objectives • iBGP full mesh—not many routers • HPE Networking BGP and MPLS technology training • iBGP full mesh is not scalable • Route Reflectors • Route Reflector behavior • Route Reflector terminology	• Route Reflector configuration • Lab # 20 • Originator ID attribute • Route Reflector hierarchy • Route Reflector redundancy • Cluster List attribute • Traffic flow through Route Reflectors
Module 18: BGP Communities Attributes	• Objectives • Communities attribute • BGP update with the Communities attribute • Example Communities attribute • No Export Community • Communities attribute example—No Export • No Export Community configuration	• ISP Communities policy • Communities can influence remote ISP • Communities attribute configuration • Lab # 21 • Extended Communities attribute • Extended Communities attribute format • Example BGP extended Communities
Module 19: Multi-Protocol BGP	• Objectives	• Multi-protocol BGP
Module 20: Introduction to MPLS	• Objectives • Multi-protocol Label Switching • Overview of MPLS • Basic operation of MPLS • Basic function of MPLS labels • MPLS shim header • MPLS terminology	• Label Switching Routers • LSRs maintain a table of labels • Label Switched Path • Types of Label Switched Paths • Forwarding Equivalence Class • Forwarding Equivalence Class examples • Lab # 22 Transition to MPLS
Module 21: MPLS Efficiency	• Objectives • Traditional IP routing before MPLS • Packets in one subnet forwarded similarly • Traditional IP delivery without MPLS • Basic MPLS behavior is efficient	• Ingress MPLS LSR • Intermediate MPLS LSRs • MPLS Egress LSR • Egress MPLS LSRs • Basic MPLS behavior
Module 22: MPLS Labels	• Objectives • MPLS label is locally significant • Where did the label come from? • Downstream LSR advertises labels upstream • Labels advertised on each hop • Two LSPs for a single FEC • How are labels advertised? • Sharing MPLS labels between LSRs • HPE Networking BGP and MPLS technology training • Label Distribution Protocol • LDP peer discovery	• LDP peer TCP connection • MPLS label format • Fields in the MPLS label • MPLS label field • Traffic Class field • Stack Bit field • Time to Live field • Egress LSR processes network layer • Egress LSR pops and routes • Penultimate hop popping • Implicit null—penultimate hop popping

Course data sheet

Module 23: MPLS Configuration	• Objectives • Basic MPLS configuration • MPLS display commands • Display LDP commands • Lab # 23 Basic MPLS configuration	• Trace to Display MPLS Labels • Display Ingress and Egress MPLS LSPs • Display Transit MPLS LSPs • Lab # 24 MPLS Label Swapping

Next steps

- Accelerated Migrating and Troubleshooting HPE Enterprise Networks, Rev. 11.31 HL040 (00314301)

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hpe.com/ww/learnnetworking

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