Introduction to IPv6

Course Summary

Description

The IPv6 Introduction course is designed to teach students the fundamentals of IPv6 and build a working foundation knowledge. The class covers the basics of IPv6 addressing, and neighbor discovery process including viewing the neighbor cache table. Furthermore, the IPv6 auto-configuration process between a client and default gateway router is detailed. Students work in pods and are assigned live equipment in class for completing their assigned labs. Routing protocols RIPng, OSPFv3 and BGP4+ are configured during class and each student is responsible to ensure their routing protocols are working correctly. Each host is configured for Dynamic DNS to register their IPv6 address and host name with the DDNS server. Pings are done using both host and router names instead of actual addresses to prove DDNS operation. HTTP, FTP, TFTP, and Telnet are investigated in labs as to IPv4 vs IPv6 capabilities. Students will learn how to create an IPv6 access-list for both permitting and denying traffic through their assigned router.

Objectives
At the end of this course, students will be able to:

- Obtain goundation knowledge of IPv6
- Understand both stateless and statefull auto-configuration methods
- Understand how host learn other host on local subnet
- Understand IPv6 addressing and how to subnet an IPv6 address
- Understand different-tunneling methods over an IPv4 only network
- Understand routing protocols OSPFv3, RIPng and MP-BGP for IPv6
- Understand how to configure DDNS for IPv6
- Understand different deployment strategies
- Understand dual-stack techniques
- Understand Pv6 security methods to protect against current IPv6 hacks

Topics

- Introduction to IPv6
- IPv6 Addressing
- IPv6 Header Information
- ICMPv6 Network Operation
- Routing Services and Protocols

- IPv6 Access-List
- DNS Overview
- IPv6 Deployment Strategies
- IPv6 Security

Audience

This course is designed for anyone needing an overview of IPv6 Managers that need to understand and start a foundation knowledge of IPv6 Technicians and field engineers requiring IPv6 knowledge

Prerequisites

Before taking this course, students should have basic knowledge of IPv4 and network principles.

Duration

Four days

Introduction to IPv6

Course Outline

I. Introduction to IPv6
A. Why IPv6
B. New technologies
C. IPv4 lifetime extension
D. Key differences between IPv4 and IPv6
E. Beijing Olympics
F. IPv5
G. IPv4 and IPv6 Comparison
H. DoD 2003 mandate
I. Transition IPv6 Day
J. NIST Recommendations
K. Abilene project (Internet 2)
L. Asia IPv6 rollout
M. MoonV6, NAv6TF, JTIC
N. ARIN requirements for address licensing
O. ARIN form/template
P. ARIN assignment

II. IPv6 Addressing
A. Binary number representation
B. Decimal-to-binary conversion
C. Hexadecimal review
D. IPv6 addressing
E. Possible IPv6 addresses
F. IPv6 address notation
G. Address compressing
H. IPv6 address space
I. IPv6 address prefix subnetting
J. IPv6 prefixes
K. Unicast addresses
L. Site-local deprecation
M. Unique local address
N. Link-local address
O. Global unicast address
P. Global address flow chart
Q. Auto-configured address states
R. Tentative
S. Preferred, deprecated
T. Valid and invalid
U. Address Timers
V. Anycast addresses
W. Multicast addresses
X. Well-known multicast
Y. 64-bit MAC address assignment
Z. Mapping an MAC address to an IPv6 address
AA. IPv6 temporary address
BB. IPv6 ping command
CC. Loopback and unspecified addresses

III. IPv6 Header Information
A. IPv4 protocol stack
B. IPv6 protocol stack
C. IPv6 dual stack
D. New header format
E. IPv6 extension headers
F. Hop-by-Hop
G. Destinations Options
H. Routing Header
I. Routing header example
J. Mobility with IPv6
K. Mobile node home agent support
L. Fragment Header
M. Fragment header example
N. IPSec Authentication Header
O. IPSec ESP Header
P. Using multiple extension headers

IV. ICMPv6 Network Operation
A. ICMPv6 message types
B. ICMPv6 ping operation
C. ICMPv6 Echo Request message
D. ICMPv6 Echo Reply message
E. Windows XP
F. Windows Vista and 07
G. Windows server 03' and 08'
H. Windows 07 GUI configuration
I. Common windows commands
J. Ipconfig command
K. Using different netsh commands
L. Neighbor Solicitation
M. ICMPv6 Neighbor Discovery
N. ICMPv6 Neighbor Solicitation message
O. Neighbor Advertisement
P. ICMPv6 Neighbor Advertisement message
Q. Router Solicitation
R. ICMPv6 Router Solicitation message
S. Router Advertisement
T. ICMPv6 Router Advertisement message
U. ICMPv6 Router Advertisement vs. DHCPv6
V. Viewing a router's neighbor cache table
W. Configuring IPv6 on a Unix workstation
X. Unix ifconfig commands
Y. Common Unix commands
Z. Configuring IPv6 on a MAC workstation
AA. Operating systems overview
BB. DHCPv6 Overview
CC. DHCPv4 and DHCPv6 comparison
DD. DHCPv6 relay agent
EE. DHCPv6 08' server configuration

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Course Outline (cont'd)

FF. ICMPv6 Redirect
GG. ICMPv6 Multicast messages
HH. ICMPv6 Time Exceeded, Destination Unreachable, etc.
II. ICMPv6 MTU path discovery
JJ. ICMPv6 packet too big error message

V. Routing Services and Protocols
A. Routing protocols supported by IPv6
B. RIPng protocol
C. RIPng enhancements
D. IPv4 RIP-2 MAC header snapshot
E. IPv6 RIPng MAC header snapshot
F. IPv4 RIP-2 IP header snapshot
G. IPv6 RIPng IP header snapshot
H. IPv4 RIP-2 UDP header snapshot
I. IPv6 RIPng UDP header snapshot
J. IPv4 RIP-2 snapshot
K. IPv6 RIPng snapshot
L. IPv6 RIPng trace file
M. Enabling IPv6 on Cisco
N. OSPFv3 protocol
O. Current OSPF RFCs
P. OSPF Areas
Q. Link state advertisement
R. OSPF area border routers
S. OSPF hello packet
T. BGP protocol
U. BGP IBGP neighboring
V. BGP EBGP neighboring
W. Configuring BGP-MP

VI. IPv6 Access-List
A. DMZ layer
B. Packet filtering
C. IPv6 Standard Access List
D. Standard list example
E. IPv6 Extended Access List
F. Extended list example
G. Reflexive access list
H. Reflexive access list example
I. Access List configurations

VII. DNS Overview
A. DNS infrastructure
B. DNS resolver
C. DNS A records
D. DNS AAAA resource record
E. DNS deployment
F. Bind9 support

G. DNS messages
H. DNS query
I. Example: DNS query
J. DNS reply
K. Example: DNS reply
L. Testing DNS

VIII. IPv6 Deployment Strategies
A. Operating systems supporting IPv6
B. IPv6 protocol stack for Windows 2000
C. Microsoft .NET 2003
D. Installing IPv6 on a .NET device
E. Windows commands
F. Client types
G. DNS infrastructure
H. Dual stack implementation
I. IPv4 and IPv6 dual-stack operation
J. IPv4 and IPv6 type codes
K. IPv6 over Ethernet
L. IPv6 tunneling
M. 6to4
N. ISATAP
O. 6over4
P. Teredo
Q. DSTM - Tunneling IPv4 over IPv6
R. IPv6 Translation
S. SIIT
T. NAT64, DNS64
U. Port Proxy/SOCKS
V. ISP prefix numbering
W. Prefix auto-configuration
X. Mobile IP support
Y. IPv6 support technologies

IX. IPv6 Security
A. IPSec tunneling
B. IPv6 IPSec overview
C. Security areas addressed
D. IPSec Framework
E. Authentication header
F. Encapsulating security payload

G. ESP transport mode
H. Internet key exchange
I. IPv6 IPSec in a Windows environment
J. Microsoft symmetric key authentication
K. Setting up the IPSec6 tunnel

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Course Outline (cont'd)

Introduction to IPv6 Migration Labs:

Lab 1: Initial Configuring and Neighbor Discovery
- Install IPv6 for Windows XP
- View your IPv6 address
- Review your configuration results
- Ping your neighboring pod's computer
- Use EtherPeek to analyze certain captured frames
- Analyze IPv6 header information
- Analyze various neighbor solicitations messages including DaD
- Investigate your PCs neighbor cache

Lab 2: Configuring and Analyzing IPv6 on the Network Router
- Set up the classroom network
- Configure and verify IPv6 on a Cisco router
- Analyze Router Solicitation and Router Advertisement messages
- Use the debug ipv6 nd command to view the exchange of Router Solicitations

Lab 3: ICMPv6 Packet Too Large Fragmentation
- Configure your router with a link MTU size of 1280 bytes
- Ping your neighbor's workstation with 1500 byte frame
- Capture the ICMPv6 Packet Too Large error message
- Ping your neighbor's workstation with 8000 byte packet
- Capture and analyze Fragment Extension Headers

Lab 4: Configuring IPv6 RIPng
- Configure IPv6 on a Cisco router
- Configure IPv6 RIGng
- Verify IPv6 RIPng configuration and operation on your router
- Analyze RIPng updates using a network analyzer

Lab 5: DDNS (Dynamic DNS)
- Configure the network to use Dynamic DNS for name resolution. Instead of pinging by IPv6 addresses, instead host names are.
- Each student will configure their workstation for Dynamic DNS registration.

Lab 6: OSPF Configuration
- Configure IPv6 OSPFv6 on your router
- Build adjacencies between other IPv6 routers
- View IPv6 OSPFv6 routing tables for different network connections
- View live OPSFv6 route updates from local router
- Configure IPv6 encryption used between routers

Lab 7: IPv6 BGP Routing
- Enable IPv6 BGP routing protocol
- Configure IPv6 BGP autonomous systems
- Configure both IBGP and EBGP neighbor statements
- View IPv6 routing tables

Lab 8: IPv6 Access Control List
- Configure your router to block telnet access from your neighboring routers
- Configure your access list so all other network devices can access your router
- Block your neighboring router from pinging your router
- Write an access list where you can ping other routers, but block neighboring ping packets

Lab 9: DNS Operation
- Configure client for IPv6 DNS name resolution
- Analyze IPv6 quad (AAA) records
- Analyze an DNS packet
- Verify DNS operation by pinging your DNS server and analyzing a DNS query

Lab 10: Building a Manual IPv6 Tunnel
- Configure a router for tunnel operation, allowing it to carry IPv6 traffic over an IPv4 network
- Test connectivity using the IPv6 address and fix any problems that occur
- Use show commands to view your configuration and verify tunnel operation