# Build Your Own IPv6 Learning Lab - for FREE

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1

## Building your own IPv6 learning lab

- Virtual technology options
- What our IPv6 lab may look like
- IPv6 basics
- IPv6 in Wireshark
- IPv6 resources



2

## What is this presentation about?

- It is about building a no-cost * virtual lab environment specifically targeted to gain experience on IPv6

* assumes you have a computer with at least a dual-core processor, 8G RAM, 250G storage, less than 8yrs old (depends on CPU), and it must support VT-x or AMD-V (nested virtualization).

More CPU/memory capability available will provide for a better experience

** if only 8GB RAM, probably limited to Linux clients only
[no Windows clients recommended in less than 16GB RAM of host RAM available]




## Building your own lab

- Can be with equipment
  - Cost, space, power, heat, noise
- Can be with virtual systems
  - Some free resources, some cost (optional)
- Subscription labs
  - Cost, access, duration

## Virtual lab system - options

- VMware Player/Workstation/Fusion/ESXi
- Oracle VM VirtualBox
- GNS3, EVE-NG, Dynamips, QEMU
- Cisco Modeling Labs
- Biggest issue, getting legal licenses for devices. Some vendors charge, some don't…



## Virtual lab system - Type 2 Hypervisors

- VMware Personal Desktop
  - Workstation Player (free)
    - not as flexible
  - Workstation Pro ($)
  - Fusion Pro for MAC ($)
- Oracle VM VirtualBox (free)

## Virtual lab system – Emulators

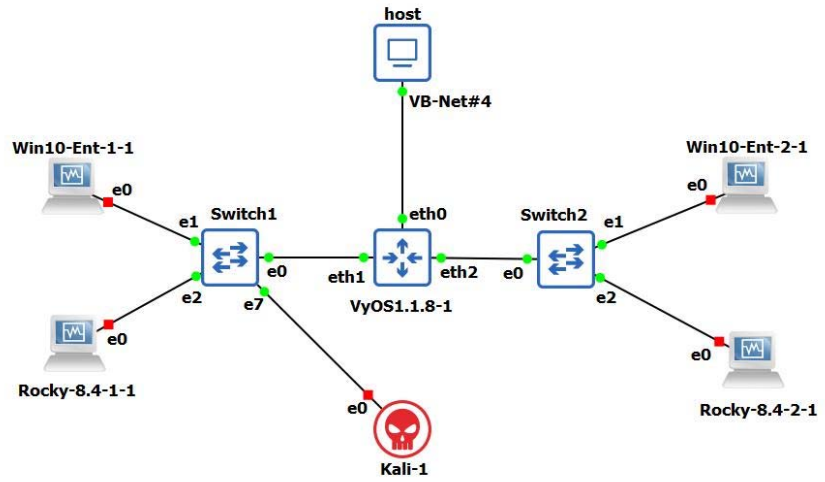
- GNS3 (free)
  - Graphical Network Simulator-3
- EVE-NG (free/$)
  - Emulated Virtual Environment Next Generation
- Cisco Modeling Labs - Personal ($)
  - fka VIRL



## IPv6 virtual lab system

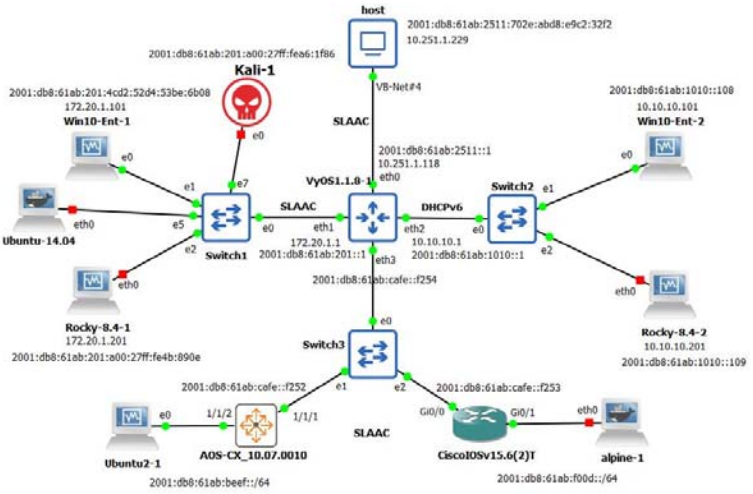
- Your computer
- VirtualBox (free)
- GNS3 (free)
- VyOS (free, older version)
- Windows client (free, timed eval)
- Linux client (free)

## GNS3 IPv6 lab

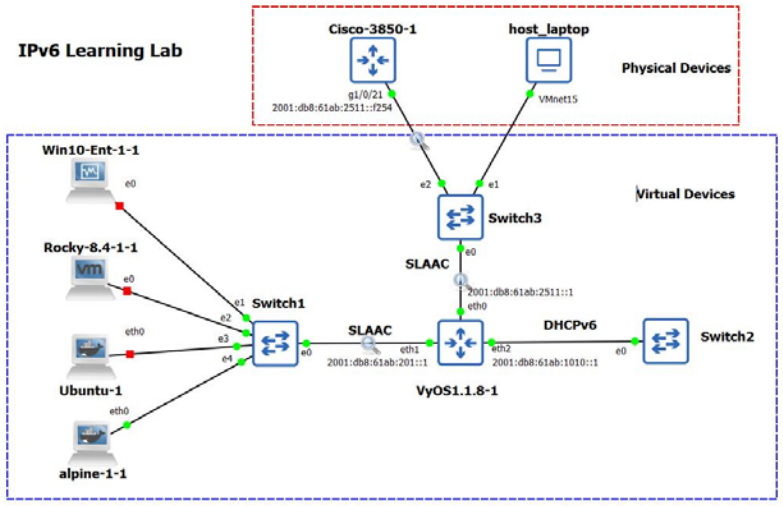





## GNS3 IPv6 lab – multiple vendors



## GNS3 IPv6 lab – virtual & physical






## IPv4/IPv6 special addresses

| Address Type | IPv4 | IPv6 |
|---|---|---|
| Default Route | 0.0.0.0/0 | ::/0 |
| Unspecified | 0.0.0.0/32 | ::/128 |
| Loopback | 127.0.0.1/8 | ::1/128 |
| Multicast | 224.0.0.0/4 | ff00::/8 |
| Link-Local | 169.254.0.0/16 | fe80::/10 |
| Global Unicast | All others | 2000::/3 |
| Unique Local | 10.0.0.0/8<br>172.16.0.0/12<br>192.168.0.0/16 | fc00::/7<br>* use fd00::/8 |
| Documentation | 192.0.2.0/24<br>198.51.100.0/24<br>203.0.113.0/24 | 2001:db8::/32 |

## IPv6 default for subnet

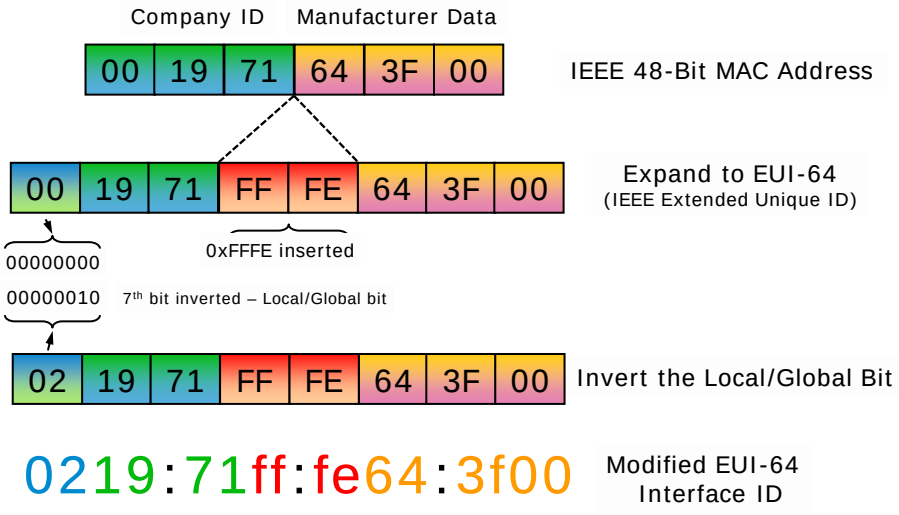
- Based on the default definition an IPv6 address is logically divided into two parts: a 64-bit network prefix and a 64-bit interface identifier (IID)
- Therefore, the default subnet size is /64
- 2001:0db8:1010:61ab:f005:ba11:00da:11a5/64

64bits for Network Identifier | 64bits for Interface Identifier | Prefix Length

- A single /64 network yields 18 billion-billion possible addresses



## Interface ID from MAC address



## Interface ID from Random Number

- RFC 4941 - Privacy Extensions for Stateless Address Autoconfiguration in IPv6
- Initial IID is derived based on mathematical computation to create a “random 64bit number” and appended to prefix to create a GUA
- An additional but different 64bit number is computed, appended to prefix, and tagged “temporary” for a 2nd GUA
- Temporary GUA should be re-computed on a frequent basis
- Temporary GUA is used as primary address for communications, as it is considered “more secure”

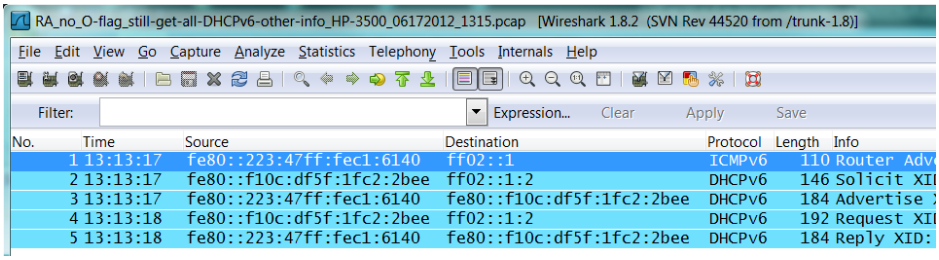

15

## IPv6 autoconfiguration options

| Address Autoconfiguration Method | ICMPv6 RA (Type 134) Flags M Flag | O Flag | ICMPv6 RA (Type 134) ICMPv6 Option Prefix Info A Flag | L Flag | Prefix Derived from | Interface ID Derived from | Other Configuration Options | # of IPv6 Addr |
|---|---|---|---|---|---|---|---|---|
| **Link-Local** (always configured) | N/A | N/A | N/A | N/A | Internal (fe80::) | M-EUI-64 or Privacy | Manual | 1 |
| Manual | Off | Off | Off | On | Manual | Manual | Manual | 2 (LL, Manual) |
| SLAAC | Off | Off | On | On | RA | M-EUI-64 or Privacy | Manual | 3 (LL, IPv6, IPv6 temp) |
| Stateful (DHCPv6) | On | N/R | Off | On | DHCPv6 | DHCPv6 | DHCPv6 | 2 (LL, DHCPv6) |
| Stateless DHCPv6 | Off | On | On | On | RA | M-EUI-64 or Privacy | DHCPv6 | 3 (LL, IPv6, IPv6 temp) |
| Combination Stateless & DHCPv6 | On | N/R | On | On | RA and DHCPv6 | M-EUI-64 or Privacy and DHCPv6 | DHCPv6 | 4 (LL, IPv6, IPv6 temp, DHCPv6) |


16

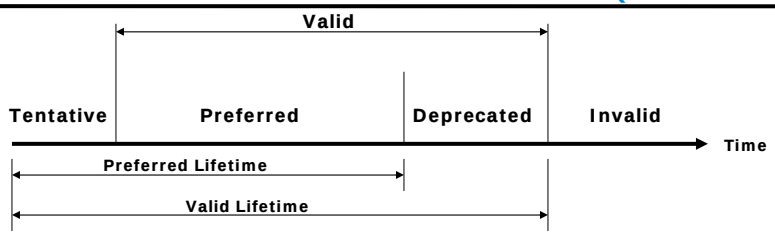
## IPv6 Stateful (DHCPv6) process




- DHCPv6**S**olicit = DHCP**D**iscover (IPv4)
- DHCPv6**A**dvertise = DHCP**O**ffer (IPv4)
- DHCPv6**R**equest = DHCP**R**equest (IPv4)
- DHCPv6**R**eply = DHCP**A**ck (IPv4)



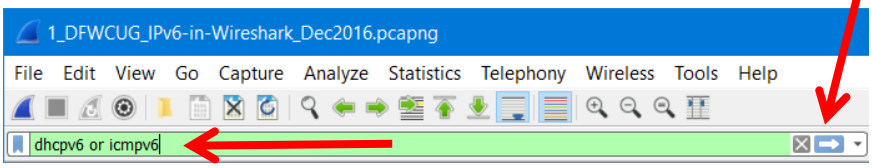

## States of an IPv6 address (timers)




- Tentative – address is in process of verification for uniqueness and is not yet available for regular communications
- Valid – address is valid for use in communication based on Preferred and Deprecated status
- Preferred – address is usable for all communications
- Deprecated – address can still be used for existing sessions, but not for new sessions
- Invalid – an address is no longer available for sending or receiving

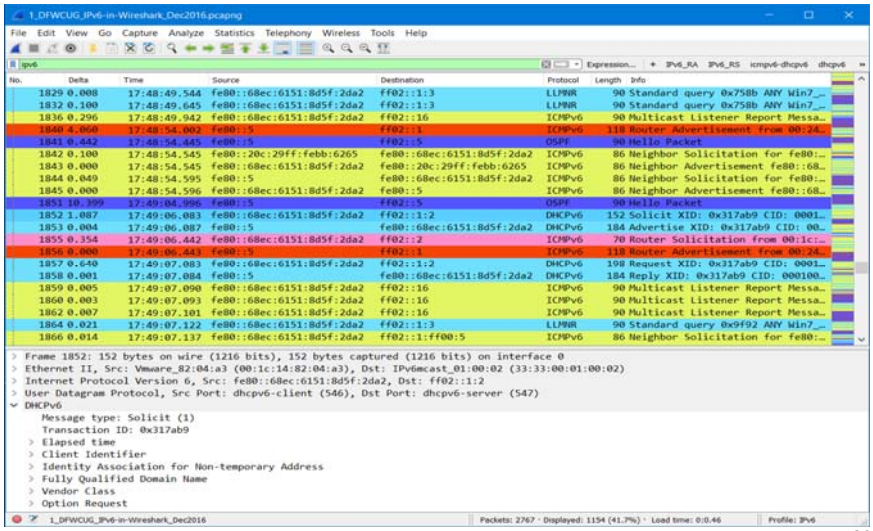
## Using Wireshark to view IPv6 pkts

- IPv6 display filter families
  - ipv6
  - icmpv6
  - dhcpv6
- IPv6 related display filters:
  - http://www.wireshark.org/docs/dfref/i/ipv6.html

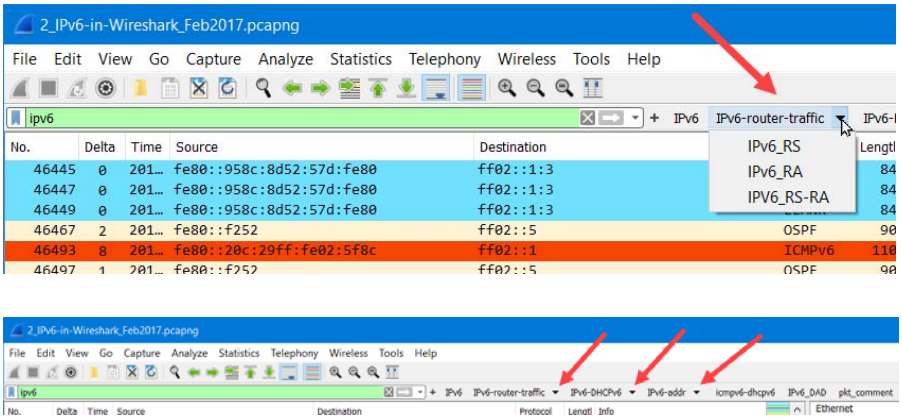





## Jeff's IPv6 Wireshark



## Nested display filter buttons



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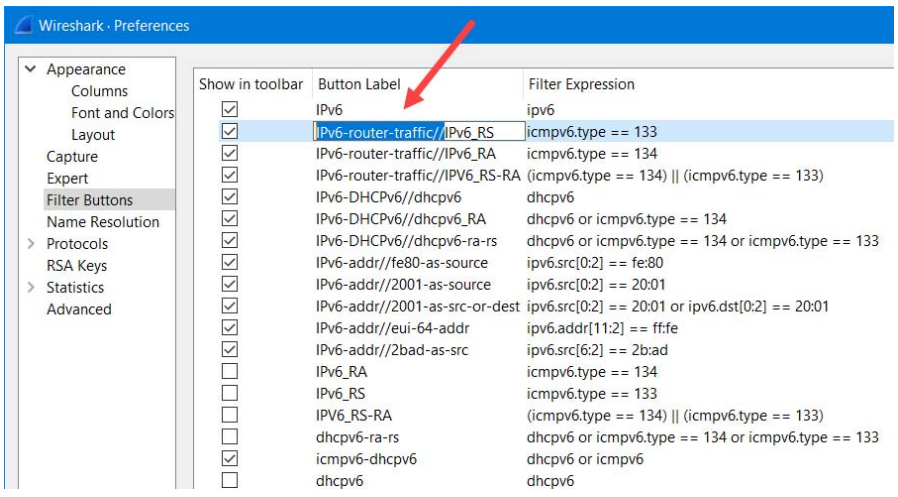
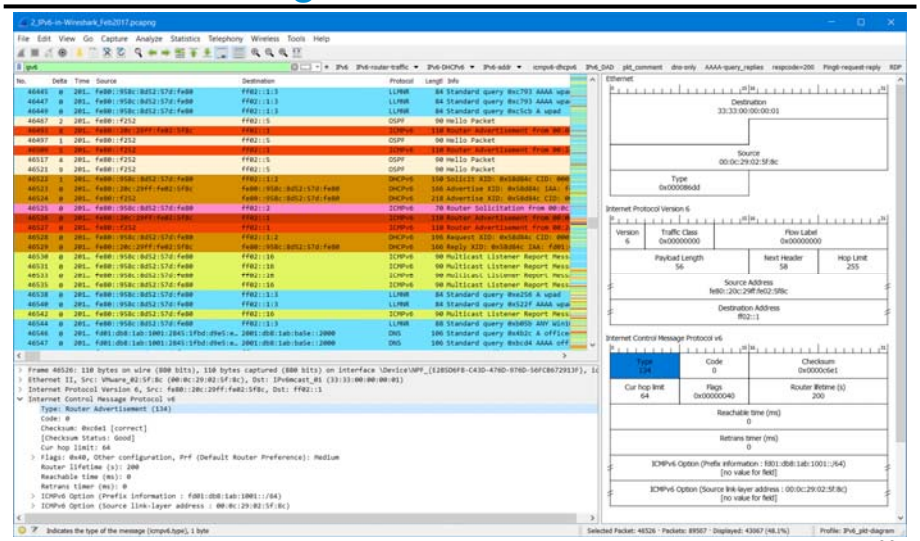


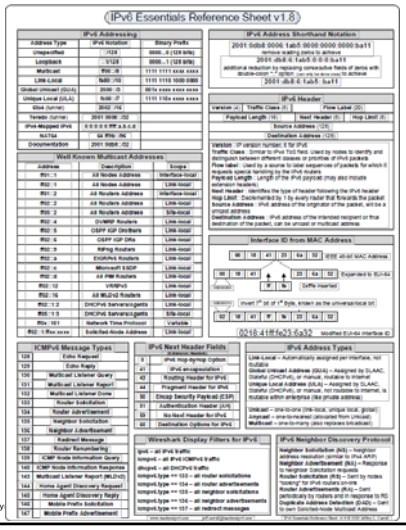
## Packet diagram



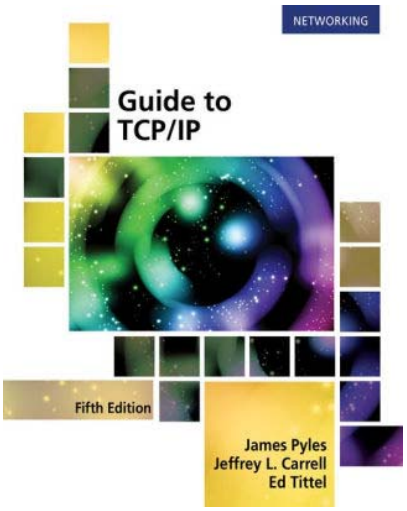


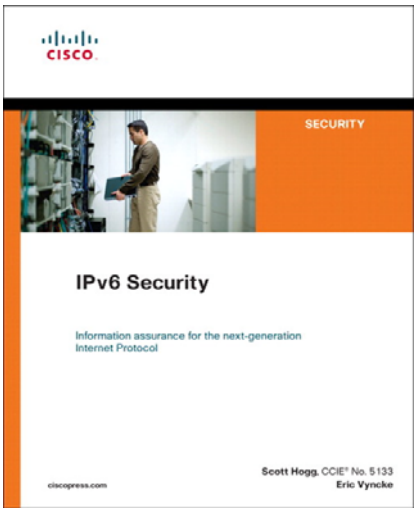
## IPv6 Essentials Reference Sheet

**http://teachmeipv6.com/IPv6-Essentials-Reference-Sheet.pdf**



## Resources



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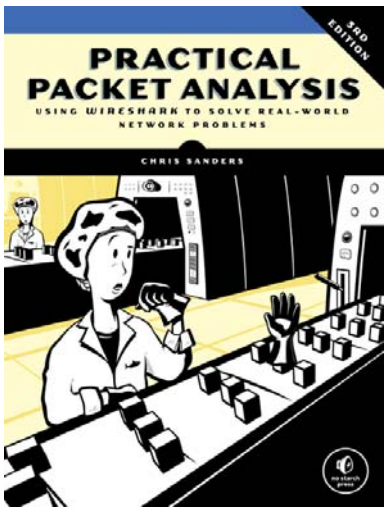


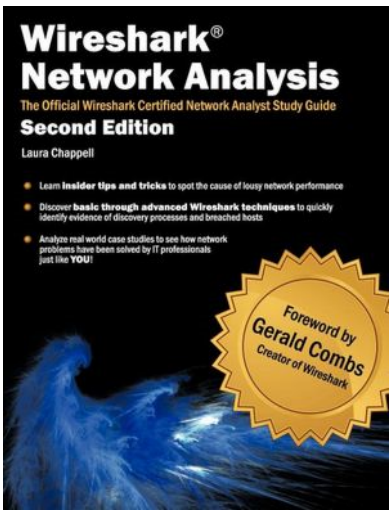

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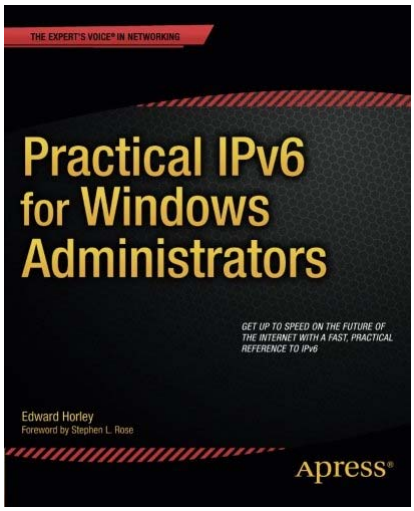


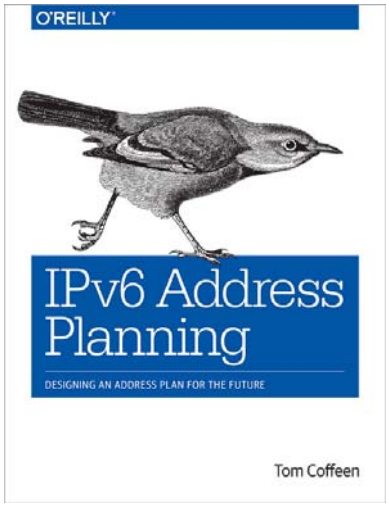




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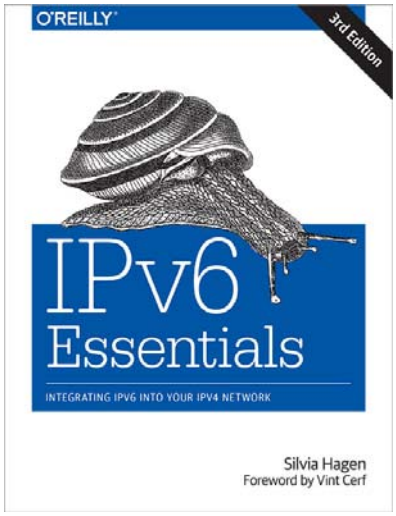

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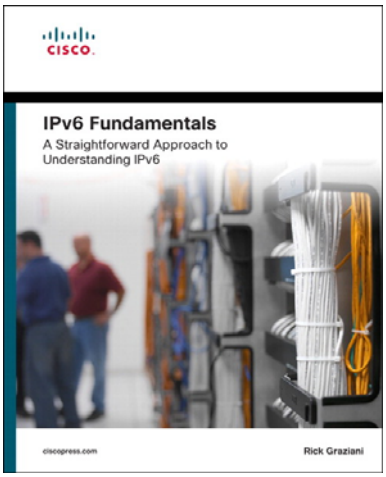


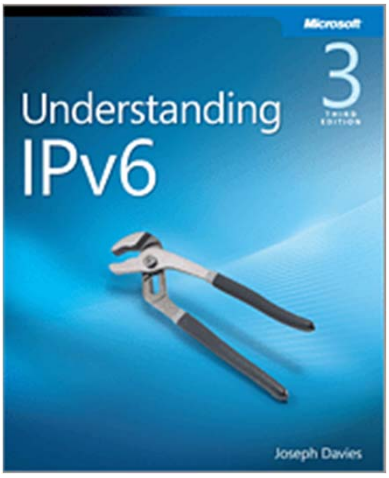



29

## Thank You for Attending!

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30