



Successfully Deploying IPv6

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Agenda

- Dual Stack Migration Planning Pitfalls
- Training for IPv6 Deployment Success
- Addressing Challenges
- IPv6 Routing
- Dual-Protocol Applications
- Troubleshooting Dual-Protocol Networks

IPv6 Planning – Dual Stack Migration

- Organizations using IPv4 today will add IPv6 as a separate protocol, run them in parallel for many years, then after many years, start to disable IPv4

IPv6 Deployment

IPv4 Deployment

Time 

IPv6 Planning Pitfalls

- Failing to build a cross-function IPv6 deployment team
 - Multidisciplinary, Collaborative, Cooperative
- Organizations need to treat IPv6 as a “Program” not just like a typical IT “Project”
 - IPv6 transition is made up of many smaller projects that will span multiple years and cross the entire enterprise
- Regular/Frequent meetings are key to maintaining pace
- Just like anything, executive buy-in and support is essential

Performing an IPv6 Readiness Assessment

- Don't try to look at everything, identify devices requiring IPv6
- Focus your efforts on the Internet perimeter
 - Look at every device in the transmission path (IPS, WAF, web proxy, DLP, ...)
- The good news is you have waited to deploy IPv6
 - Now most IT products come standard with IPv6 capabilities
- Don't be concerned about an IPv4-only management plane – that will come later
- Some devices may remain IPv4-only until they die

Training for Success

- Assume your IT organization has not taken the initiative to immerse themselves in IPv6
- People need to be trained early in the process, but not too early that they forget what they learned
 - Train “just in time”, not years before an IPv6 address is actually configured on a production device
- Train for different skillsets (appdev, sysadmin, net admin, sec admin, helpdesk, PMs, ...)
- Much of your IPv4 experience is applicable to IPv6
- Don't fear the larger addresses – Learn to “Think in Hex”

IPv6 Addressing

- IPv4-Think is dangerous when planning IPv6 addressing
 - Crazy Talk: Using decimal #s, embedding VLAN #, IPv4 address converted to hex
- There is no scarcity of IPv6 addresses
 - If there is no scarcity, there can be no waste
 - Don't try to assign only the minimum-needed prefix length
 - Plan for the number of subnets, not the number of hosts
- Perform addressing for simplicity and ease of management
 - Don't be concerned about lots of reserved space

IPv6 Addressing

- Don't force levels of hierarchy that are not needed
- Use standard prefix lengths: /48, /56, /64
- Use nibble-boundary – don't use /50, /57, /65, ...
- Consistency between sites can increase operational efficiency, however, not every site needs the same addressing plan
 - Branches need a different plan than a data center “site”
- Stick with Global Unicast Addresses (GUA) 2000::/3
- Avoid Unique Local Addresses (ULA) FC00::/7

IPv6 Routing

- IP addressing and routing go hand-in-hand
- All IP routing protocols have IPv6 capabilities
- Separating control plane for two data planes can be desirable
 - Establish BGP peer over IPv4 TCP 179 for sharing IPv4 routes
 - Establish BGP peer over IPv6 TCP 179 for sharing IPv6 routes
- Don't forget to use a 32-bit RID to the IPv6 routing process
- Peering using global (preferred) or link-local addresses
- Consider using locally-administered link-local addresses
 - fe80::cccc:0001, fe80::dddd:0002, ...
- Type carefully – don't fat-finger the address

Dual-Protocol Applications

- Assessing current code for IPv6-capability
 - Most applications are not creating socket-level connections
 - Most applications use higher-level APIs or rely on lower-level web services for connectivity
- Create code that is Address-Family (AF) independent
- Presentation-to-Numeric (p2n) & Numeric-to-Presentation (n2p)
 - Robustness principle: Be conservative in what you send, be liberal in what you accept
- Be careful of data structures for storing 128-bit addresses
- Create code that performs dual-protocol DNS resolution and incorporates Happy Eyeballs (RFC 6555)
- Write code that properly handles Path MTU Discovery (PMTUD)

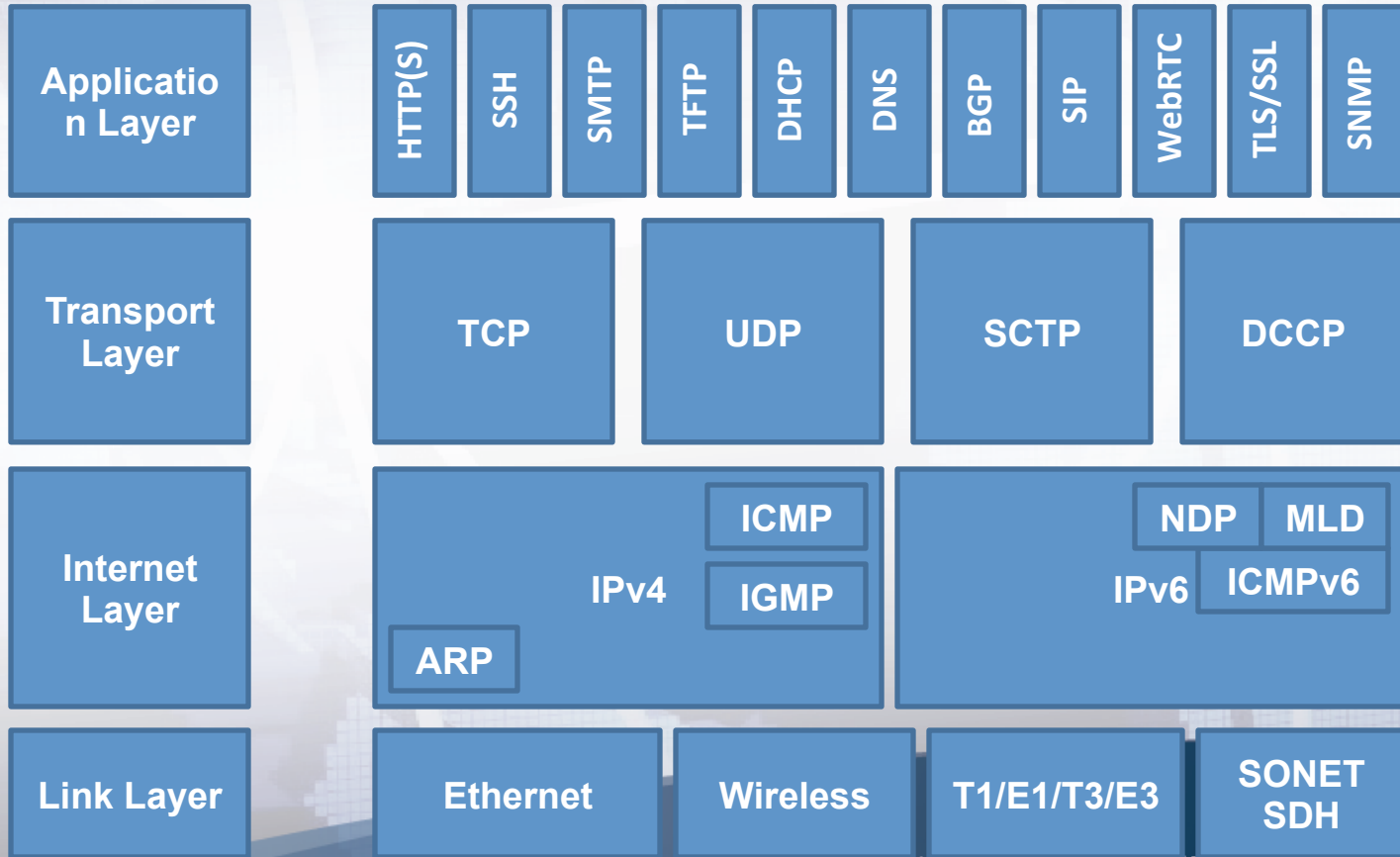
IPv6 Security Considerations

- Understand how IPv4 and IPv6 are different in terms of networking (NDP, extension headers, dynamic tunnels, ...)
- Don't deploy IPv6 if you lack the products to secure the protocol
- Don't be overly worried about IPv6 NDP security weaknesses
 - You haven't secured your IPv4 LANs either
 - <https://community.infoblox.com/blogs/2015/02/10/holding-ipv6-neighbor-discovery-higher-standard-security>

Troubleshooting Dual Protocol Networks

- Even if you do not deploy IPv6, there could still be IPv6-related issues that you must deal with.
- You now have IPv6-enabled nodes in your environment.
- Using a disciplined troubleshooting methodology will pay dividends when dealing with multi-part problems.
- Troubleshoot IPv6 in segments (LAN1, WAN, LAN2)
- Troubleshooting NDP requires a magnifying lens.
 - You may need to break out the protocol analyzer
 - Looking for an IPv6 needle in a haystack of IPv4

Troubleshooting Dual Protocol Networks



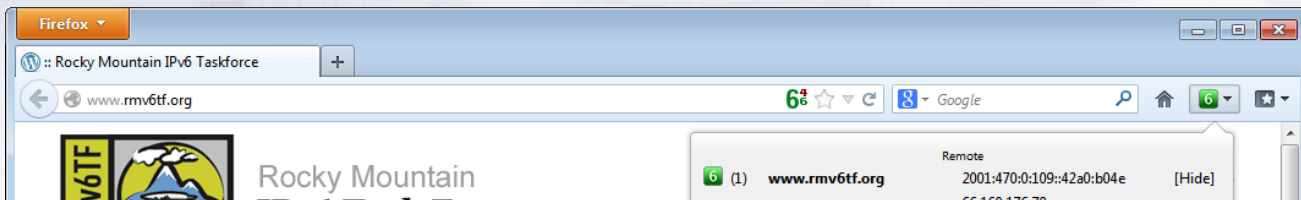
End-to-End IPv6 Troubleshooting

- Ping (ping6) (by name, by IP address, in both directions, specify source address, 1500-byte MTU)
 - Linux: `ping6 -I eth0 fe80::1`
 - Windows: `ping fe80::1%12`
 - Cisco: `ping fe80::1%GigabitEthernet0/0`
 - `ping -I 1500 2001:db8:dead:c0de::1`
- Traceroute (traceroute6), tracert
- Tcptraceroute6 (www.remlab.net/ndisc6/)
- Microsoft `C:\>pathping -6 2001:db8:11::1`
- `mtr -r6 www.rmv6tf.org c100` (www.bitwizard.nl/mtr/)
- Pchar, pathchar, iperf, jperf
- Netcat (`nc -6`), telnet, ssh, nmap `-6 -sT 2001:db8::1`

Troubleshooting Dual Protocol Networks

- Check yourself from the Internet-perspective
 - Leverage IPv6-capable looking glasses
 - Is your traffic really using IPv6?
- In a dual-protocol environment there are many tasks that will need to be performed twice (once for each IP version)
- Some connections could use IPv4 and/or IPv6
 - Web pages could be delivered over a combination of protocols. How do you know which protocol was used?
 - Browser add-ons, plug-ins can be helpful

IPv6 Browser Plug-ins, Add-Ons



| Remote | IP Address |
|------------------------------------|----------------------------------|
| http://www.rmv6tf.org | 2001:470:0:109::42a0:b04e |
| http://widgets.twimg.com | 93.184.216.139 |
| http://connect.facebook.net | 2600:1406:3:18400::seed |
| http://capitola.amerinoc.com | 216.17.111.5 |
| http://rmv6tf.org | 2001:470:0:109::42a0:b04e |
| http://fonts.googleapis.com | 2607:fb0:4001:c02::5f |
| http://www.google-analytics.com | 2607:fb0:400f:801::1007 |
| http://dym7iokkjiif.cloudfront.net | 216.137.39.35 |
| http://static.ak.facebook.com | 2001:559:0:52::6011:6ca1 |
| https://s-static.ak.facebook.com | 2600:1406:3:18100::236 |
| http://search.twitter.com | 199.59.148.84 |
| http://www.facebook.com | 2a03:2880:10:c:f01:face:b00:c:04 |
| http://a0.twimg.com | 93.184.216.169 |
| http://profile.ak.fbcdn.net | 2001:559:0:52::b854:b732 |
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About The RMv6TF
The Rocky Mountain IPv6 Task Force is a regional sub-chapter of the North American IPv6 Task Force. The IPv6 Task Force is dedicated to the advancement and adoption of the Internet Protocol version 6 (IPv6).

The RMv6TF promotes IPv6 and works to educate the community on IPv6 and its benefits. The RMv6TF performs research and development and showcases IPv6 technology and services and shares this knowledge with the public. The RMv6TF works to put on local IPv6-focused events and further the use of IPv6 within the Rocky Mountain region. The RMv6TF is a non-profit/tax-exempt organization that industry and government can look to for guidance on IPv6 transition information and advice about best practices and solutions involving IPv6.

2013 North American IPv6 Summit
The 2013 North America IPv6 Summit is currently being planned for April 17-19, 2013 at the Grand Hyatt Denver Colorado. More details about the event can be found at the following link.
[Click Here to Find Out More About the 2013 IPv6 Summit](#)

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Thank You!

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