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 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 requireing 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)

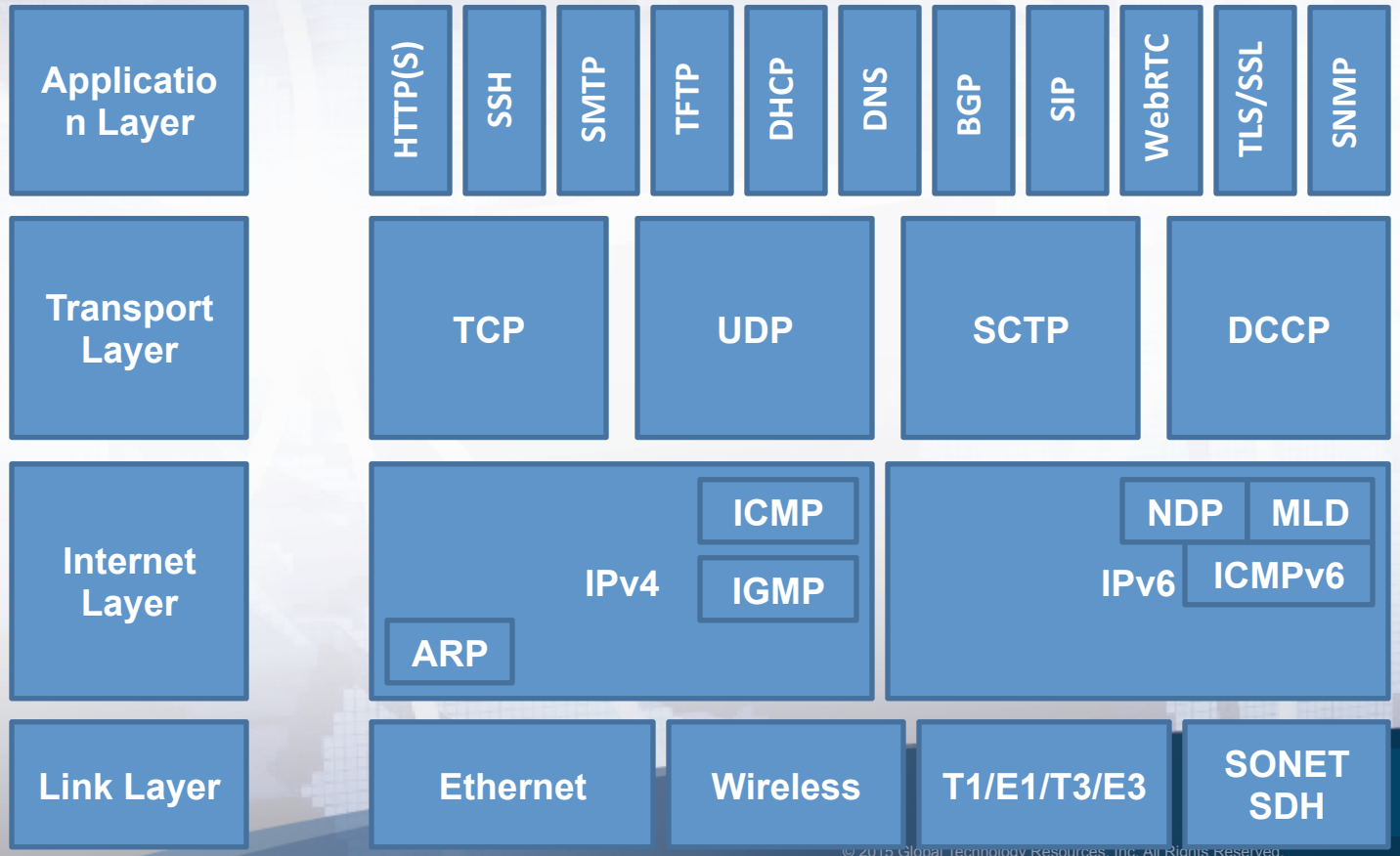
IPv6 Security Considerations

- 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 -l 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