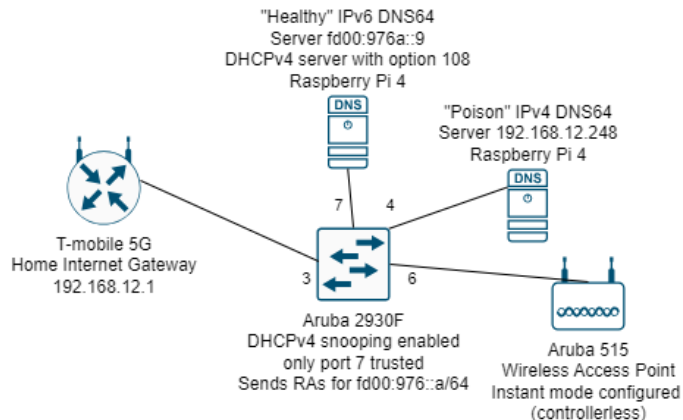


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Improving transition to IPv6-only via RFC8925 and IPv4 DNS Interventions



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THE HEXADECIMAL ELEPHANT IN THE ROOM

Argonne loans 32,768 IPv4 addresses to SCinet every year

- Why do we need IPv6 at SC24 given SCinet's IPv4 surplus?
 - Worldwide LHC Computing Grid <https://twiki.cern.ch/twiki/bin/view/LCG/Wlclpv6>
 - SC23's RFC8925 deployment was successful <https://www.osti.gov/biblio/2438319>
- Why does IPv6-only matter for data-intensive science?
 - IoT sensors on 4G/5G Cellular do not need to fight IPv4 CGNAT
 - <https://www.anl.gov/mcs/waggle-an-open-platform-for-intelligent-attentive-sensors>
 - FFRDCs need to comply with IPv6 government mandates
 - <https://www.whitehouse.gov/wp-content/uploads/2020/11/M-21-07.pdf>
 - DOE National Laboratories need to comply with order 200.1A
 - <https://www.directives.doe.gov/directives-documents/200-series/0200-1-border-a-chg2-ltdchg>

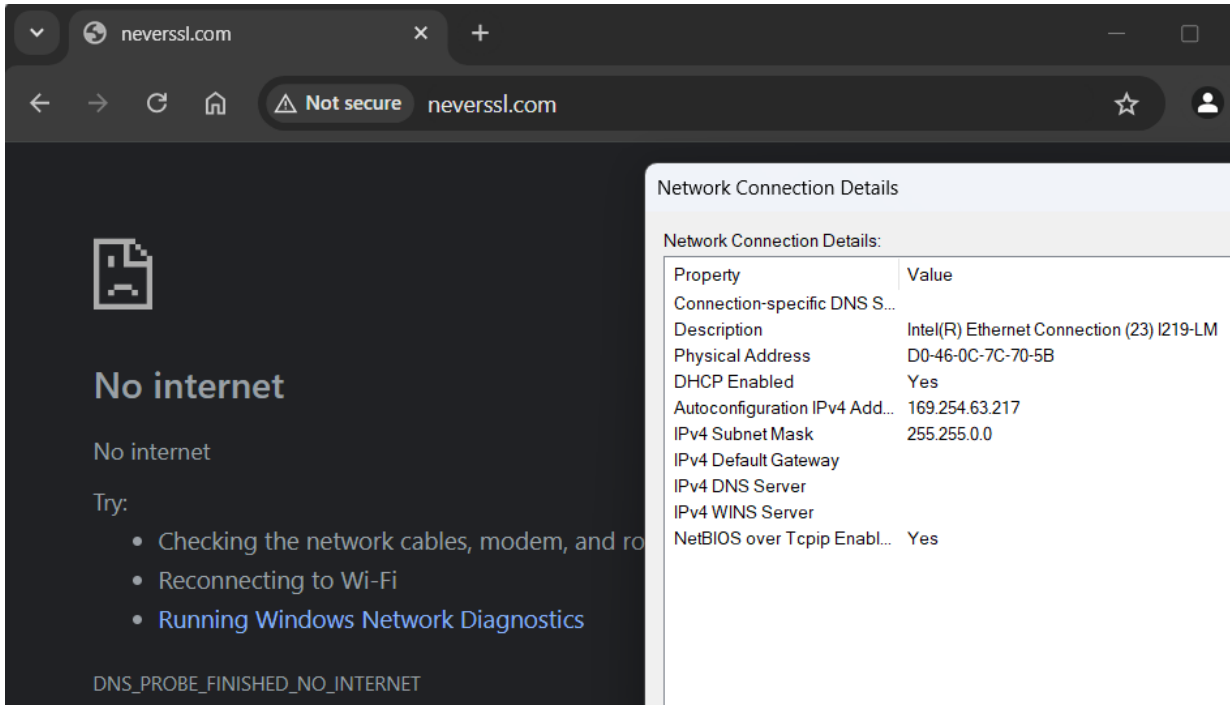
THE SC23V6 RFC8925 DILEMMA

“IPv6-mostly” is great, but it is not perfect

- Devices with IPv6 disabled could still use SC23v6 SSID
 - Leaves attendees thinking they’re successfully using IPv6 when they are not
 - Difficult to determine how many SC23v6 clients were operating IPv6-only
- Devices supporting RFC8925 but blocking IPv6 traffic lose ALL connectivity
 - This was the main reason we didn’t do RFC8925 on the main SC23 SSID
 - <https://datatracker.ietf.org/doc/draft-link-v6ops-6mops/> section 7.3.1
- We want a way to inform clients they are not in compliance with IPv6 mandates
 - Simply breaking IPv4 internet connectivity on SC24v6 would be poor UX

V4-ONLY USER EXPERIENCE ON V6-ONLY NETS

Is WiFi bad? Is upstream connectivity broken? NAC issue?



The screenshot shows a browser window with the address bar displaying 'neverssl.com'. The page content is a 'No internet' error message with a sad face icon. Below the error message, there are instructions to 'Try:' and a list of troubleshooting steps: 'Checking the network cables, modem, and router', 'Reconnecting to Wi-Fi', and 'Running Windows Network Diagnostics'. A 'Network Connection Details' window is open on the right side of the browser, showing a table of network properties for an Intel(R) Ethernet Connection (23) I219-LM.

No internet

No internet

Try:

- Checking the network cables, modem, and router
- Reconnecting to Wi-Fi
- [Running Windows Network Diagnostics](#)

DNS_PROBE_FINISHED_NO_INTERNET

Network Connection Details

Network Connection Details:

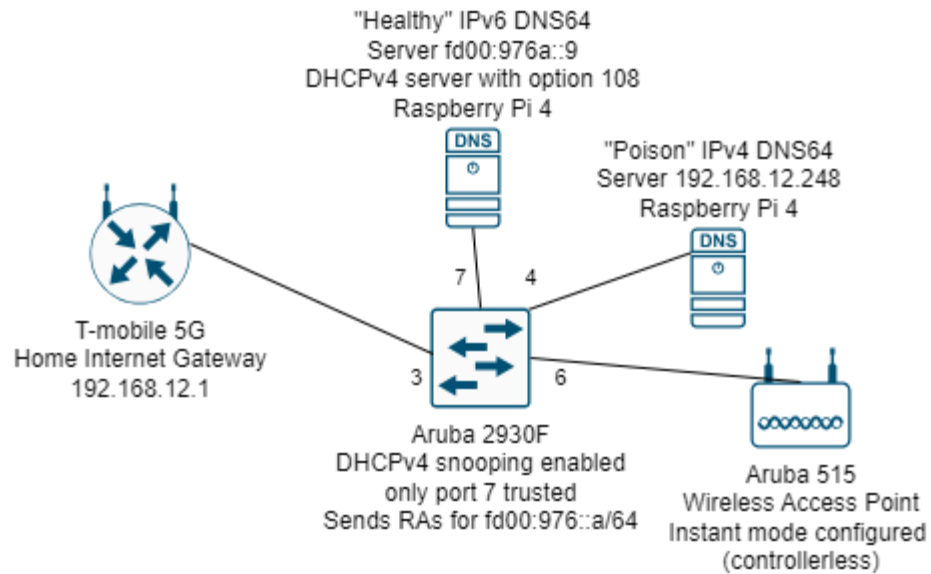
Property	Value
Connection-specific DNS S...	
Description	Intel(R) Ethernet Connection (23) I219-LM
Physical Address	D0-46-0C-7C-70-5B
DHCP Enabled	Yes
Autoconfiguration IPv4 Add...	169.254.63.217
IPv4 Subnet Mask	255.255.0.0
IPv4 Default Gateway	
IPv4 DNS Server	
IPv4 WINS Server	
NetBIOS over Tcpi...	Yes

IN-FLIGHT WIFI FOR V4, SCINET WIFI FOR V6

Can we solve this poor UX problem without creating more problems?

- Discussion after SC23 about IPv4 captive portal policy on SC24v6 SSID
 - **MUST NOT** have any impact on IPv6-only clients (CLAT or DNS64)
 - **SHOULD NOT** have any impact on dual-stack clients using DNS64
 - This is also highly desired for Argonne's WiFi deployment
- Initial goal of redirecting IPv4-only clients to test-ipv6.com
 - Makes it obvious that lack of IPv6 support is why internet is unavailable
 - Redirect may be changed to custom test-ipv6.com mirror with remediation advice
- Attempts to implement this on wireless controller without an AAA server failed
 - This failure led to us trying the poisoned DNS server idea, which worked well

TESTBED TOPOLOGY



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V4-ONLY USER EXPERIENCE ON TESTBED NET

No IPv6 connectivity is obvious, helpdesk can quickly triage



Test your IPv6. x + - □

Not secure neverssl.com

Test IPv6 FAQ Mirrors stats

Test your IPv6 connectivity.

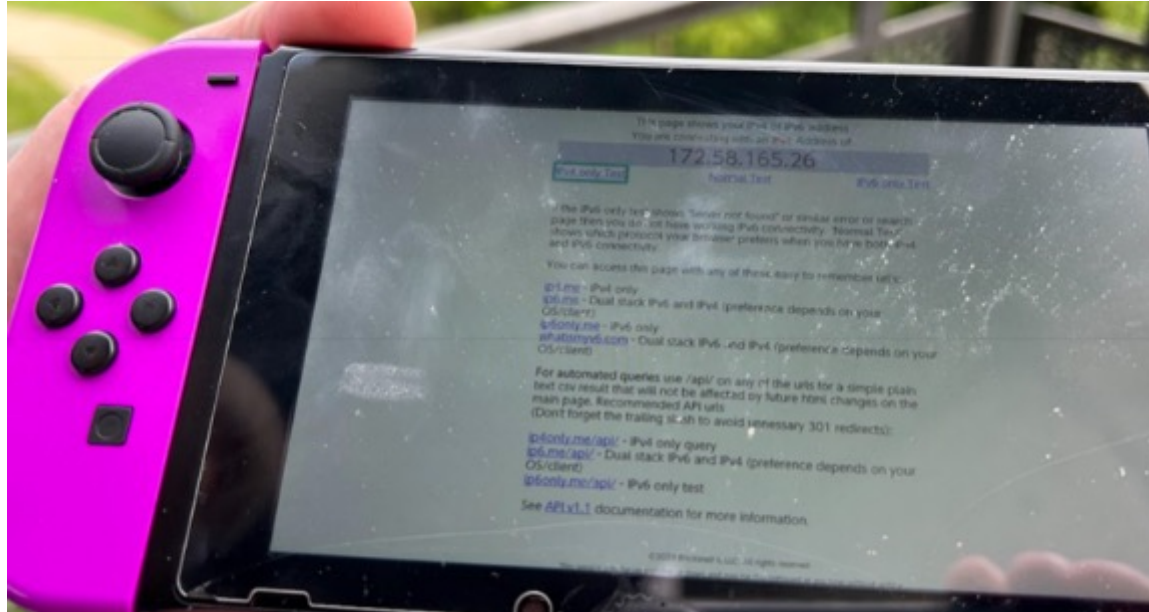
For the Help Desk Summary Tests Run Share Results / Contact

Other IPv6 Sites

- Your IPv4 address on the public Internet appears to be 172.56.17.34
- Your Internet Service Provider (ISP) appears to be T-MOBILE-AS21928, US
- Since you have IPv6, we are including a tab that shows how well you can reach other IPv6 sites. [\[more info\]](#)
- No IPv6 address detected [\[more info\]](#)
- To ensure the best Internet performance and connectivity, ask your ISP about native IPv6. [\[more info\]](#)
- Your DNS server (possibly run by your ISP) appears to have IPv6 Internet access.

Your readiness score

10/10 for your IPv6 stability and readiness, when publishers are forced to go IPv6 only



LESSONS LEARNED

```
C:\Users\tcost>nslookup vpn.anl.gov
Server: Unknown
Address: 130.202.36.253

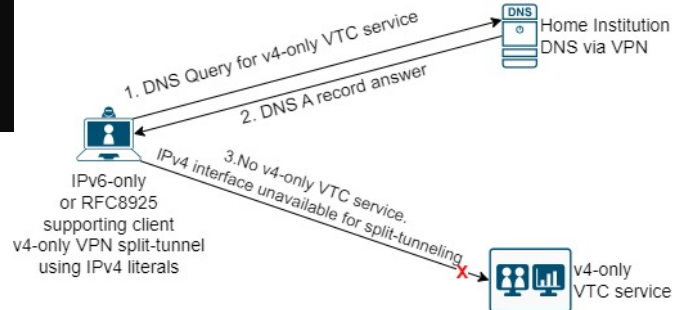
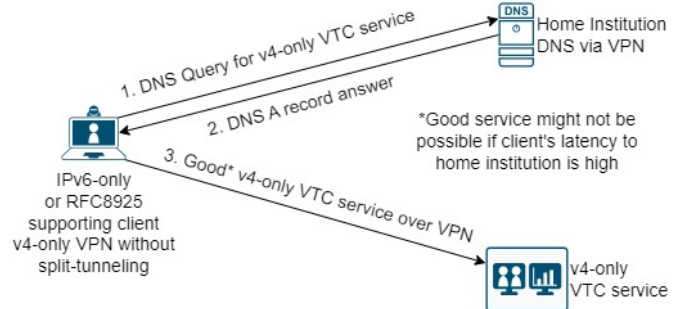
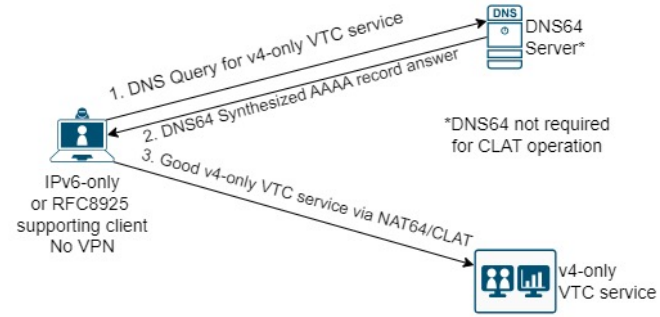
Name: vpn.anl.gov.rfc8925.com
Address: 23.153.8.71
```

```
C:\Users\tcost>ping -n 1 vpn.anl.gov
```

```
Pinging vpn.anl.gov [64:ff9b::82ca:e4fd] with 32 bytes of data:
Reply from 64:ff9b::82ca:e4fd: time=3ms
```

```
# Forward all AAAA record queries to healthy DNS64 server=192.168.12.251
```

```
# Provide a specific A record response for all A record queries
# ip4.me
address=#/23.153.8.71
# test-ipv6.com
address=#/69.164.221.187
```

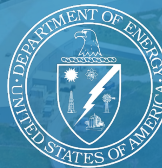


TRY IT NOW!

SC24v6 SSID is based on this INDIS paper's results

- Main difference is redirect to test-ipv6.24.sconf.org
 - Custom mirror allows us to modify results, tell users to visit SCinet helpdesk
 - Visit booth 2049 Wed Nov 20, 11:20am, for presentation on this
- Eduroam is double-edged sword
 - Seamless roaming from home institution onto SCinet secure WiFi is great
 - Many attendees stay on Eduroam without considering other SSID choices
 - Desire to treat Eduroam as “control group” SSID, always dual-stacked
 - RFC7593 (Eduroam Architecture) may need an IPv6 refresh after SC24...

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