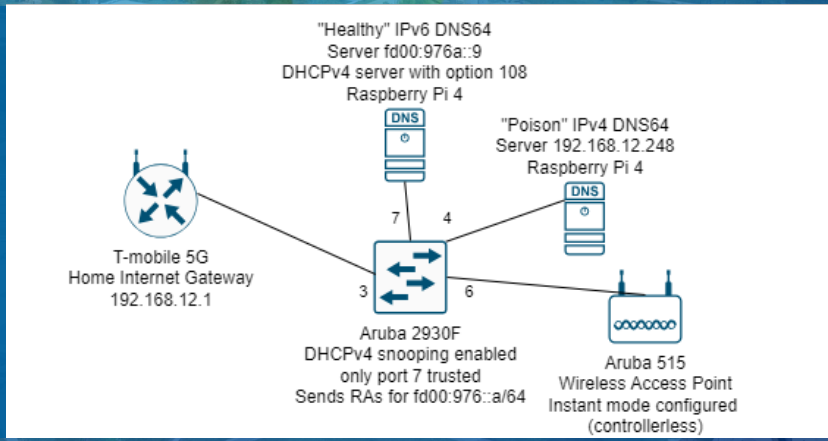
18 NOV 2024

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/WlcgIpv6
  - 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

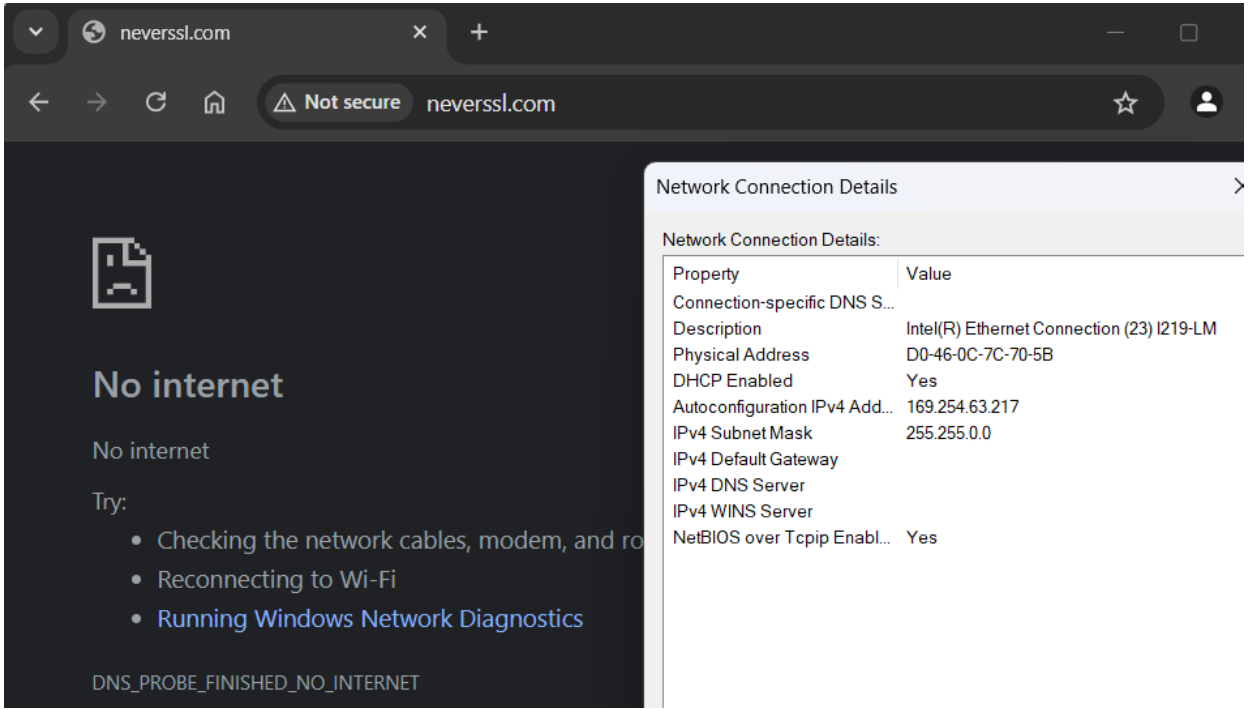
- Devices with IPv6 disabled could still use SC23v6 SSID
  - Leaves attendees thinking they're successfully using IPv6 when they are not
  - Difficult to determine how many SC23v6 clients were operating IPv6-only

- 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?



IN-FLIGHT WIFI FOR V4, SCINET WIFI FOR V6

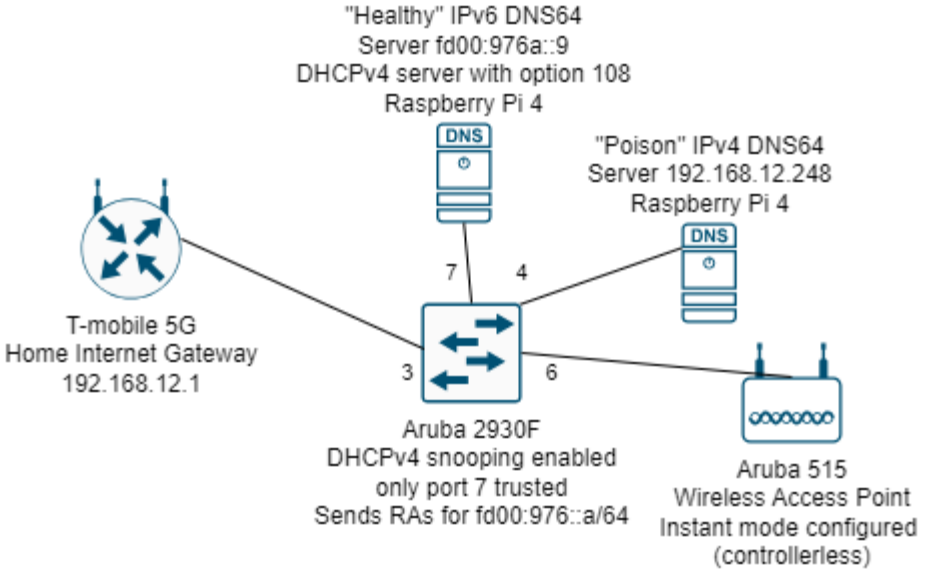
Can we solve this poor UX problem without creating more problems?

- 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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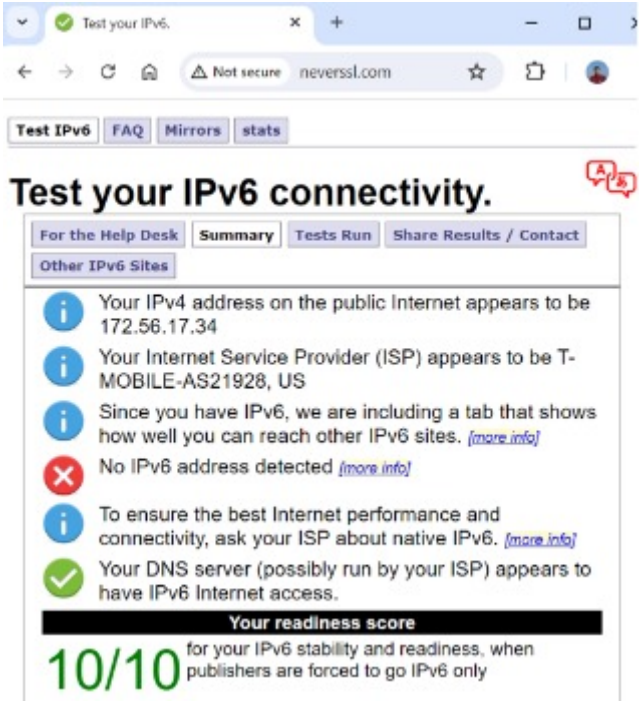
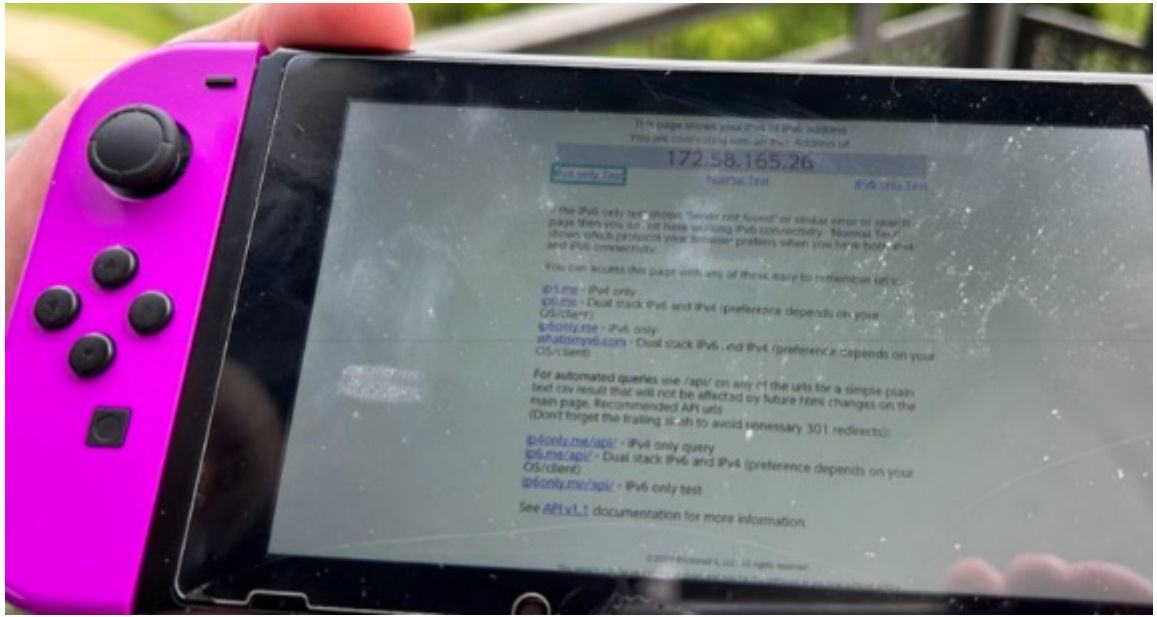
V4-ONLY USER EXPERIENCE ON TESTBED NET

No IPv6 connectivity is obvious, helpdesk can quickly triage

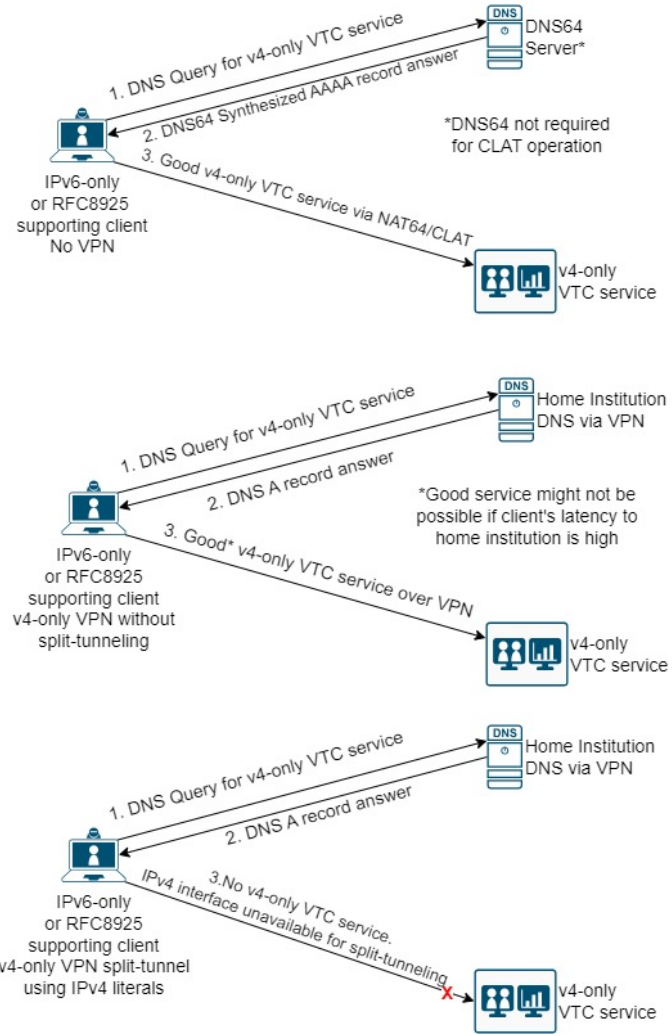




LESSONS LEARNED

```
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
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
```

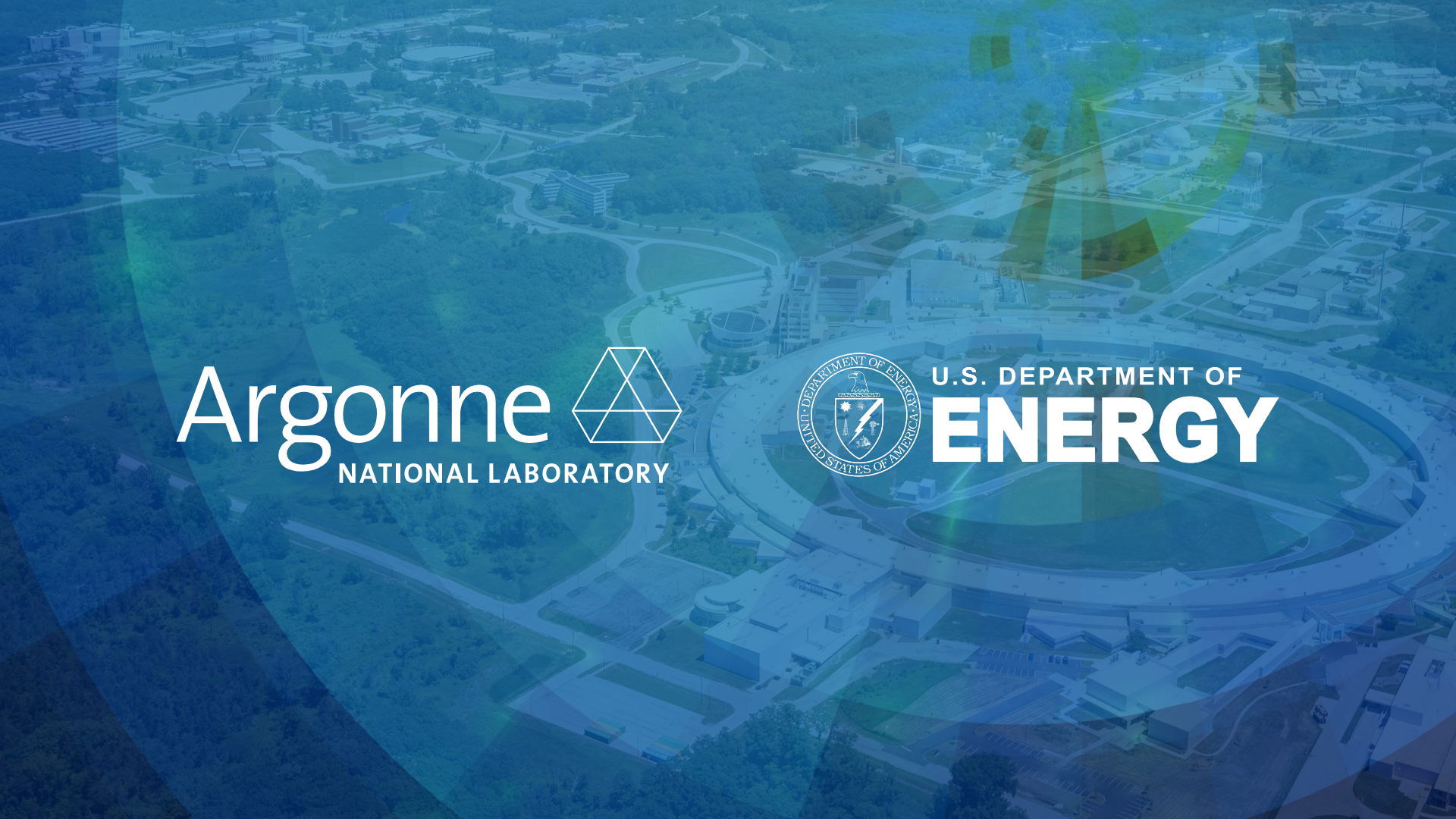


TRY IT NOW!

SC24v6 SSID is based on this INDIS paper's results

- Main difference is redirect to test-ipv6.24.scconf.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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