



Benefits of IPv6 For Software Development

Chris Cummings

Full Stack Network Automation Software Engineer

Energy Sciences Network (ESnet)
Lawrence Berkeley National Laboratory
U.S. Department of Energy

2023 UK IPv6 Council Annual Meeting

November 21, 2023

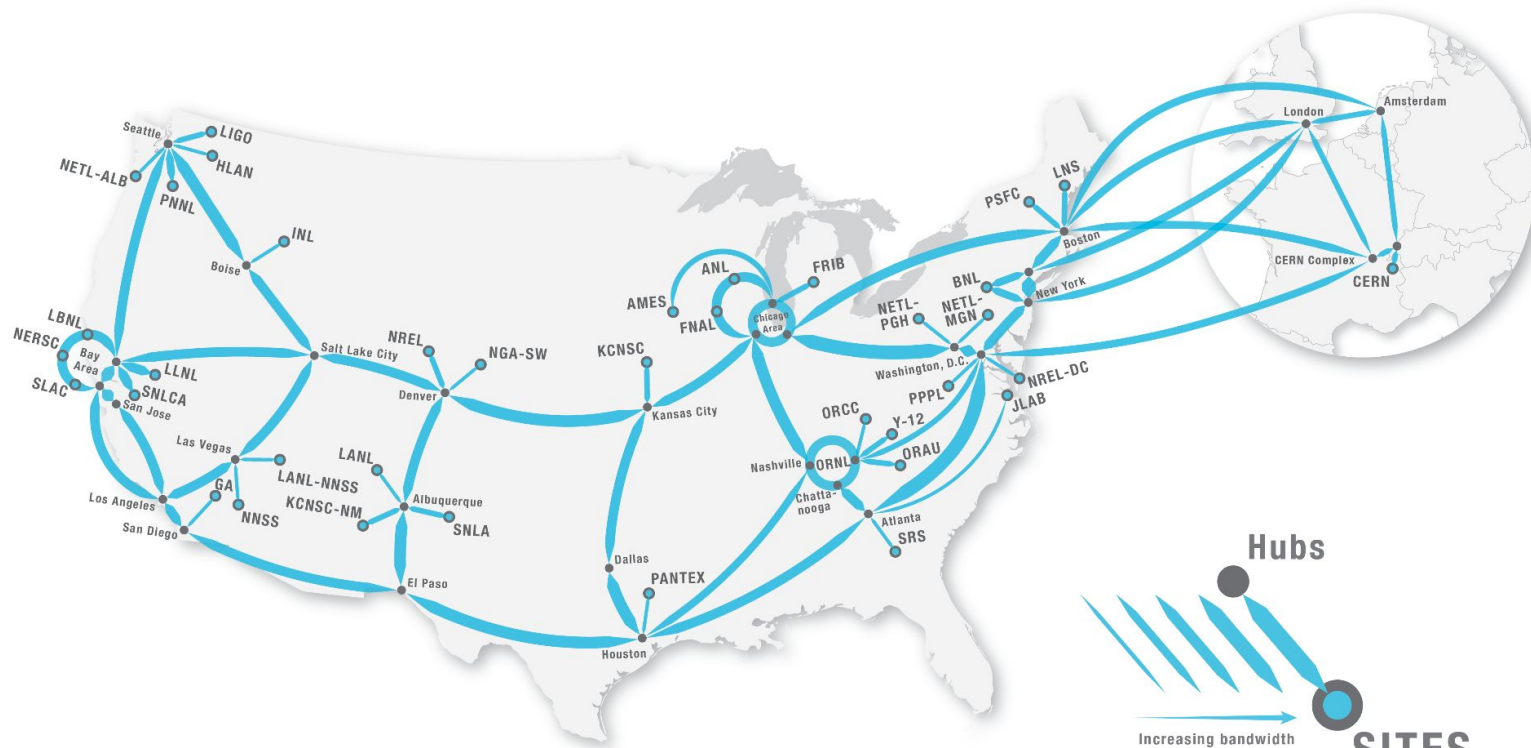


Overview

- ESnet and R&E Networks
- How v6 Can Help You
- Traps and Pitfalls
- Tips and Tricks
- Conclusions
- Q&A

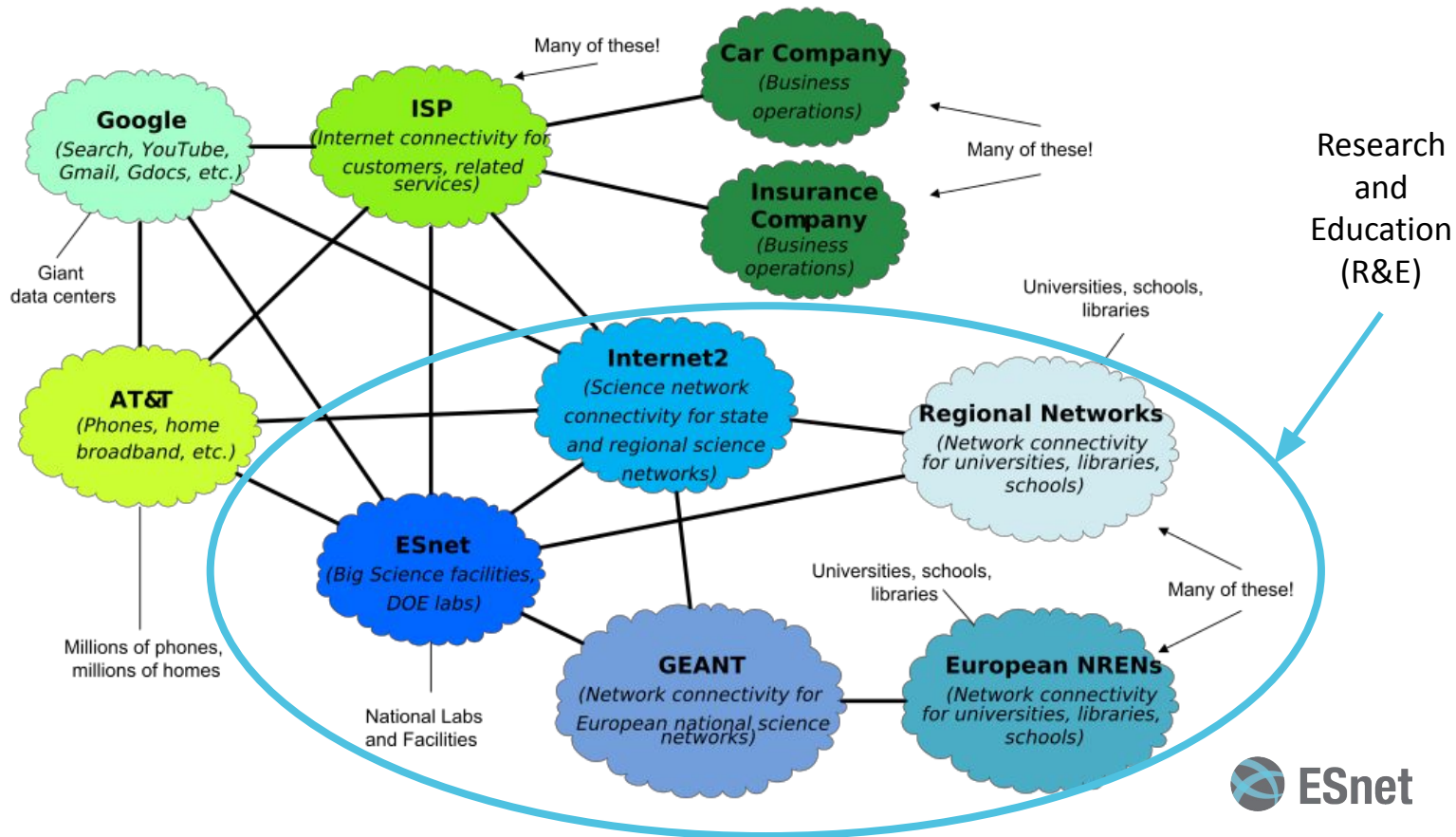
ESnet6

What is ESnet?



*Locations generalized for clarity

What is an R&E Network?



R&E vs. Commercial ISPs:

Normal ISP:[1]



ESnet:[2]



How v6 Can Help You

Ease of Development and Management

- No NAT to worry about!
- NAT traversal is *complicated*^[3]
- End-to-End Connectivity reduces complexity
- Lower latency^[4] means better customer satisfaction!
- IP addresses in logs aren't masked by NAT

Cost Savings

- CSPs are starting to charge for IPv4^[5]
- End-to-End makes troubleshooting easier
- You get to change on your own timeline

Aligning with Rules and Regulations

- Apple now requires IPv6 only support!^[6]
- Working with the US Federal government? Better run v6!
- Many governing bodies have started making v6 a requirement

Excuse for Fixing Tech Debt

- Now you can get rid of hardcoded IPs!
- A great chance to update your stale libraries!
- Fix that bad parsing engine!
- Move your DB schemas towards proper IP storage
- Fix misuse of sockets to support multiple IP layers (AI_UNSPEC)

Traps and Pitfalls

Development Environments

- Docker *still* has some issues.
- Kubernetes 3rd party applications seem to lag in v6 (core is fine)
- Many enterprise IT solutions still muck with v6
- Delay in infrastructure teams rolling out v6 to datacenters
- Github

Impact of v6 Deployment Methods

- Source Address Selection can be tricky (ULA, *cough*)
- IPv6 Only, IPv6 Mostly, Dual Stack, CLAT, XLAT... All behave differently
- Dealing with multiple IPs per device is a paradigm shift for some.
- Ships in the night—Potentially different datapaths!

There Be Dragons

- IPv4 can be easily enumerated...IPv6, not so much!
- Hardcoding addresses will bite you.
- Don't assume a single AF (until we disable v4!)
- Give both AFs equal attention!

Tips and Tricks

Tips

- Your inputs and validations must support both AFs!
- Displaying addresses might take up a bit more room now.
- Make sure your tests (you have those, right?) cover v6.
- When monitoring your application health, monitor both paths.
- Make sure your logging output contains the right information.
- IPv6 is BIG. Use it!

Horley Math

“At a run rate of 10 million containers per second, a standard /48 that you would allocate to a data center for docker hosts it would take you 3.8 billion years to consume all the IPv6.”

—

Ed Horley^[7]

Testing for IPv6

- Make sure you test in all v6 deployment scenarios!
- Coming Soon: Portable IPv6 Test Pods!^[8]
- Make sure security tools are looking at v6 too.

Conclusions

Conclusions

- Write your software for the future (it's here!)
- Why buy two protocols when you can have one for half the price!
- Translation mechanisms are mature—Ask IT to turn off v4!
- Be careful—But don't be scared
- Use v6 on your terms—Don't wait until you're forced to!

Questions?

References

- [1] Title: “High Five”, Author: [austrini](#), Source: [WikiMedia Commons](#), License: [CC BY 2.0](#)
- [2] Title: “Shinkansen N700 with Mount Fuji”, Author: [tansaisuketti](#), Source: [WikiMedia Commons](#), License: [CC BY-SA 3.0](#)
- [3] <https://tailscale.com/blog/how-nat-traversal-works/>
- [4] [Scott Hogg on Infoblox Blog](#)

References

- [5] [AWS Charging for IPv4](#)
- [6] <https://developer.apple.com/support/ipv6/>
- [7] [IPv6 and Docker — Ed Horley](#)
- [8] [ARIN IPv6 Test Pod Grant](#)