

Using ESnet SmartNIC for Line Rate IPv6 Translation on FPGAs

Chris Cummings
Network Automation Software Engineer

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

TNC24

Rennes, France

June 2024

Problem Space

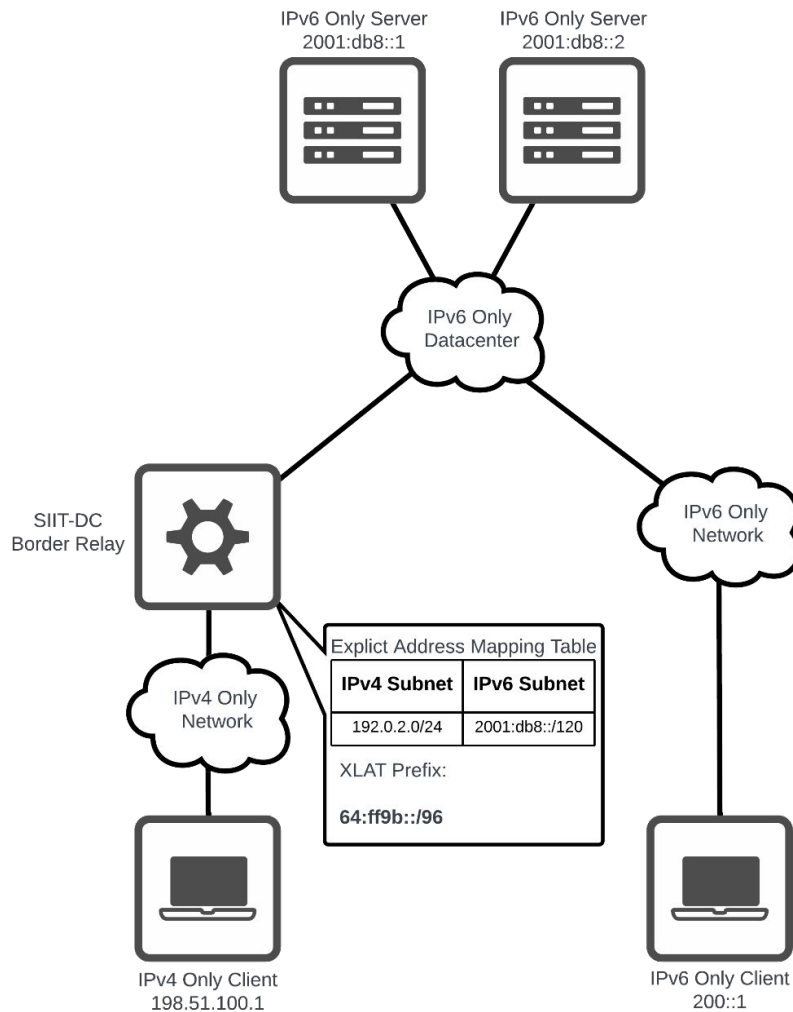
- IPv6: The future is here, but not *all* the way here
- Some things can't be upgraded for IPv6 (expensive scientific instruments)
- Dual-stacking isn't necessarily the right solution anymore (OMB M-21-07)
- v4-only and v6-only segments still need to communicate... How?
- There is a tried-and-true solution...

NETWORK PROBLEMS

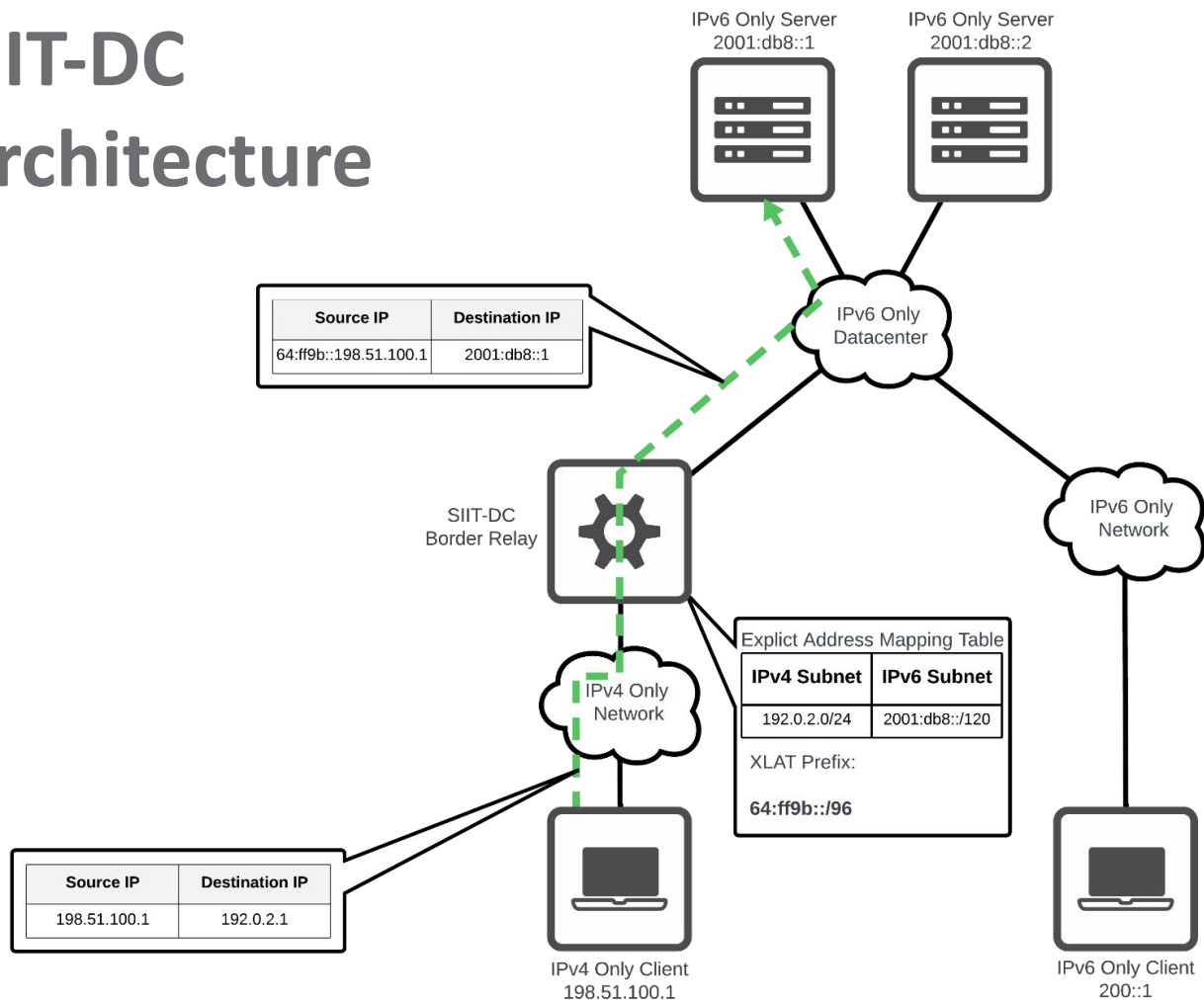
ENGINEERS

NAT

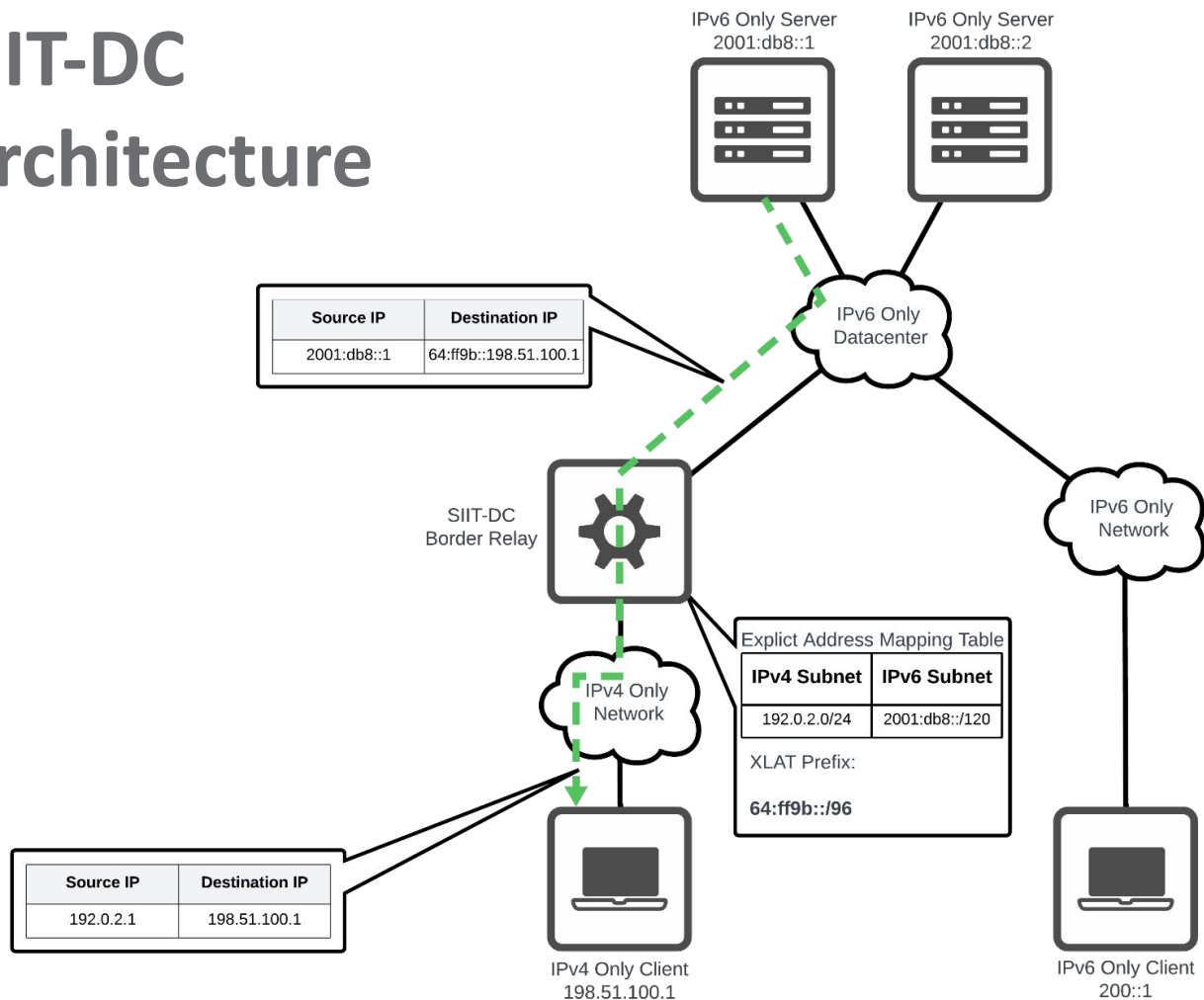
SIIT-DC Architecture



SIIT-DC Architecture



SIIT-DC Architecture



Why Build Your Own?

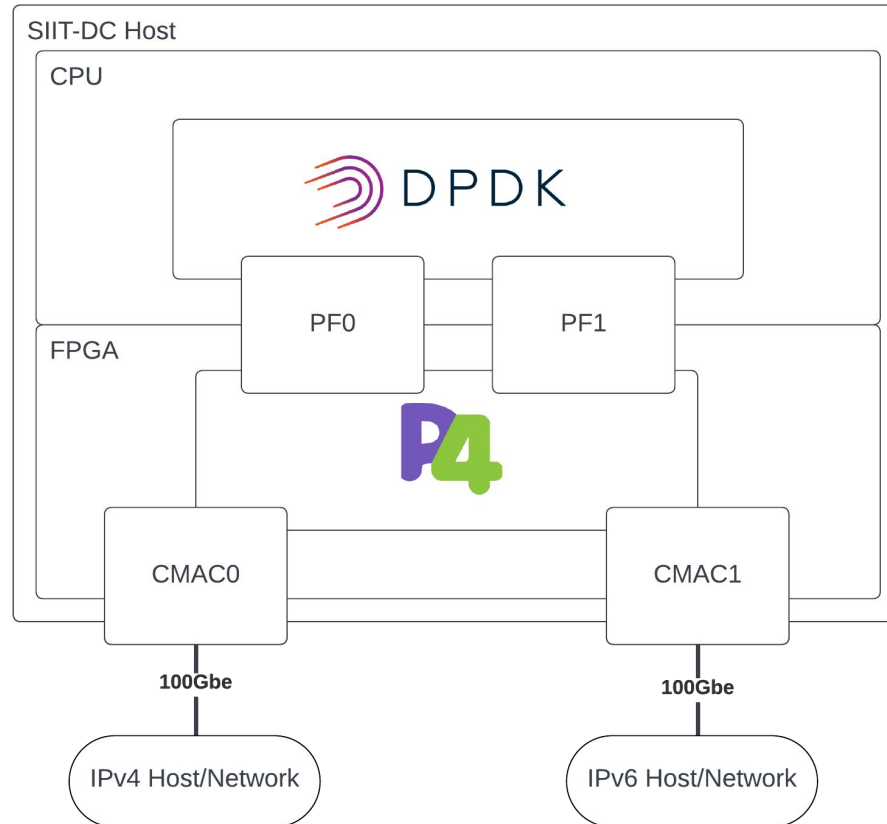
- NRENs face unique challenges, specifically with large science flows
- We couldn't find any SIIT-DC translators that actually run in hardware
- General purpose CPU is great... *in aggregate*
- ESnet SmartNIC lets you build *fast* hardware applications *fast*.

Hardware

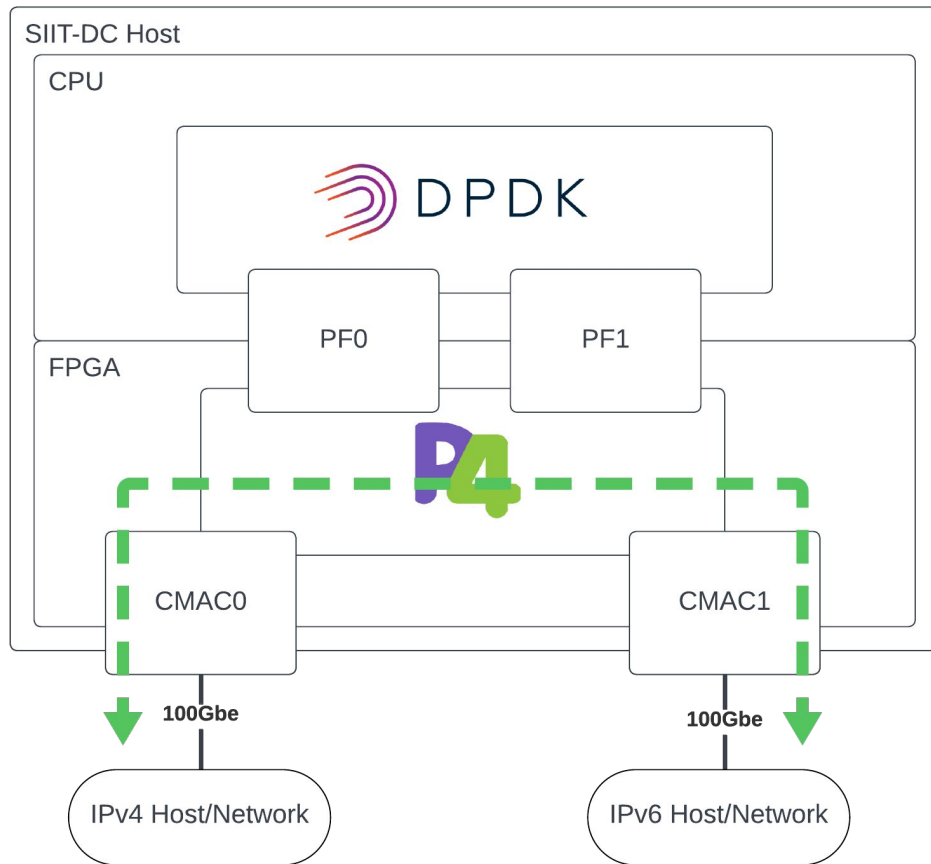
- Xilinx Alveo U280 FPGA^[3]
- 2x 100GbE Ethernet CMAC interfaces
- 8x PCIe Gen4 Lanes
- Intel Xeon E5-2670 CPU in Host Server



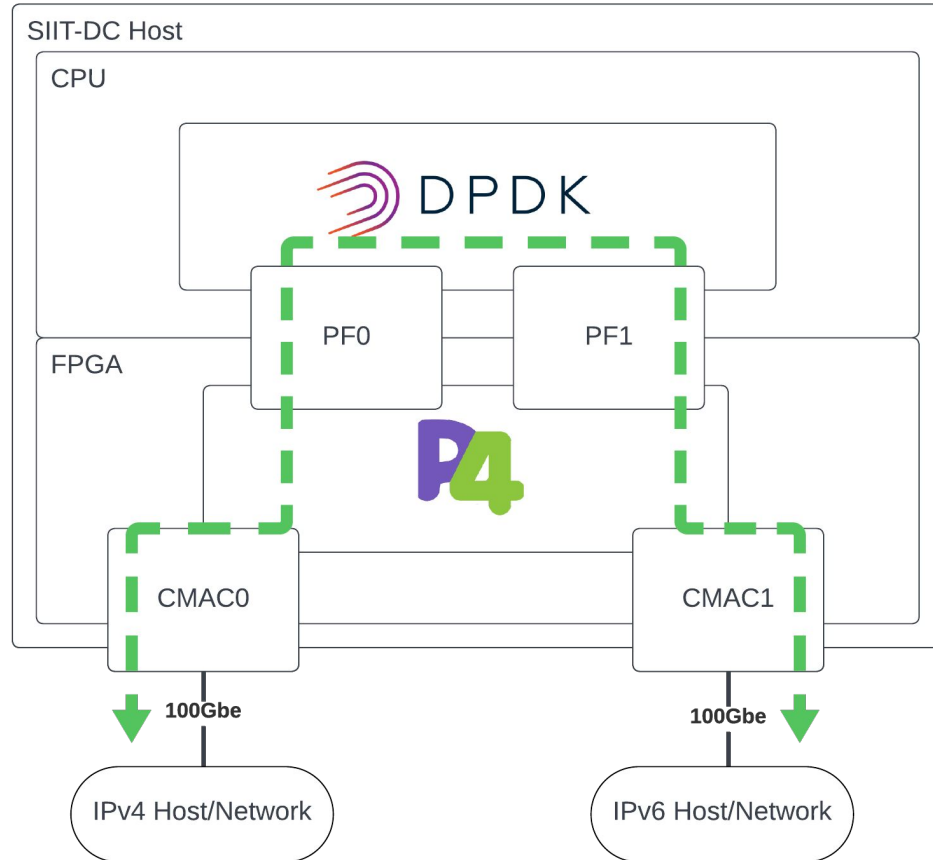
Architecture



Fast Path Overview



“Slow” Path Overview



What is ESnet SmartNIC?

- Framework for developing FPGA-based applications
- Helps you deploy your FPGA-based applications
- Uses docker compose
- Repos Links:
 - [esnet-smartnic-fw](#)
 - [esnet-smartnic-hw](#)

Special Thanks!

Sean Cummings, IIT/ESnet

Dr. Nik Sultana, IIT

Mohammad Firas Sada, IIT

Yatish Kumar, ESnet

Stacey Sheldon, ESnet

Scott Richmond, ESnet

Peter Bengough, ESnet

You!

Questions?

- Contact Us:
 - Sean Cummings
 - scummings@hawk.iit.edu
 - <https://www.linkedin.com/in/sean-cummings-6968061b4/>
 - Chris Cummings
 - chriscummings@es.net
 - <https://www.linkedin.com/in/chriscummingsak/>

References

- [1] Title: “Shinkansen N700 with Mount Fuji”, Author: [tansaisuketti](#), Source: [WikiMedia Commons](#), License: [CC BY-SA 3.0](#)
- [2] Title: “High Five”, Author: [austrini](#), Source: [WikiMedia Commons](#), License: [CC BY 2.0](#)
- [3] Title: “Alveo U280 Data Center Accelerator Card”, Author: AMD Xilinx, Source: [AMD Xilinx U280 Product Page](#)