



ESnet

ENERGY SCIENCES NETWORK

ESnet HPC & Cloud Connectivity

Dale W. Carder

Lawrence Berkeley National Laboratory

Workshop for USATLAS-USCMS HPC/Cloud Blueprint
2022-09-26



U.S. DEPARTMENT OF
ENERGY

Office of Science



DOE HPC (and US Tier-1) Connectivity

- ESnet6 built physical network into each DOE national lab
 - ex: ANL, BNL, FNAL, LBNL (NERSC), ORNL
 - optical system is open, can source modems from any vendor
 - extremely cost-effective
 - ESnet6 routers on-site, can offer all services consistently
 - site upgrades from $n \times 100\text{G}$ to $n \times 400\text{G}$ underway now
 - NERSC targeting 1Tbit/sec
- personal opinion:
 - site infrastructure (border routers, security stuff, dtn's, storage) will be a more limiting factor than the wide-area network during ESnet6
 - wide disparity in HPC support for data-centric workflows



Cloud Connectivity options

Public Cloud

- Use cloud provider's public facing network
- Direct peering (\$)

Private Cloud

- use cases: BYO (Private) addressing, connect back to home institution
- Dedicated Interconnect (1Gbps or greater) -\$\$\$\$
- Partner Interconnection (Hosted & Dedicated from 50Mbps) -\$\$
- Cloud Exchange - \$\$\$

ESnet Cloud Connectivity today

Public Cloud

- via private fiber interconnects
 - 3x100G to Google (Seattle, Chicago, NYC)
 - 6x100G to Oracle
- Shared fabrics
 - 5x100G to Microsoft
 - 5x100G to Amazon

Private Cloud

- Partner Interconnection (Hosted & Dedicated from 50Mbps) -\$\$
 - 10x100G to PacketFabric
- Cloud Exchange
 - 2x10G, likely will be deprecated



Additional items

- API for dynamic Layer 2 circuits
- Internal automation for dynamic L3vpn instantiation
- Integration with Rucio via SENSE
- DOE Integrated Research Infrastructure (IRI)
- FPGA acceleration

Ecosystem connectivity

- Some NSF HPC sites are particularly well connected
 - some are not!
- US Universities & regional networks
 - ESnet coordinating 1:1 with every US T2 for HL-LHC
- LHCONE and AUP issues
 - defacto usage of IP addresses as authorization tokens
 - very unclear path for integrating cloud sites
- Trans-atlantic scale
 - ESnet currently 5x100, additional 2x400 links in progress