ESnet

ENERGY SCIENCES NETWORK

ESnet6 Project Overview JET Meeting

Patty Giuntoli

ESnet6 Project Director

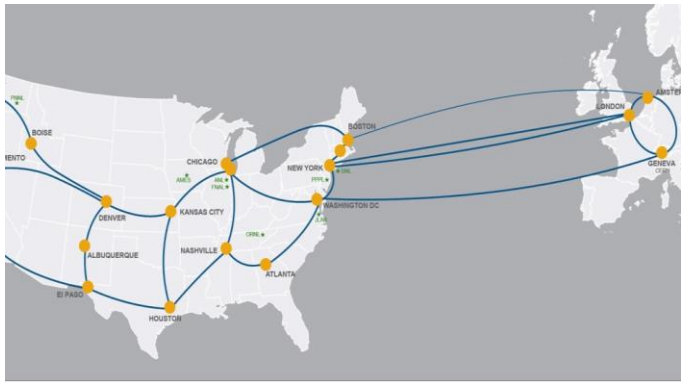
18-September-2018

U.S. DEPARTMENT OF ENERGY

Office of Science

BERKELEY LAB

ESnet is a dedicated mission network engineered to accelerate a broad range of science outcomes.



ESnet5 has provided unique capabilities, optimized for science, since 2011

ESnet's scientific facility infrastructure is nearing end-of-life and capacity demands continue to increase, driving the need for a new network: ESnet6

To continue to meet Mission needs, capability gaps must be resolved:

- Capacity: Network must be able to serve increasing science demand
- Reliability and Resiliency: Replace end-of-life equipment, improve cybersecurity protection
- Flexibility: Network needs to adapt to changing compute models, multi-facility workflows, real-time data analysis, streaming

SC approved ESnet6 CD-1/3A August 3, 2018

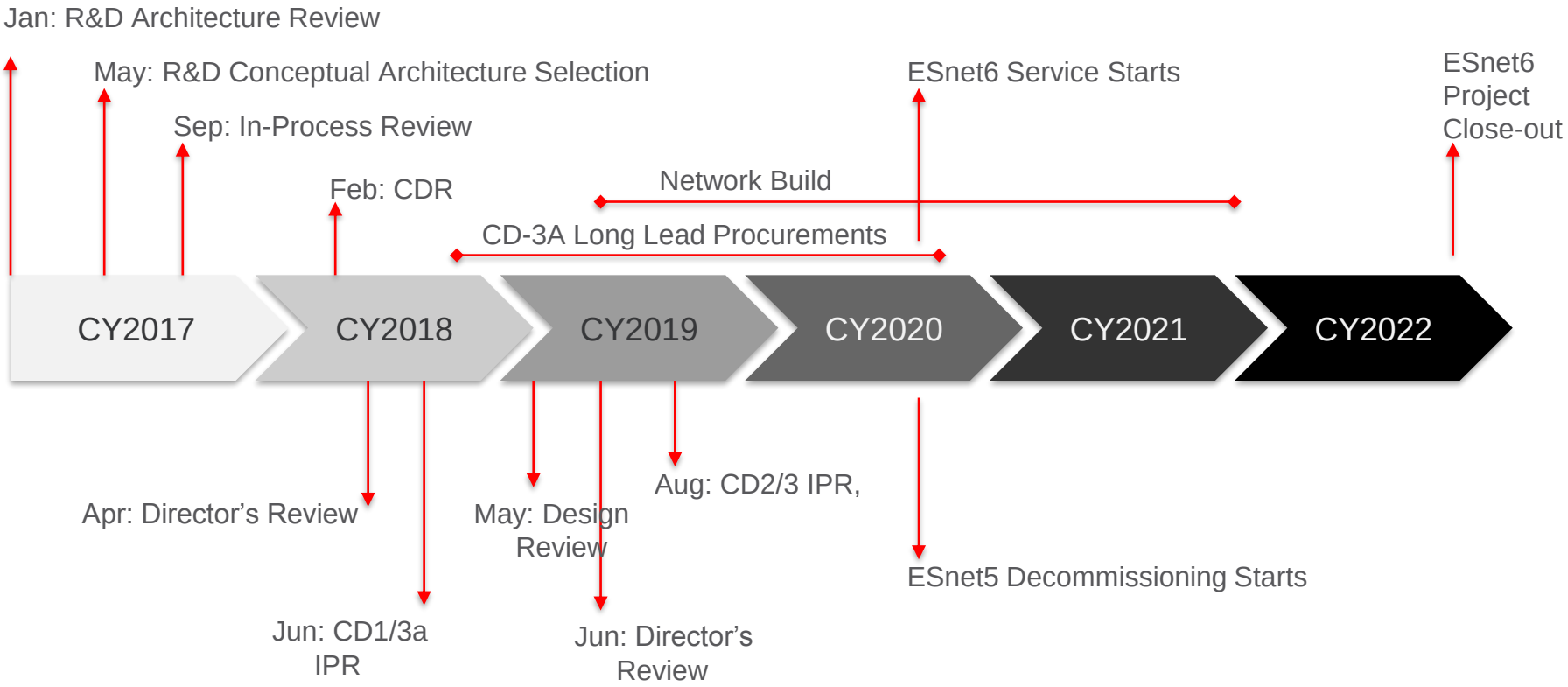
ESnet

ESnet6: Level 1 (Critical Decision) Milestones

Level 1 Milestone	Date
CD0: Approve Mission Need	5-December-2016 (Actual)
CD1: Approve Alternative selection, Conceptual Design and Cost Range	3-August 2018 (Actual)
CD3a: Approve Long Lead Procurement Authority	3-August 2018 (Actual)
CD2/3: Approve Performance Baseline/Start of Construction	4QFY2019
CD4: Approve Project Completion (includes 12 month schedule float)	1QFY2024

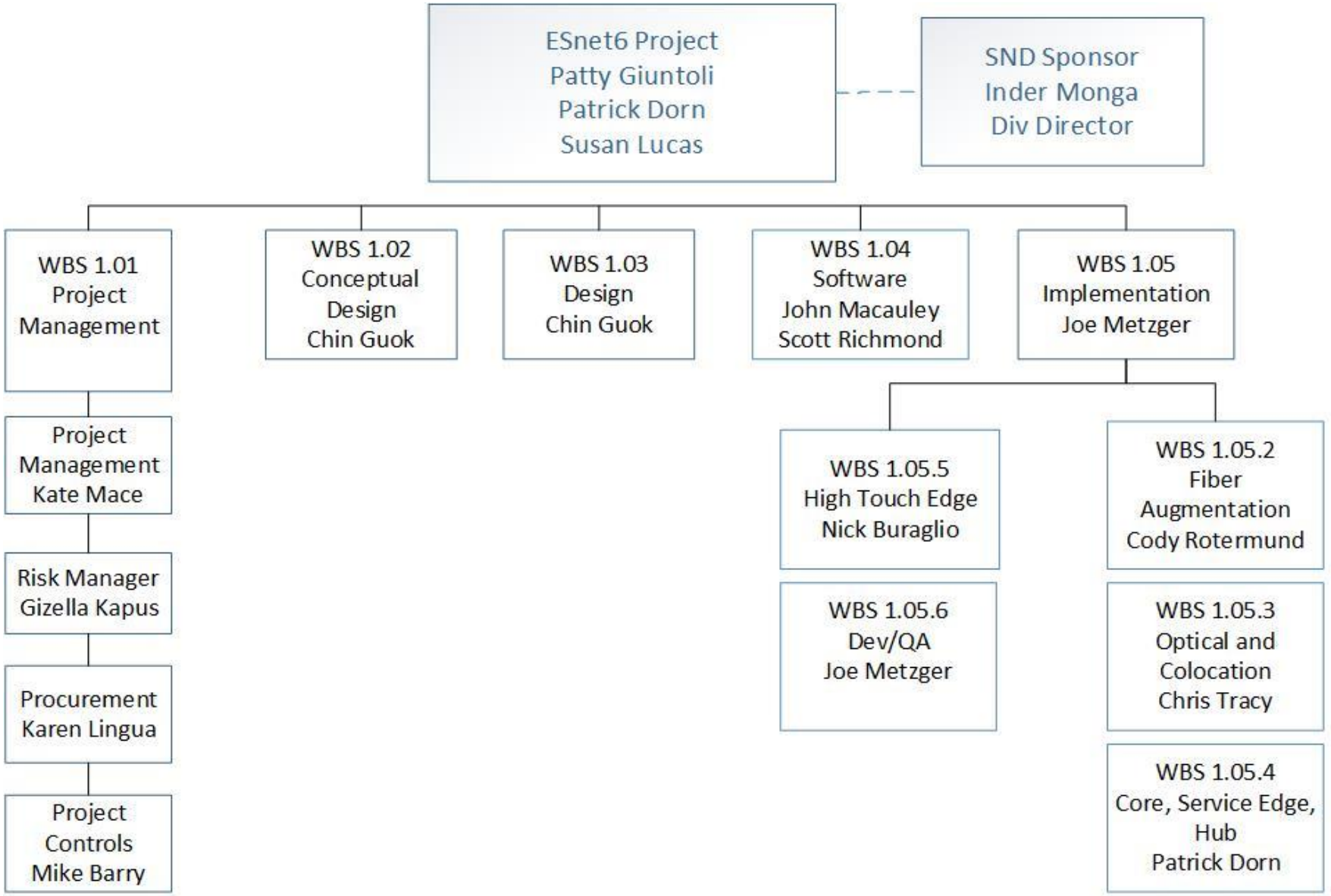
ESnet

ESnet6 Proposed Project Timeline

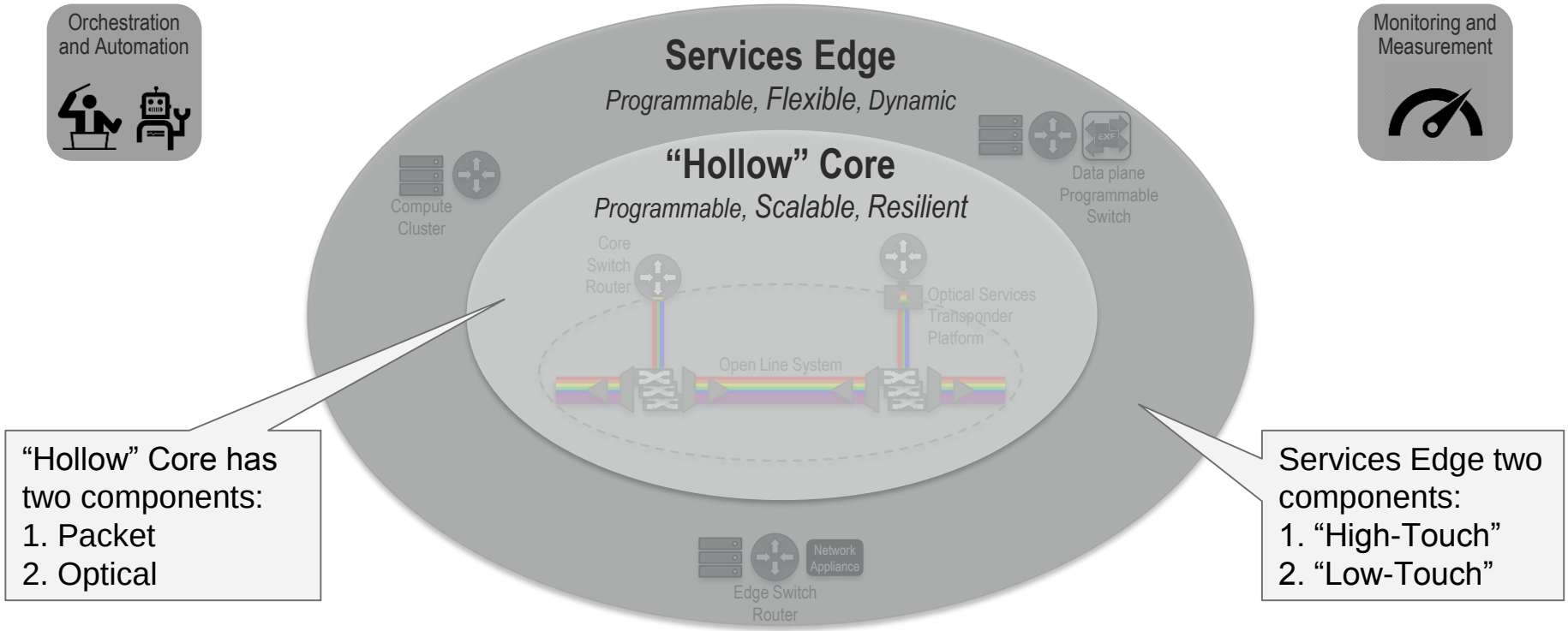


ESnet

ESnet6 Project Organization Chart



ESnet6 (“Hollow-Core”) Conceptual Architecture Overview



“Hollow” Core

- ***Programmable*** – Software driven APIs to allocate core bandwidth as needed, and monitor status and performance.
- ***Scalable*** – Increased capacity scale and flexibility by leveraging latest technology (e.g. FlexGrid spectral partitioning, tunable wave modulation).
- ***Resilient*** – Protection and restoration functions using next generation Traffic Engineering (TE) protocols (e.g. Segment Routing (SR)).

Services Edge

- ***Programmable*** – Software driven APIs to manage edge router/switch and retrieve telemetry information.
- ***Flexible*** - Data plane programmable switches (e.g. FPGA, NPU) in conjunction with compute resources to prototype new services (driven by Software Defined Networks (SDN))
- ***Dynamic*** – Dynamic instantiation of services using SDN paradigms (e.g. Network Function Virtualization (NFV, Virtual Network Functions (VNF), service chaining).

ESnet

Final Design Work Plan

Key activities underway to meet May 2019 Final Design Review

Optical Core	Open Line System, Transponders
Packet Core	Protocols, QoS, Buffering, scheduling, network loading, timing
Low Touch	Services edge: protocols, filtering, security
High Touch	Service selection, capability, prototyping
Data Plane	Data transport, protocols
Control Plane	Connectivity, placement, resiliency, security
Management Plane	Definition, in-band, out-of-band, prototyping
Monitoring and Measurement	Requirements, gap analysis with current systems
Traffic Engineering	Segment routing investigation, fallback scenarios
Automation	Federated architecture, Integration with vendor NMS, prototyping
Security	For each services edge, requirements, architecture

ESnet

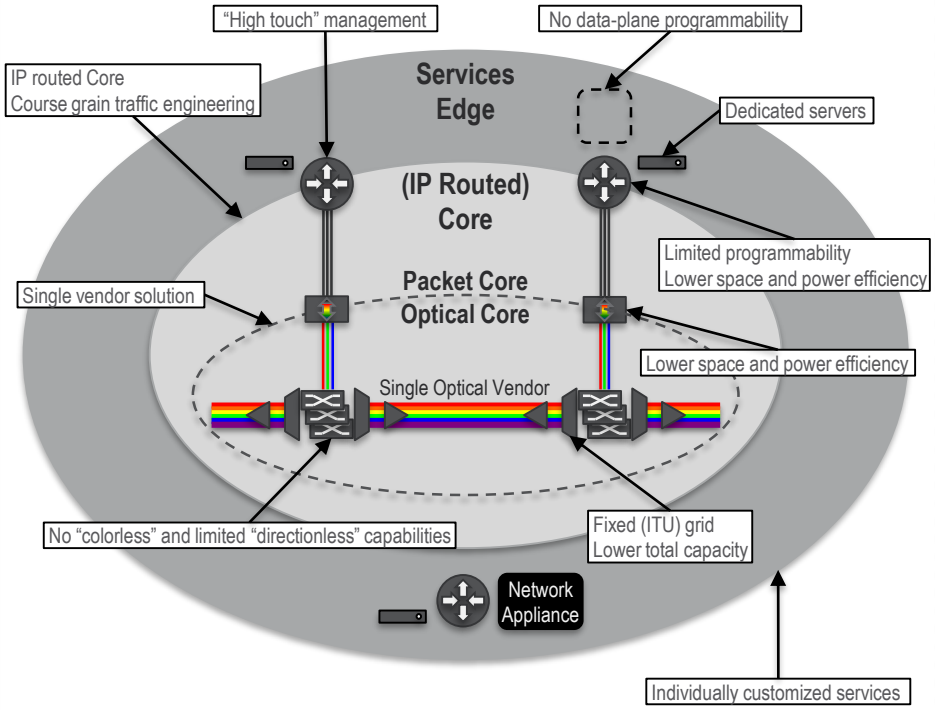
Segment Routing Investigation: ESnet6

- Much research into support, operations, completeness of protocol suite(s)
  - Segmenting Routing (SR) has major-vendor support
    - Carrier vendors (Cisco, Juniper, Nokia) all have
    - Protocol suite is in varying levels of completeness per vendor
    - TE and redundancy protocols are the most commonly under active development
    - Protocol suite is vast - many deployment options
  - Traffic Engineering (TE) controller is where the magic lies
    - Controller space is still emerging
    - Protocols are still being refined
      - PCEP seems to be the most complete
    - Options for controllers is limited but commercially supported

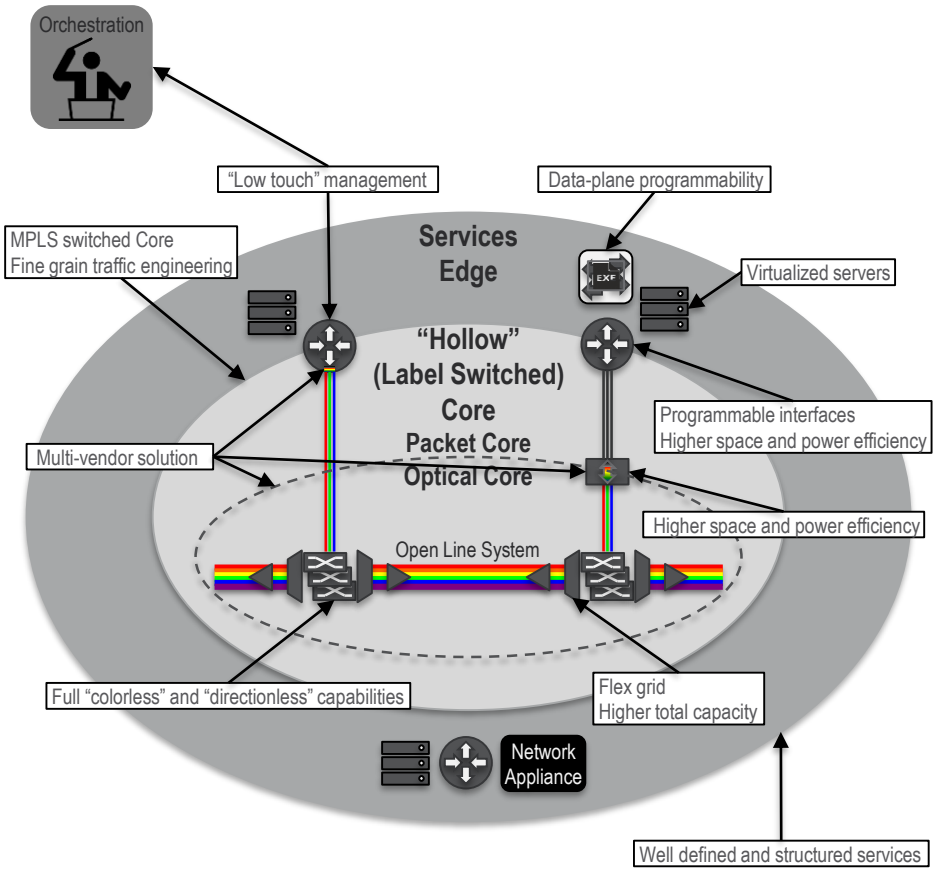
ESnet

ESnet5/6 Comparison Overview

ESnet5 (Deployed)



ESnet6 (Proposed)



ESnet

"Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Networking and Information Technology Research and Development Program."

The Networking and Information Technology Research and Development (NITRD) Program

Mailing Address: NCO/NITRD, 2415 Eisenhower Avenue, Alexandria, VA 22314

Physical Address: 490 L'Enfant Plaza SW, Suite 8001, Washington, DC 20024, USA Tel: 202-459-9674, Fax: 202-459-9673, Email: nco@nitrd.gov, Website: https://www.nitrd.gov