

## MOVING BIG DATA



### DOE's Ultra-Fast Communication Network User Facility Supports Global Science

ESnet moves big data at blistering speeds. Credit: ESnet.

#### INNOVATIONS

##### INFRASTRUCTURE THAT KEEPS DATA MOVING

DOE innovations drove the establishment of ESnet, the world's fastest network dedicated to science.

- Network protocols developed by ASCR researchers overcame early internet design flaws that caused data traffic jams. The algorithms they devised remain the foundation of today's tools for avoiding internet congestion.
- ASCR researchers developed circuit reservation mechanisms that allow researchers to obtain guaranteed bandwidth at scheduled times. This ensures they can move massive, time-sensitive data sets efficiently to collaborators thousands of kilometers apart.
- The ASCR-funded Science DMZ architecture underpins fast, secure research infrastructure at the U.S. national laboratories, universities and beyond.

#### IMPACT

##### LARGE-SCALE COLLABORATION AND DISCOVERY

Sustained ESnet upgrades over four decades have continued to push the boundaries of performance, reliability and programmability.

- The rapid movement of vast quantities of data over ESnet was a key contributor to the Nobel Prize-winning discovery of the Higgs boson in 2012.
- Today ESnet moves more than four petabytes of data—the equivalent of a million high-definition movies—across the United States and internationally every day. That's more than an exabyte each year.
- ESnet connects with more than 150 research and education networks and cloud providers, placing DOE laboratories at the center of international science.

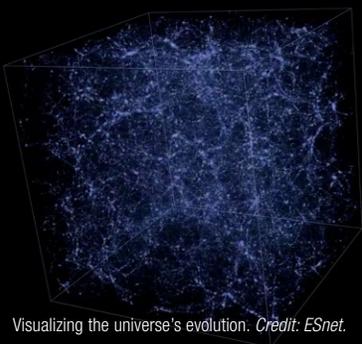
#### TAKEAWAY

##### ESNET KEEPS U.S. SCIENCE ON THE LEADING EDGE

The rapid communication network established and operated by DOE is essential to scientific discovery. Innovations by ASCR-funded scientists have kept DOE at the leading edge of networking for more than four decades, giving DOE a significant edge in modern scientific discovery.

Content provided by Department of Energy multiprogram laboratory researchers. Prepared by the Krell Institute for the ASCAC Subcommittee on the 40-year History of ASCR.

Computer networks are 10 million times faster than they were 40 years ago, rocketing from a meager 56 kilobits per second in 1980 to more than 100 gigabits per second today. The Department of Energy's (DOE's) networking innovations have driven key improvements and provided scientists and engineers with extremely high-speed connections to support science at every corner of the United States and abroad. Today the Energy Sciences Network (ESnet), a state-of-the-art user facility supported by DOE's Office of Advanced Scientific Computing Research (ASCR), moves massive quantities of data to enable ground-breaking science in many disciplines such as physics, fusion energy, biology, and the environmental and energy sciences.



Visualizing the universe's evolution. Credit: ESnet.