

## Joining the Science Data Super Highway

Background: In March 2012, the NAC's IT Infrastructure Committee (ITIC) recommended "that NASA aggressively pursue partnerships with other Federal agencies, specifically NSF and DOE, as well as public/private opportunities." This recommendation specifically called out the science data infrastructure lead by the DOE's Energy Sciences Network (ESNet) being built to provide 100 Gb/s connectivity to many of the major science research facilities in the US, many of which are performing NASA-sponsored science research. While the ITIC found that there was some limited participation by NASA's Communication Services Organization, the OCIO's organization that provides for NASA's Wide Area Network, this participation was on an ad-hoc basis and provided temporary service for "special events." The ITIC found that OSO had neither requirements nor funding from SMD to continue to participate in the ESNet or to expand to other centers of NASA-sponsored research at universities and other non-NASA science research organizations.

In July 31, 2013, the Chairs of the ITIC and the Science Committee met with senior management in SMD. The purpose of the meeting was for the Chairs to point out several findings and recommendations made by the ITIC including the lack of participation by SMD in investigating and sponsoring upgrades to science data transmission rates connecting its many sponsored-research groups. Over the past 18 months, the BDTF has found that this omission still exists within the SMD programs. There is no focused activity or even awareness of this circumstance. Yet ESNet is continuing to expand and build upon its successes.

A feature of the ESNet is the implementation of the "campus DMZ," a network architecture designed for high-performance applications, with the science network distinct from the general-purpose network, and with security policies and enforcement mechanisms that are tailored for high performance science environments. A key concept of the DMZ<sup>1</sup> is the use within the environs of local research groups of dedicated systems for data transfer, called Data Transfer Nodes (DTNs), which effectively act as optical fiber termination devices, with optical network interface cards and adequate storage and

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<sup>1</sup> See [fasterdata.es.net/science-dmz](http://fasterdata.es.net/science-dmz) .  
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compute to handle the big data transfers.

The BDTF further learned that over the last five years the NSF had awarded over 100 grants (each ~\$500,000) so that universities could upgrade their internal science data nets to provide a dedicated ESNNet-like DMZ Big Data network, with speeds up to 100 Gbps, as well as to connect to the national infrastructure (regional networks or Internet2).

The BDTF has also learned of the successes coming from the establishment of the Pacific Research Platform (PRP), a science data super highway supporting a wide variety of big data science and engineering applications by connecting ~25 research institutions in California and the West Coast, with extensions to Hawaii, NCAR, and Chicago, as well as several international destinations. The PRP is funded under an NSF grant to experiment with creating a regional DMZ, by joining together many campus DMZs using the CENIC/Pacific Wave regional optical network<sup>2</sup>. A key component which makes this regional superhighway feasible is an implementation of the ESNNet DTN as a task-designed PC (desk-side or rack) with terabytes of FLASH memory and 10, 40, or two 40-Gbps network interface cards, which are used at the research group-level as a specialized gateway and data transfer node needed to connect the local area networks of most research groups to the high-bandwidth networks. The PRP has deployed over 40 of these purpose-built devices, typically costing \$5-20k each.

The BDTF points out that there is precedent for SMD direct support of advanced networking for its research community. The initial expansion of Internet services to the Nation's science research establishments was largely promoted and funded by the NASA Science Internet Program established in the Office of Space Science and Applications (OSSA, a predecessor organization to SMD) in 1988. This was performed in close collaboration with the NSF and the DOE. This OSSA program enabled the NASA-supported science community to become the early innovators into the Internet era.

Recommendation: SMD should establish a temporary 2- to 3-year position to focus on providing access to the Nation's Science Data Super Highway provided by DOE's

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<sup>2</sup> See [cenic.org](http://cenic.org) and [pacificwave.net/about](http://pacificwave.net/about).

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ESNet, the PRP, and allied services such as the Internet2. This program officer would investigate in detail the requirements and opportunities for extending the Nation's Science Data Super Highway to many of NASA's sponsored research groups. This officer would sponsor a program of about \$3-5M/year which would be divided among two elements: (1) a ROSES solicitation so that research groups can propose to acquire necessary hardware and software in order to set up their own science DMZ that would connect into the larger campus and national science data networks and (2) provide requirements and funds to the Agency's CSO to acquire necessary links - where vitally needed - to bridge to junction points in the high-speed National networks. Initially the program officer might be recruited as an IPA from one of the several organizations participating in the ESNet or Pacific Research Platform. After two years, SMD should evaluate the need to continue this position and funding needs.

### Major Reasons for the Recommendation:

Over the past six years the Federal Government has been investing heavily in upgrading transmission capabilities for science data into many science research groups throughout the nation – connecting science research groups to science archives, collaborating groups and data to/from high-performance computing centers. Many NASA-supported research groups are being left out of this new way of doing business. In order to spread Science DMZs into the NASA-sponsored research groups, there needs to be a cognizant program officer at NASA HQ who is on top of the details, coordinating at the agency/department levels and overseeing a grants program that permit the research groups to get funding to implement their Science DMZ. Thirty years ago at the dawn of the Internet age, NASA Science led the way in extending Internet connectivity to the Nation's science research centers. New infrastructure upgrades for science data transmission are taking place with NASA Science largely standing by. It's not too late for NASA Science to participate and provide opportunities for many of its sponsored research groups to join the Data Super Highway.

### Consequences of No Action on the Recommendation:

NASA-sponsored research groups will be left behind in this new era of 100 Gbps

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transmission. Yet it is NASA science data that are at core of the attacks on some of the nation's most challenging science problems.