

perfSONAR

Performance-Monitoring Middleware

INTERNET

The Challenge

Achieving true end-to-end network performance is critical to ensuring the continued development and adoption of next-generation Internet technologies and applications. The Internet2 community has long supported the need for strong end-to-end performance tools and data that are readily available, easy to find, reliable, and automated. The goal is to eliminate the need to troubleshoot network performance issues by increasing network awareness, reducing diagnostic costs, identifying performance issues early, and standardizing efficient means of addressing issues as they arise.

A Development Consortium

In support of this vision, the international perfSONAR consortium, in which Internet2 is a founder and leading collaborator with ESnet, GÉANT2, and Rede Nacional de Ensino e Pesquisa (RNP), has led the perfSONAR development effort. This effort has focused on making network performance data easier to share across multiple domains in a standard way—thereby enabling more advanced visualization and analysis. The consortium has also worked to encourage performance data generation, and widespread international data sharing to grow the breadth of available performance tests.

The perfSONAR Framework

The core of the perfSONAR framework comprises a set of open protocol standards for interoperability between measurement and monitoring systems. Overall, perfSONAR can be viewed as a set of open source web services that can be mixed-and-matched and extended to create a performance-monitoring framework.

By developing a standards-based, modular, decentralized, and extensible model, perfSONAR is applicable to multiple generations of network monitoring systems, while also allowing it to be customized for individual science applications.

Measurement and Diagnostic Tools

perfSONAR integrates network measurement tools and archives, discovery, authentication and authorization, data manipulation, resource protection, and topology. Using perfSONAR, a network engineer or application can easily and automatically discover additional monitoring resources, authenticate locally, gain authorization to use remote network resources (to an extent defined by the resource owner), acquire performance monitoring data from remote sites via standard protocol, and customize the analysis and visualization process.

"GÉANT2 uses perfSONAR to gain a global overview of the services it provides for CERN's Large Hadron Collider—the biggest scientific experiment ever! perfSONAR will allow us to identify where problems lie more quickly—before they become significant for the researchers. Our collaboration with Internet2 is very important as it ensures that all portions of this framework will be interoperable between U.S. and European toolsets."

Nicolas Simar, Dante

Internet2 has created several diagnostic tools (BWCTL, NDT, OWAMP, and Thrulay) and makes network data public when possible.

Internet2 Development Efforts

Internet2 currently contributes to perfSONAR development efforts in a variety of ways, including development, design, and deployments of measurement points, measurement archives, and lookup services. Of special interest is a set of services developed in Perl (a platform preferred by U.S. engineers) by Internet2 – in partnership with ESnet, SLAC, FNAL, University of Delaware, University of Indiana and Georgia Tech. These services are collectively referred to as perfSONAR-PS (perfSONAR Perl Services) and they have been written to be interoperable with the Java-based solutions preferred by many European national research and education networks.

Another major effort by Internet2 has included the development of standards for performance information sharing via the Open Grid Forum (OGF) Network Measurement Working Group. Integration of Internet2-developed diagnostic tools serve as 'good' examples of perfSONAR services that encourage further development of tools in the broader community.

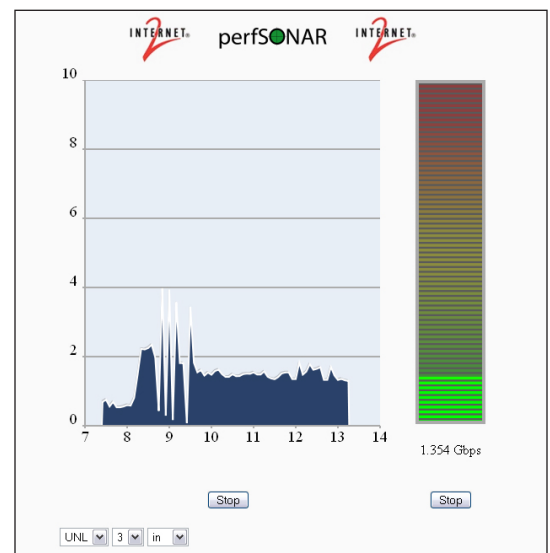
A perfSONAR Example

At the Fall 2007 Internet2 Member Meeting, Internet2—in collaboration with University of Nebraska–Lincoln (UNL), together with colleagues from ESnet, Fermilab, and the Great Plains Network—dynamically set up a 10 Gbps dedicated circuit between the UNL campus and Fermilab in Batavia, Illinois as a demonstration of Internet2's Dynamic Circuit (DC) Network. Once the circuit was created, the data traffic flowing across the shared IP network seamlessly switched over to the

DC Network, and quickly transferred one-third of a terabyte of data—equivalent to the capacity 40 standard DVDs.

perfSONAR was a critical component of this demonstration. Because it is designed to understand the underlying topology of a network, including the complex hybrid IP/circuit network topologies that exist on the Internet2 Network, perfSONAR collected and reported performance data on the IP and DC Network links in a standardized manner. The perfOMeter provided an eye-catching visualization of the data flows, first as they nearly flooded the 10Gig UNL IP link, and then as the load transitioned to the DC Network link.

perfSONAR's ability to share network diagnostic information across administrative domains makes it an important tool for projects like the LHC, and other collaborations between multiple national and international organizations. perfSONAR simplifies the troubleshooting and evaluation of performance issues across networks—allowing network administrators to diagnose and verify network problems across complex multi-domain topologies.



The perfSONAR perfOMeter

perfSONAR is an effort of ESnet, GÉANT2 JRA1, Internet2, and RNP. More information, as well as a full list of participants can be found at:

www.perfsonar.net