Network Awareness in the Open Science Grid

Shawn McKee/University of Michigan

Session: Building Network Awareness in High Energy Physics Data Models

2014 Technology Exchange / Indianapolis, IN

October 27th 2014
The overview for those not familiar with Open Science Grid:

- OSG supports an active community of 20+ multi-disciplinary research groups
- Has areas in Production/Operations, User Support, Technology and Software and Campus Grids

- OSG has a footprint on ~120 campuses and labs in the U.S.

- OSG Delivers up to 2 Million CPU hours every day
  - Almost 700M hours of Distributed High-Throughput Computing per year, of which ~90M were provided as “opportunistic resources”
  - About 60% go to LHC, 20% to other HEP, 20% to many other sciences

- OSG transfers ~1 PetaByte of data every day
**OSG Networking Area Mission**

- **OSG Networking** was added at the beginning of OSG’s second 5-year period in 2012 (Now middle of year 3)
- The “Mission” is to have OSG become the network service data **source** for its constituents
  - Information about network performance, bottlenecks and problems should be easily available.
  - Should support OSG VOs, users and site-admins to find and help fix network problems and bottlenecks.
  - Provide network metrics to higher level services so they can make informed decisions about their use of the network (*Which sources, destinations for jobs or data are most effective?*)
OSG Networking Service

- OSG is building a centralized service for gathering, viewing and providing network information to users and applications.

- **Goal:** OSG becomes the “source” for networking information for its constituents, aiding in finding/fixing problems and enabling applications and users to better take advantage of their networks.

- The critical missing component is the datastore to organize and store the network metrics and associated metadata:
  - perfSONAR-PS stores data in a MA (Measurement Archive)
    - Each host stores its measurements (locally)
  - OSG (via MaDDash) is gathering relevant metrics from the complete set of OSG and WLCG perfSONAR-PS instances
  - This data must be available via an API, must be visualized and must be organized to provide the “OSG Networking Service”
Longer Term OSG Networking Plans

- Years 4-5 need to build upon the first 3 years.
- What kinds of capabilities can we enable given a rich datastore of historical and current network metrics?
  - Users want "someone" to tell them when there is a network problem involving their site or their workflow.
  - Can we create a framework to identify when network problems occur and locate them? (*Must* minimize the false-positives).
- Issues that seem like "network issues" can often be due to problems at the ends (on the servers, in the software, in the configuration) or at least not WAN problems but LAN problems.
OSG Networking Year 3-5 Work Areas

- Continue to do what we do now, and:
  - Support higher-level network services
  - Develop effective Alarming and Alerting
  - Improve the ability to manage and use network topology
  - Gather, organize and export network diagnostic work
  - Enable OSG researchers to find/fix End-to-End issues
  - Prepare-for and integrate Software Defined Networking
Continuing to Do What We Do…

Basic things still need to happen in all years:

- Upgrades and bug-fixes to tools that gather, display and provide network metrics
- Tuning and optimizing existing testing
- Maintenance and creation of documentation
- Support for new ideas and feature requests.
- Exploring needs for new metrics to better meet researcher needs.

But what interesting possibilities should we focus on given OSG’s unique position regarding our hosting of network metrics from all of OSG and WLCG?
Higher Level Service Support

- OSG needs to be able to support "higher-level services" that require network metrics to make decisions regarding data transfers and higher-level workflow optimizations involving the network.

- What metrics and with what timeliness are best for meeting this need?
  - This can be very complicated to answer in practice.
  - We will need to work closely with the developers of such services and iteratively adapt what is provided to make this as effective as possible.
  - Should point the way to missing components
Being able to "alarm" on real network problems is a good target: indicate (via monitoring) there is a network problem.

The next step is to actually "alert" on network problems.

- The difference between an alarm and an alert is the target. An alarm can appear in some monitoring system for an operator to respond to while an alert is targeted at a person or list of persons (email, page, etc.).

- To effectively alert requires that we first have a valid 'network' alarm AND that we be able to localize the problem more specifically than "along the end-to-end path". Alerts should be only sent to those able to fix the problem.

The recently funded PuNDIT project (NSF grants 1440571 and 1440585) is trying to address network problem identification and localization.

- A “satellite” project for OSG
New Network Tools/Capabilities

- Some important and interesting possibilities for what OSG might provide in the future include the creation of tools and visualization systems which manage network topologies (which are time-dependent).
  - Combining topology and metrics is powerful for identifying and localizing network problems; currently a very manual process.

- Using these tools users can look for correlations with the metrics measured across those topologies.
  - This type of tool can be used to help localize problems.

- Note it is only by using the complete set of OSG network metrics that this becomes possible.
  - PuNDIT network range tomography will be critical here.
Can we create tools to manipulate, visualize, compare and analyze network topologies from the OSG network datastore contents?

Can we build upon these tools to create a set of next-generation network diagnostic tools to make debugging network problems easier, quicker and more accurate?

Even without requiring the ability to perform complicated data analysis and correlation, basic tools developed in the area of network topology-based metric visualization would be very helpful in letting users and network engineers better understand what is happening in our networks.
Most scientists just care about the end-to-end results:
- How well does their infrastructure support them in doing their science?

Network metrics allow OSG to differentiate end-site issues from network issues.

There is an opportunity to do this better by having access to end-to-end metrics to compare & contrast with network-specific metrics.

- What end-to-end data can OSG regularly collect for such a purpose? Should we?
- Is there some kind of common instrumentation that can be added to some data-transfer tools? (NetLogger in GridFTP, having transfers "report" results to the nearest perfSONAR-PS instance?, etc)

Can we support end-to-end path creation for specific needs?
- Currently a challenge; most paths lack needed hardware end-to-end
Within the next few years evolving technology in the area of Software Defined Networking (SDN) may be able to provide researchers with the ability to construct their own Wide-Area networks with specified characteristics.

What will OSG be able to do to integrate this type of capability with the rest of the OSG infrastructure?

We need to plan for how best to enable evolving capabilities in the network for OSG users and admins

- What is the impact on the OSG software stack?
- What strategic modifications/additions are useful?
OSG is busy integrating network awareness within its infrastructure to support the needs of its users, VOs and collaborators.

Interesting times ahead as SDN becomes more viable:

- Will need to inform other OSG areas on new capabilities
- Intend to pilot new capabilities to best determine value for OSG

QUESTIONS?