Update: Network Monitoring using perfSONAR-PS for LHC VOs

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WLCG Grid Deployment Board

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Introduction

❋ This is an update on the LHC network monitoring, primarily the perfSONAR-PS toolkits and associated modular dashboard, as well as some "network news"

❋ Outline:

  ❑ A brief history and review

  ❑ Current status and example issues

  ❑ New since the last presentation

❋ Feel free to ask questions at anytime during the presentation…

Motivations for Common LHC Network Monitoring

※ LHC collaborations rely upon the network as a critical part of their infrastructure, yet finding and debugging network problems can be difficult and, in some cases, take months.

※ There is no differentiation of how the network is used amongst the LHC experiments. (Quantity may vary)

※ We need a standardized way to monitor the network and locate problems quickly if they arise

※ We don't want to have a network monitoring system per VO!

History of perfSONAR

* perfSONAR a joint effort of ESnet, Internet2, GEANT and RNP to standardize network monitoring protocols, schema and tools

* USATLAS adopted perfSONAR-PS toolkit starting in 2008. All Tier-2s and the Tier-1 instrumented by 2010.

* Modular dashboard developed by Tom Wlodek/BNL based upon USATLAS requirements to better understand deployed infrastructure

* LHCOPN choose to adopt in June 2011…mostly deployed within 3 months (by September 2011).

Network Monitoring for LHC: Goals/Purpose

❋ **Goals:**

  ❋ **Find and isolate "network" problems; alerting in a timely way**

  ❋ **Characterize network use (base-lining)**

  ❋ **Provide a source of network metrics for higher level services**

❋ **First step:** get monitoring in place to create a baseline of the current situation between sites

❋ **Next:** as sites evolve (join LHCONE, update their infrastructure) track the impact based upon measurements

❋ **perfSONAR's main purpose is to aid in network diagnosis** by quickly allowing users to isolate the location of problems. **In addition it can provide a standard measurement of various network performance related metrics over time** as well as "on-demand" tests.

LHC perfSONAR-PS Deployments

❊ We want to measure (to the extent possible) the entire network path between LHC resources. This means:

   ❑ We want to locate perfSONAR-PS instances as close as possible to the storage resources associated with a site. The goal is to ensure we are measuring the same network path to/from the storage.

❊ There are two separate instances that should be deployed: latency and bandwidth

   ❑ The **latency instance** measures one-way delay by using an NTP synchronized clock and send 10 packets per second to target destinations

   ❑ The **bandwidth instance** measures achievable bandwidth via a short test (20-60 seconds) per src-dst pair every 4 hour period

Modular Dashboard: Centralized Info

❋ Having a large number of perfSONAR deployments is great for instrumenting our networks, but all these instances are not easy to track, summarize or understand.

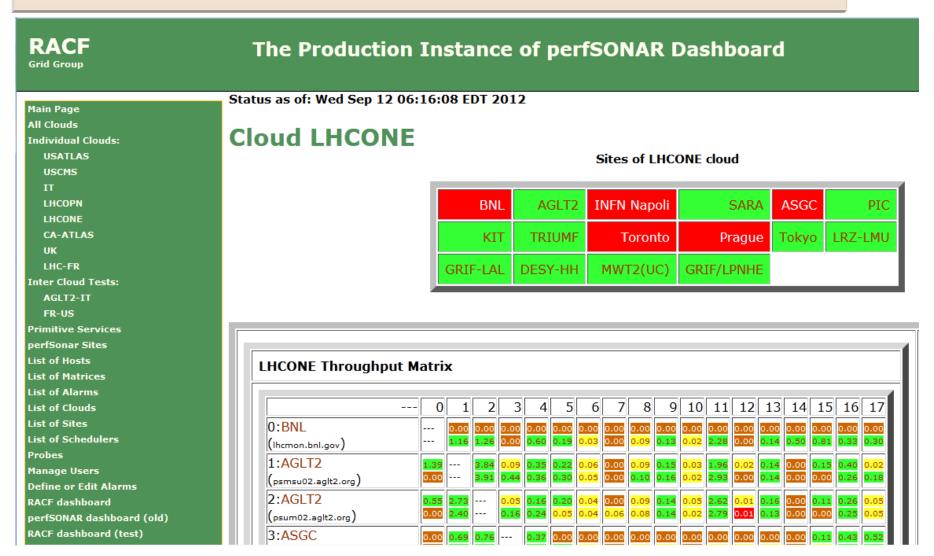❋ The current modular dashboard is being used to track a large number of LHC perfSONAR-PS installations:

https://perfsonar.racf.bnl.gov:8443/exda/

The dashboard provides a highly configurable interface to monitor a set of perfSONAR-PS instances via simple plug-in test modules. Users can be authorized based upon their grid credentials. Sites, clouds, services, tests, alarms and hosts can be quickly added and controlled.

LHC "Clouds" Being Tracked

❄ ATLAS (includes some multi-VO sites)

  ❑ USATLAS (United States; 10 sites)

  ❑ IT (Italy; 4 sites)

  ❑ CA-ATLAS (Canada; 6 sites)

  ❑ UK (United Kingdom; **14 sites**)

  ❑ LHC-FR (France; 4 sites)

❄ CMS

  ❑ USCMS (United States; 10 sites)

  ❑ Some sites in Brazil and Europe are being added

❄ LHCOPN (all Tier-1 and CERN; 12 sites)

❄ LHCONE (Selected sites to track progress; 18 sites)

❄ Almost doubled the number of sites in ~9 months

Example of Dashboard (LHCONE)

RACF
Grid Group

The Production Instance of perfSONAR Dashboard

Status as of: Wed Sep 12 06:16:08 EDT 2012

Cloud LHCONE

Main Page
All Clouds
Individual Clouds:
    USATLAS
    USCMS
    IT
    LHCOPN
    LHCONE
    CA-ATLAS
    UK
    LHC-FR
Inter Cloud Tests:
    AGLT2-IT
    FR-US
Primitive Services
perfSonar Sites
List of Hosts
List of Matrices
List of Alarms
List of Clouds
List of Sites
List of Schedulers
Probes
Manage Users
Define or Edit Alarms
RACF dashboard
perfSONAR dashboard (old)
RACF dashboard (test)

Sites of LHCONE cloud

BNL	AGLT2	INFN Napoli	SARA	ASGC	PIC
KIT	TRIUMF	Toronto	Prague	Tokyo	LRZ-LMU
GRIF-LAL	DESY-HH	MWT2(UC)	GRIF/LPNHE		

LHCONE Throughput Matrix

---	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
0:BNL (lhcmon.bnl.gov)	--- / ---	0.00 / 1.16	0.00 / 1.26	0.00 / 0.00	0.00 / 0.60	0.00 / 0.19	0.00 / 0.03	0.00 / 0.00	0.00 / 0.09	0.00 / 0.13	0.00 / 0.02	0.00 / 2.28	0.00 / 0.00	0.00 / 0.14	0.00 / 0.50	0.00 / 0.81	0.00 / 0.33	0.00 / 0.30
1:AGLT2 (psmsu02.aglt2.org)	1.39 / 0.00	--- / ---	3.84 / 3.91	0.09 / 0.44	0.35 / 0.36	0.22 / 0.30	0.06 / 0.05	0.00 / 0.00	0.09 / 0.10	0.15 / 0.16	0.03 / 0.02	1.96 / 2.93	0.02 / 0.00	0.14 / 0.14	0.00 / 0.00	0.15 / 0.00	0.40 / 0.26	0.02 / 0.18
2:AGLT2 (psum02.aglt2.org)	0.55 / 0.00	2.73 / 2.40	--- / ---	0.05 / 0.16	0.16 / 0.24	0.20 / 0.05	0.04 / 0.04	0.00 / 0.06	0.09 / 0.08	0.14 / 0.14	0.05 / 0.02	2.62 / 2.79	0.01 / 0.01	0.16 / 0.13	0.00 / 0.00	0.11 / 0.00	0.26 / 0.25	0.05 / 0.05
3:ASGC	0.00	0.69	0.76	---	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.43	0.52

See https://perfsonar.racf.bnl.gov:8443/exda/?page=25&cloudName=LHCONE

Using the Dashboard

❄ The dashboard is very useful for all of us to use to get a quick picture of the status for a particular grouping (cloud)

❄ It is also **very useful for sites** to debug their configurations!

❄ Note that you can quickly drill down and get error details as well as history plots or tables.

❄ I strongly wish to encourage anyone interested in network monitoring to use the dashboard to check the capabilities:

https://perfsonar.racf.bnl.gov:8443/exda/?page=25&cloudName=LHCONE

❄ Authorization for Mgmt via X509 supported.

perfSONAR-PS Issues Observed

❋ Getting working monitoring deployed was a **first main step**
  ❑ Focusing on a set of inter-site monitoring configuration raises awareness of the current shortcomings in our infrastructure
❋ Two primary problems we noted:
  ❑ Traffic between Tier-2Ds and Tier-1s is:
    ⌘ **Often routed on congested GPN** links
    ⌘ **Passing thru a firewall, limiting performance**
❋ Issue with MTU setting. Suggestion for LHCONE is to use jumbo frames. We need to understand the impact on our measurements.
❋ Test durations: 1G vs 10G. 20 seconds OK for 1G, but what about 10G? 60 seconds seems more reasonable.
❋ Getting alerts running: Issues with false positives.
❋ Higher level alarms: when, how?
❋ Modular dashboard: intro, use, future, issues

Improving perfSONAR-PS Deployments

❋ Based upon the issues we have encountered we setup a Wiki to gather best practices and solutions to issues we have identified:

http://www.usatlas.bnl.gov/twiki/bin/view/Projects/LHCperfSONAR

❋ This page is being shared with the perfSONAR-PS developers and we expect many of the "fixes" will be incorporated into future releases.

❋ Please feel free to add to the Wiki (either directly or by emailing me updates/changes/additions).

Examples of Recent Issues

❄ Jason Zurawski/Internet2 has been central in helping to support and debug perfSONAR-PS instances and results

❄ Here are some recent typical issues (last few weeks):

- ❑ SWT2/UTA: Site has bad performance to select destinations
    - ⌘ perfSONAR-PS data shows start of problem 3 months ago
    - ⌘ Under investigation

- ❑ ASGC: Site is achieving poor throughput results
    - ⌘ Main issue is configuration related; large RTT requires either longer tests or increased network buffers

- ❑ Univ of Oxford: Poor data transfer performance
    - ⌘ perfSONAR-PS data shows good network throughput
    - ⌘ Under investigation but may be application tuning issue

- ❑ MWT2/UC/UIUC: Had transfer issues
    - ⌘ Used perfSONAR-PS traceroute to determine LHCONE routing issue

News and Updates (1/2)

❋ News: a number of new network-related items

❋ Open Science Grid has a new area in **networking**

- ❑ Shawn McKee is area-coordinator
- ❑ Focus on improving perfSONAR-PS installs, network tool/troubleshooting documentation and modular dashboard
- ❑ Provide OSG service for collecting network metrics

❋ New development effort for Modular Dashboard

- ❑ Needed to provide scalability and feature evolution
- ❑ Joint effort of ESnet/Internet2/FNAL/BNL/OSG (and others)
- ❑ See draft page at
  https://www.opensciencegrid.org/bin/view/Documentation/NetworkingModularDashboard

News and Updates (2/2)

- Internet2 is developing a perfSONAR-PS "Mesh Configuration" component
  - Draft info at http://code.google.com/p/perfsonar-ps/wiki/MeshConfigurationInstallation
  - Needs testing-of, and feedback-on, LHC use-cases

- In the US a newly funded proposal: ANSE
  - **A**dvanced **N**etwork **S**ervices for **E**xperiments (Caltech,Michigan,UTA,Vanderbilt)
  - Focus on incorporating network services into ATLAS/PaNDA and CMS/PhEDEX. Starts this Fall; funded for 2 years

- WLCG has setup a Network Working Group
  - Chair is Michael Ernst/BNL
  - http://indico.cern.ch/getFile.py/access?contribId=7&resId=0&materialId=slides&confId=202090

Challenges Ahead

❇ Getting hardware/software platform installed at all sites

❇ Dashboard development: Need additional effort to produce something suitable quickly. Ensure it meets our needs…

❇ Managing site and test configurations

  ❑ **Testing and improving "centralized" (VO-based) configurations**

  ❑ Determining the right level of scheduled tests for a site, e.g., Tier-2s test to other same-cloud Tier-2s (and Tier-1)?

  ❑ Address 10G vs 1G tests that give misleading results

❇ **Alerting:** A high-priority need but complicated:

  ❑ Alert who? Network issues could arise in any part of end-to-end path

  ❑ Alert when? Defining criteria for alert threshold. Primitive services are easier. Network test results more complicated to decide

❇ Integration with VO infrastructures and applications

GDB Involvement

❈ The GDB could help to coordinate and motivate getting the needed deployments in place

❈ As noted: we want one set of network monitoring tools in place and have converged on perfSONAR

  ❑ How to organize sites and VOs?

    ⌘ perfSONAR-PS has communities to self-identify: recommendations?
    ⌘ Scheduled tests: which ones, how often, what is missing?

  ❑ Dashboard "infrastructure". How best to configure and leverage it?

    ⌘ Could use additional input in development process and coding

❈ **What ways are appropriate for the GDB to be involved?**

How to Make Progress?

❄ Using the LHCONE case as an example it seems possible to make significant progress in getting a standardized monitoring infrastructure in place quickly.

❄ Need to improve installs to be "set-it and forget-it"

❄ Integration with the experiments software stacks and DDM systems is now a high-priority (LS1 is an opportunity)

   ❑ First network monitoring metrics

   ❑ Next: SDN (Software Defined Networking)

❄ All VOs need to be aware of the need for network monitoring and the possibilities for sharing a common solution. Requires VO "pressure" to get sites to deploy

❄ VOs must assign effort to configure and gather VO view of network from shared perfSONAR measurement locations

Discussion/Questions

Questions or Comments?

Network Impact of perfSONAR

❋ To provide an idea of the network impact of a typical deployment here are some numbers as configured in the US

❑ **Latency tests** send 10Hz of small packets (20 bytes) for each testing location. USATLAS Tier-2's test to ~10 locations. Since headers account for 54 bytes each packet is 74 bytes or the rate for testing to 10 sites is **7.4 kbytes/sec**.

❑ **Bandwidth tests** try to maximize the throughput. A 20 second test is run from each site in each direction once per 4 hour window. Each site runs tests in both directions. Typically the best result is around **925 Mbps on a 1Gbps link for a 20 second test**. That means we send 4x925 Mbps*20 sec every 4 hours per testing pair (src-dst) or about 5 Mbps average.

❑ Tests are configurable but the above settings are working fine.