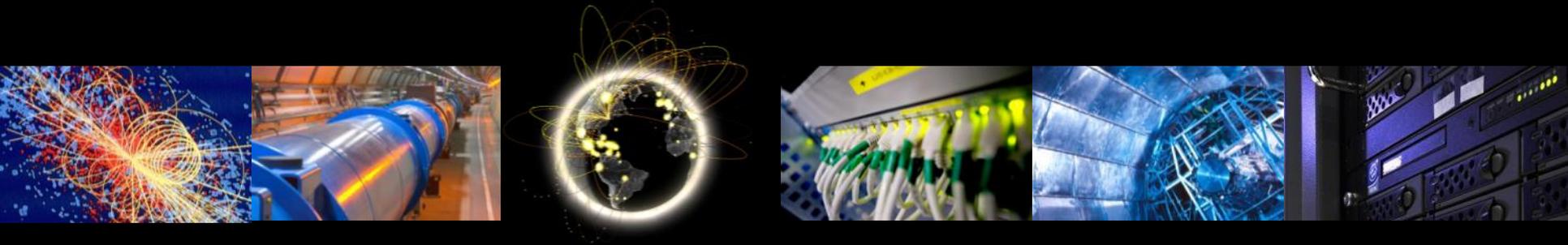


Integrating Network and Transfer Metrics to Optimize Transfer Efficiency and Experiment Workflows

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Network Integration Motivations

- A crucial contributor to the success of the massively scaled global computing system that delivers the analysis needs of the LHC experiments is the **networking infrastructure** upon which the system is built.
 - The LHC experiments have been able to exploit excellent high-bandwidth networking in adapting their computing models for the most efficient utilization of resources.
 - However there are still challenges and opportunities to make this even more effective for our needs.

Evolving Network Capabilities

- We already have deployed End-to-end monitoring of our networks using perfSONAR.
 - perfSONAR, combined with data flow performance metrics, further allows our applications to adapt based on real time conditions.
- New, advanced networking technologies are slowly becoming available as production equipment is upgraded and replaced
 - Software Defined Networking(**SDN**) holds the potential to further leverage the network to optimize workflows and dataflows
- We foresee eventual proactive control of the network fabric on the part of high level applications such as experiment workload management and data management systems. **We must prepare for this...**

Network Monitoring in WLCG/OSG

- **Goals:**
 - Find and isolate “network” problems; alerting in time
 - Characterize network use (base-lining)
 - Provide a source of network metrics for higher level services
- **Choice of a standard open source tool: perfSONAR**
 - Benefiting from the R&E community consensus
- **Tasks achieved by the perfSONAR TF:**
 - Get monitoring in place to create a baseline of the current situation between sites
 - Continuous measurements to track the network, alerting on problems as they develop
 - Develop test coverage and make it possible to run “on-demand” tests to quickly isolate problems and identify problematic links

Network and Transfer Metrics WG

- Started in May 2014, bringing together network and transfer experts
- Follows up on the perfSONAR TF goals
- Mandate
 - Ensure all relevant **network** and **transfer metrics** are identified, collected and published
 - Ensure sites and experiments can better understand and fix networking issues
 - Enable use of network-aware tools to improve transfer efficiency and optimize experiment workflows
- Membership
 - WLCG perSONAR support unit (regional experts), WLCG experiments, FTS, Panda, PhEDEx, FAX, Network experts (ESNet, LHCOPN, LHCONE)

Network and Transfer Metrics WG

- Objectives
 - Coordinate commissioning and maintenance of WLCG network monitoring
 - Finalize, harden and maintain the perfSONAR deployment
 - Ensure all links continue to be monitored and sites stay correctly configured
 - Verify coverage and optimize test parameters
 - Identify and continuously make available relevant transfer and network metrics
 - Document metrics and their use
 - Facilitate their integration in the middleware and/or experiment tool chain
- Since inception, main focus was to finalize deployment and commissioning, extend the infrastructure, but also to jump start common projects with network and transfer metrics

perfSONAR Deployment

http://grid-monitoring.cern.ch/perfsonar_report.txt for stats

259 perfSONAR instances registered in GOCDB/OIM
233 Active perfSONAR instances
172 Running latest version (3.4.2)
LHCONE Instances at WIX, MANLAN, GEANT Amsterdam



- Initial deployment coordinated by WLCG perfSONAR TF
- Commissioning of the network followed by WLCG Network and Transfer Metrics WG

Infrastructure Monitoring

- Based on OMD/check_mk and MadDash
- MadDash developed as part of perfSONAR – 1.2 version released recently
- OMD/check_mk extended to cover WLCG perfSONAR needs
- Developed bootstrapping and auto-configuration scripts
 - Synchronized with GOCDDB/OIM and OSG configuration interface
- Packaged and deployed in OSG
- Developed new plugins - core functionality
 - Toolkit Version, Regular Testing, NTP, Mesh configuration, Esmond (MA), Homepage, Contacts
 - Updated to perfSONAR 3.4 information API/JSON
- High level functionality plugins
 - Esmond freshness – checks if perfSONAR node's local MA contains measurements it was configured to perform
 - Extremely useful during commissioning

Infrastructure Monitoring

- Auto-summaries are available per mesh
- Service summaries per metric type
- **GOAL:** To ensure we continue to reliably obtain ALL network metrics

Check_MK 1.2.4p5 Hostgroup OPN

Tactical Overview

Hosts	Problems	Unhandled
251	30	30

Services

Services	Problems	Unhandled
3084	720	720

Quicksearch

Views

- Dashboards
 - Host & Services Problems
 - Main Overview
 - Network Topology
- Hosts
 - All hosts
 - All hosts (Mini)
 - All hosts (tiled)
 - Favourite hosts
 - Host search

state	Host	Icons	Alias	OK	Wa	Un	Cr	Pd
UP	ccperfonar1.in2p3.fr		ccperfonar1.in2p3.fr	10	2	0	0	0
UP	ccperfonar2.in2p3.fr		ccperfonar2.in2p3.fr	10	2	0	0	0
UP	lcgps01.gridpp.rl.ac.uk		lcgps01.gridpp.rl.ac.uk	10	2	0	0	0
UP	lcgps02.gridpp.rl.ac.uk		lcgps02.gridpp.rl.ac.uk	10	2	0	0	0
UP	lhcbandwidth.twgrid.org		lhcbandwidth.twgrid.org	10	2	0	0	0
UP	lhclatency.twgrid.org		lhclatency.twgrid.org	9	0	0	3	0
UP	lhcomon.bnl.gov		lhcomon.bnl.gov	9	2	0	1	0
UP	lhperfonon.bnl.gov		lhperfonon.bnl.gov	10	2	0	0	0
UP	perfonar-bw.cern.ch		perfonar-bw.cern.ch	9	2	0	1	0
UP	perfonar-de-kit.gridka.de		perfonar-de-kit.gridka.de	9	2	0	1	0
UP	perfonar-IT.cern.ch		perfonar-IT.cern.ch	10	2	0	0	0
			perfonar-ow.cnaf.infn.it	10	2	0	0	0
			perfonar-ps.cnaf.infn.it	9	2	0	1	0
			perfonar-ps.ndgf.org	10	2	0	0	0
			perfonar-ps2.ndgf.org	10	2	0	0	0
			perfonar2-de-kit.gridka.de	10	2	0	0	0
			ps-bandwidth.lhcomon.triumf.ca	10	2	0	0	0
			ps-gsd01.sdfarm.kr	10	2	0	0	0
			ps-gsd02.sdfarm.kr	10	2	0	0	0
			ps-latency.lhcomon.triumf.ca	10	2	0	0	0
			ps.lhcopn-ps.sara.nl	10	2	0	0	0
			ps2.lhcopn-ps.sara.nl	10	2	0	0	0
			psb01.pic.es	10	2	0	0	0
			psl01.pic.es	10	2	0	0	0
			psonar3.fnal.gov	10	2	0	0	0
			psonar4.fnal.gov	10	2	0	0	0

Stale services

- Addons
 - Search Graphs
 - Other
 - Comments

t2ps-bandwidth.physics.ox.ac.uk

State	Service	Status detail	Age	Checked	Icons	Perf-O-Meter
OK	perfonAR 3.4+ Toolkit Version	OK toolkit version found 3.4.1	2015-02-17 07:22:26	27 sec		
OK	perfonAR Administrator Details	OK - Administrator is Ewan Mac Mahon, email e.macmahon1@physics.ox.ac.uk (cached:0)	2014-12-11 19:57:58	3 hrs		
OK	perfonAR BWCTL Bandwidth Test Controller	TCP OK - 0.139 second response time on 163.1.5.211 port 4823	2014-12-11 19:58:23	29 min		139.213 ms
WARN	perfonAR esmond Freshness Bandwidth Direct	WARNING Found stale hosts for certain events, time-range: 3700	2015-02-17 21:47:47	3 hrs		
WARN	perfonAR esmond Freshness Bandwidth Reverse	WARNING Found stale hosts for certain events, time-range: 3700	2015-02-17 21:48:10	3 hrs		
OK	perfonAR esmond Measurement Archive	OK esmond reachable	2014-12-11 19:56:42	3 hrs		
OK	perfonAR Homepage	OK homepage reachable	2015-01-27 19:58:50	3 hrs		
OK	perfonAR Latitude/Longitude Configured	OK - Latitude is 51.81806, Longitude is -1.30489 (cached:1)	2014-12-11 19:54:37	3 hrs		
OK	perfonAR Mesh Configuration	OK auto-URL configured	2015-01-26 13:55:06	3 hrs		
OK	perfonAR NTP Service	OK NTP synchronized	2015-01-29 20:16:35	28 min		
OK	perfonAR Regular Testing Service	OK Regular Testing enabled and running	2015-01-29 20:17:03	28 min		
OK	perfonAR Toolkit Version	OK - Version 3.4.1 OK (cached:1)	2014-12-11 19:56:17	3 hrs		

OSG perfSONAR Datastore

- All perfSONAR metrics should be collected into the OSG network datastore
 - This is an Esmond datastore from perfSONAR (postgresql+cassandra backends)
 - Loaded via RSV probes; currently one probe per perfSONAR instance every 15 minutes.
- Validation and testing ongoing in OSG
 - Plan is to have it production ready by Q3 2015
- Datastore on psds.grid.iu.edu
 - JSON at <http://psds.grid.iu.edu/esmond/perfsonar/archive/?format=json>
 - Python API at http://software.es.net/esmond/perfsonar_client.html
 - Perl API at <https://code.google.com/p/perfsonar-ps/wiki/MeasurementArchivePerlAPI>

Integration Projects

- Goal
 - Provide platform to integrate network and transfer metrics
 - Enable network-aware tools (see ANSE <http://cern.ch/go/M9Sj>)
 - Network resource allocation along CPU and storage
 - Bandwidth reservation
 - Create custom topology
- Plan
 - Provide latency and trace routes and test how they can be integrated with throughput from transfer systems
 - Provide mapping between sites/storages and sonars
 - Uniform access to the network monitoring
- Pilot projects
 - FTS performance – adding latency and routing to the optimizer
 - Experiment's interface to datastore

Experiments Interface to Datastore

- Aim
 - Develop publish/subscribe interface to perfSONAR
 - Enable possibility to subscribe to different events (filter) and support different clients - integration via messaging, streaming data via topic/queue
 - Provide mapping/translation btw sonar infrastructure and experiment's topology
- Components
- esmond2mq – prototype already exists
 - Retrieves all data (meta+raw) from esmond depending on existing mesh configs
 - Publishes to a topic
- Proximity/topology service
 - Handle mapping/translation of services (service to service; storage to sonar), service to site (sonar to site)
 - Test different algorithms (site mapping, traceroutes, geoip)
 - Evaluate if existing tools can be reused for this purpose

Closing remarks

- perfSONAR widely deployed and already showing benefits in troubleshooting network issues
 - Additional deployments within R&E/overlay networks still needed
- Significant progress in **configuration** and **infrastructure monitoring**
 - Helping to reach full potential of the perfSONAR deployment
- **OSG datastore** – community network data store for all perfSONAR metrics – planned to enter production in Q3
- Integration projects aiming to aggregate network and transfer metrics
 - FTS Performance
 - Experiment's interface to perfSONAR
- **ANSE project** is providing “hooks” in PANDA and PhEDEx to utilize future SDN capabilities as they become available at our sites and in our networks.



Questions?