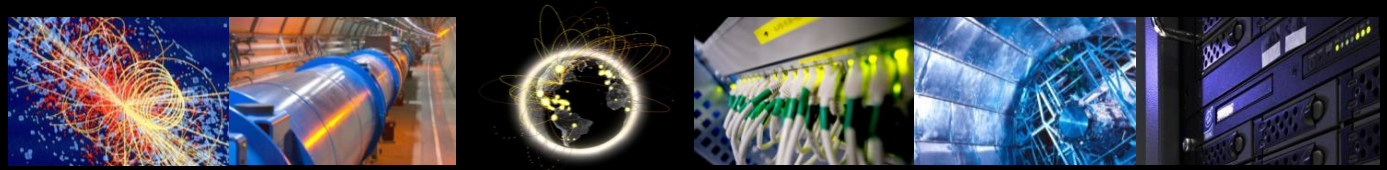
LHCOPN/LHCONE Monitoring Update

Shawn McKee, Marian Babik
on behalf of WLCG Network Throughput WG



WLCG
Worldwide LHC Computing Grid

Open Science Grid

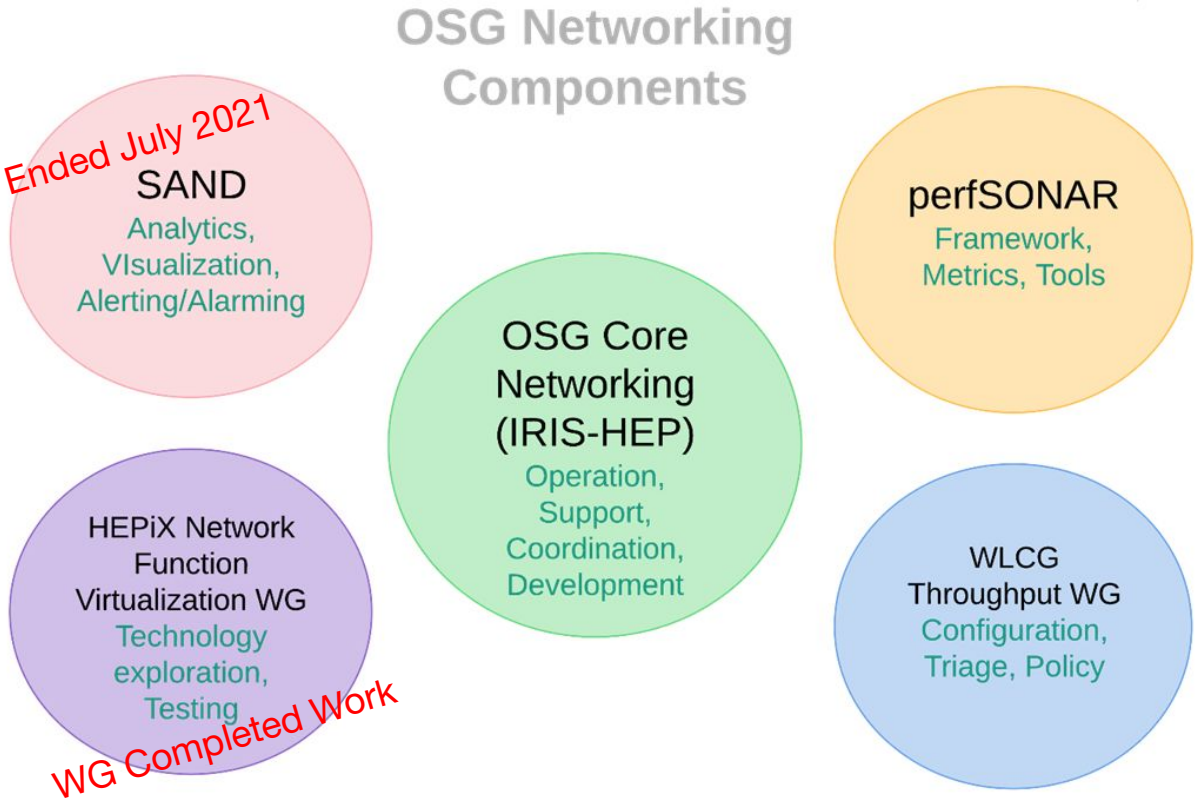
Outline

- OSG/WLCG Network Monitoring and WLCG Network Throughput WG
- perfSONAR community updates
- LHCOPN/LHCONE perfSONAR infrastructure status
- New Analytics and Tools
- Summary

OSG/WLCG networking projects

There have been 4 coupled projects around the core OSG Net Area

1. **SAND** (NSF) project for analytics (ended)
2. **HEPiX** NFV WG (finished work)
3. **perfSONAR** project
4. **WLCG Network** Throughput WG



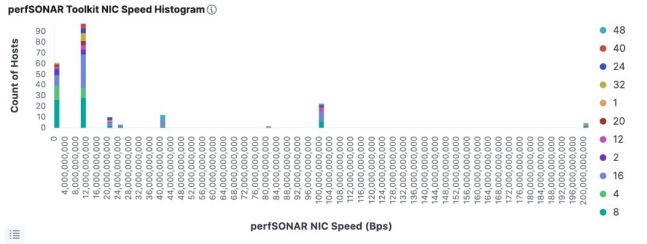
perfSONAR News

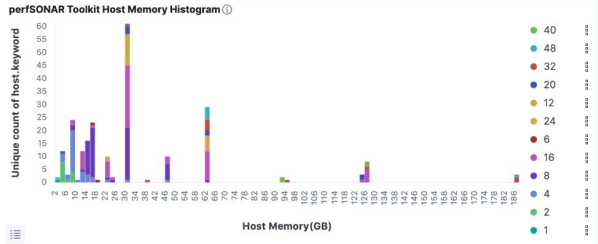
- perfSONAR 5 (beta out soon)
  - ElasticSearch as local archive (replacing esmond/Cassandra) + Logstash
  - Grafana visualisations (dashboards)
  - Toolkit support for latest Debian, RHEL8 compatible systems (Alma)
    - CS8 not officially supported
    - Will require full reinstall (backup not needed)
- 4.4.3 bug fix released Oct. 10th
  - Updated to iperf 3.11 and bug-fixing pScheduler
- Currently seeing issues with 4.4.3 nodes and problems hitting resource limits on busy nodes after running for a long time
- Based on our feedback another bugfix release is in the works (4.4.4)
  - The issue with nodes hitting the connection pool limit should be fixed

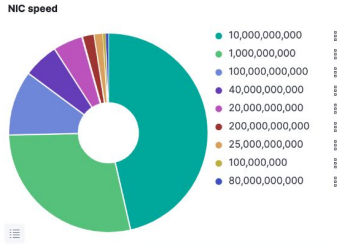
perfSONAR deployment

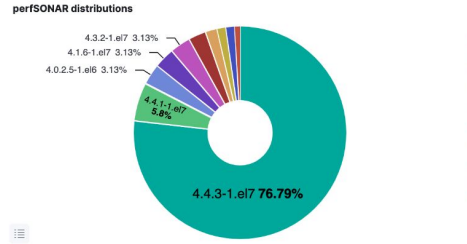
238 Active perfSONAR instances - **207 production endpoints** - T1/T2 coverage

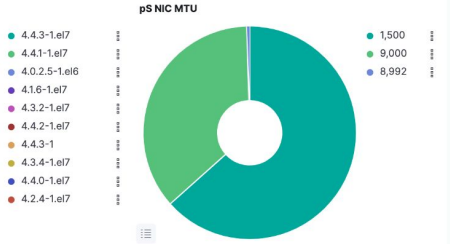
- Continuously testing over 5000 links - testing coordinated and managed from central place
- Dedicated latency and bandwidth nodes at each site - **Open platform (testing and data)**

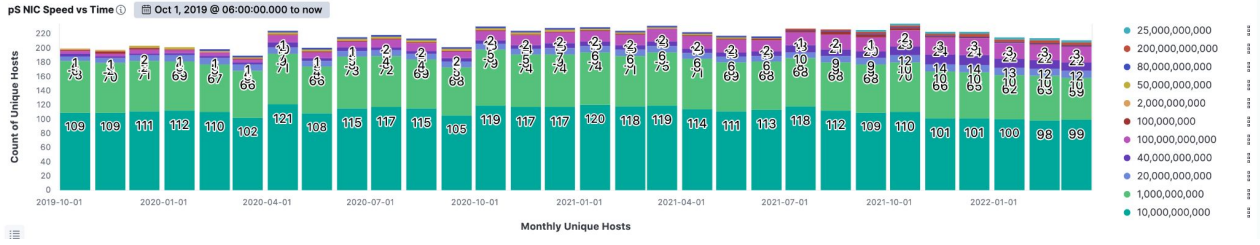












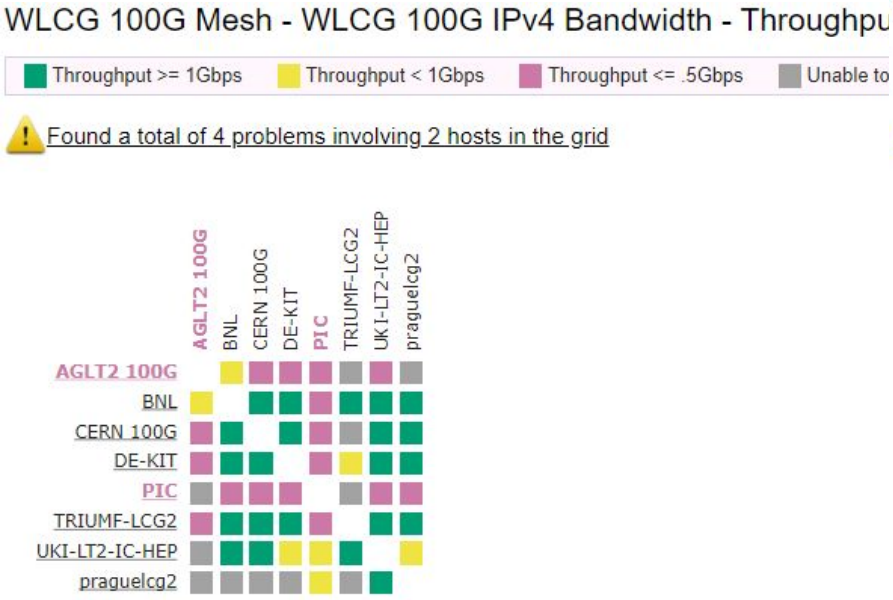
Our global toolkit deployment has a range of systems in terms of age and capability

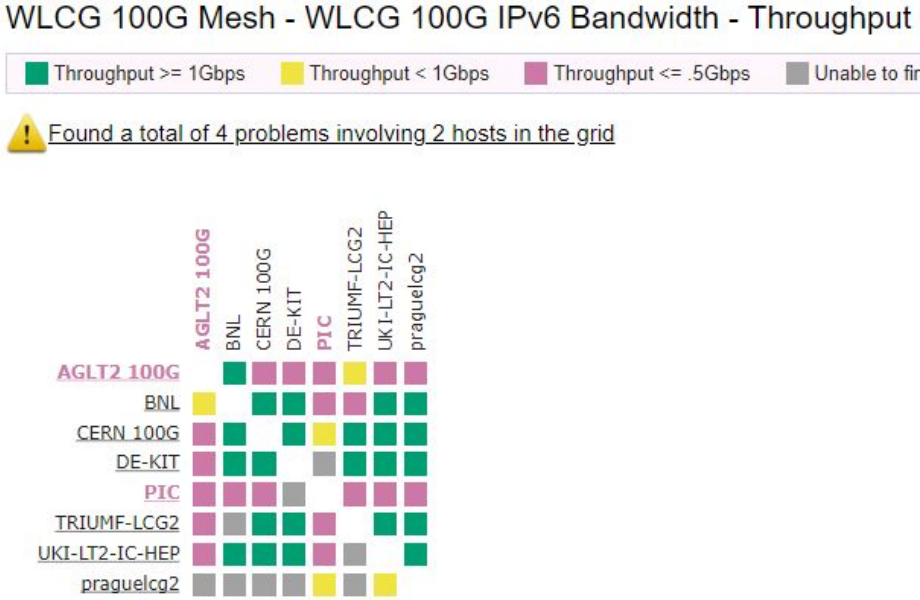
[Dashboard in ELK]

Sites should remember to not only upgrade perfSONAR software but also the underlying **hardware,** as nodes become too old or are unable to test at the site storage speed.

100Gbps Testing 10th Oct 2021

- LHCOPN/LHCONE 100Gbps mesh





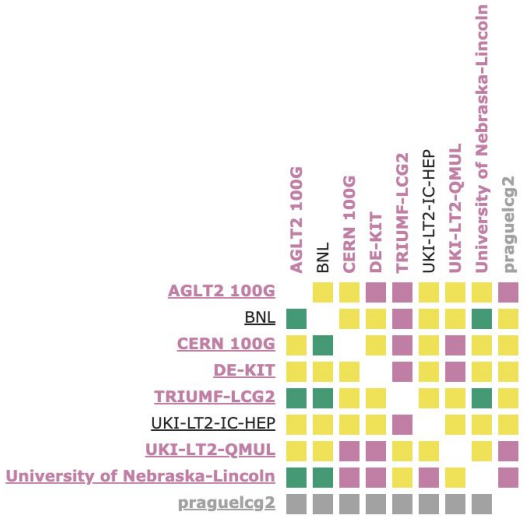
100Gbps Testing 28th March 2022

- LHCOPN/LHCONE 100Gbps mesh
  Mesh changes: QMUL replaced pic; thresholds updated

WLCG 100G Mesh - WLCG 100G IPv4 Bandwidth - Throughput

Throughput >= 10Gbps | Throughput < 10Gbps | Throughput <= 1Gbps | Unable to fir

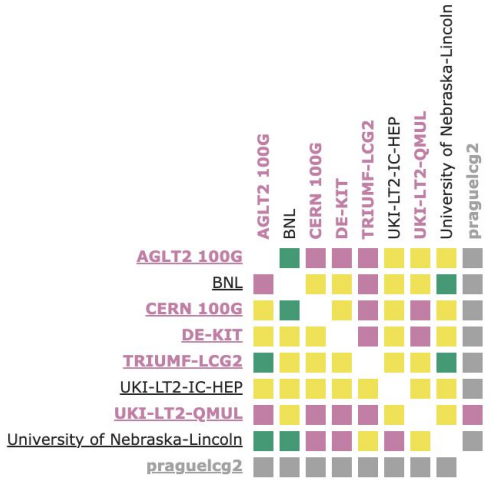
Found a total of 9 problems involving 7 hosts in the grid



WLCG 100G Mesh - WLCG 100G IPv6 Bandwidth - Throughput

Throughput >= 10Gbps | Throughput < 10Gbps | Throughput <= 1Gbps | Unable to fi

Found a total of 8 problems involving 6 hosts in the grid

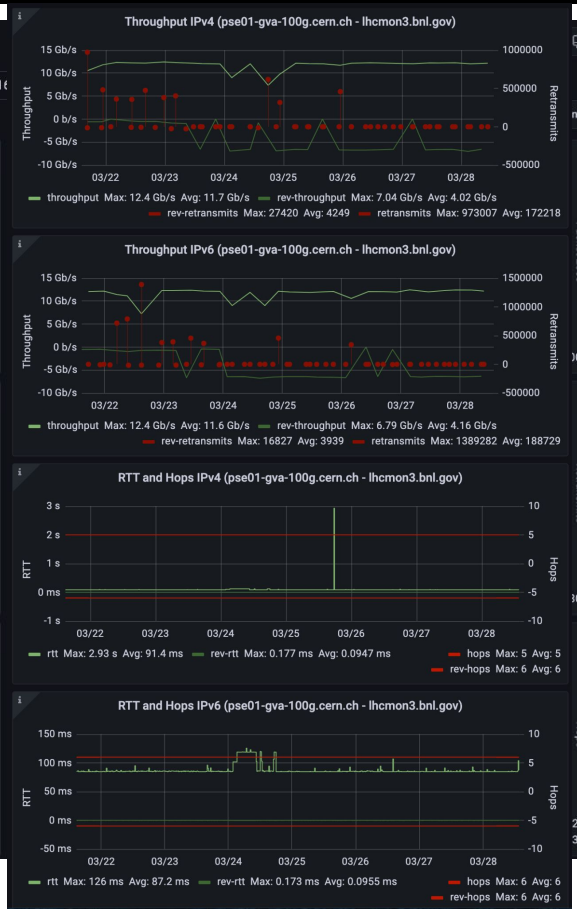


100Gbps Testing

- Monthly meetings since January
  - Aim to achieve 10% of avail. capacity (~10Gbps) on a regular basis
  - Discussing ways to tune the nodes and improve stability
  - wlcg-perfsonar-100g mailing list (join)
- Various issues found and fixed at different sites
  - Still looking into TRIUMF inbound and QMUL outbound rates
- Tunings
  - Used psetf along with ES/Kibana dashboards to check status
  - TCP buffers and MTU appear to have made the biggest difference
    - TCP buffers by default at ~ 200MB, need to be increased to 1GB
  - References:
    - https://fasterdata.es.net/host-tuning/linux/100g-tuning/
  - Tried FQ but that actually decreased the throughput in tests (not work-conserving)
  - NIC interrupts/core sync only possible via manual tests
- New host-based Grafana dashboard available

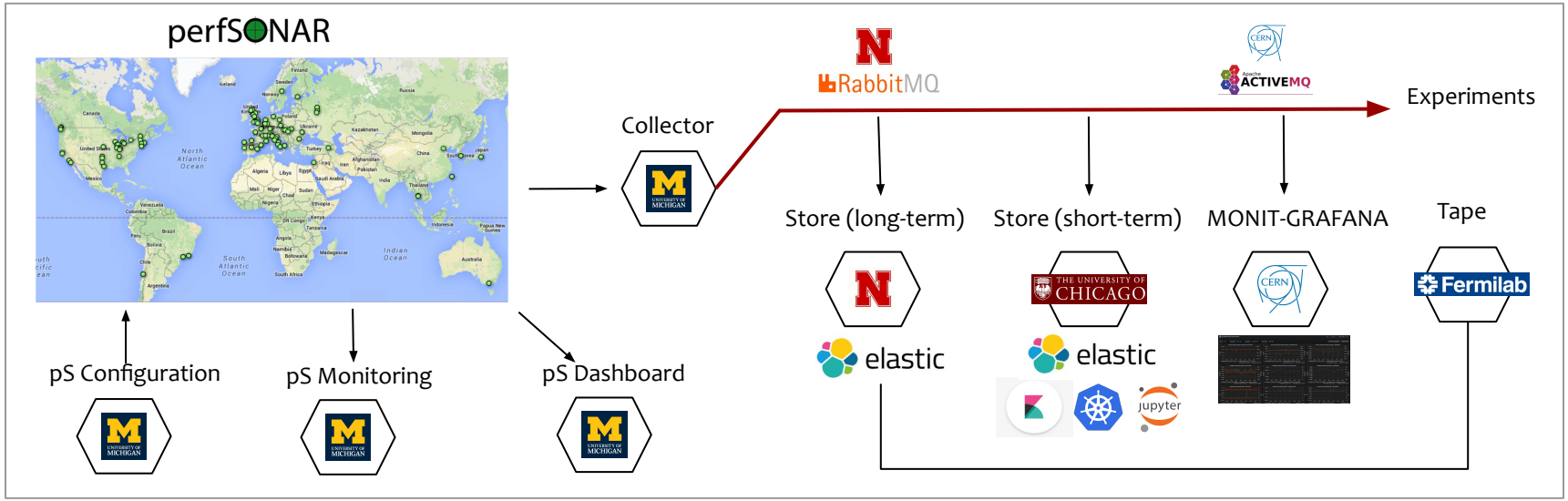
Grafana dashboard

Grafana dashboard



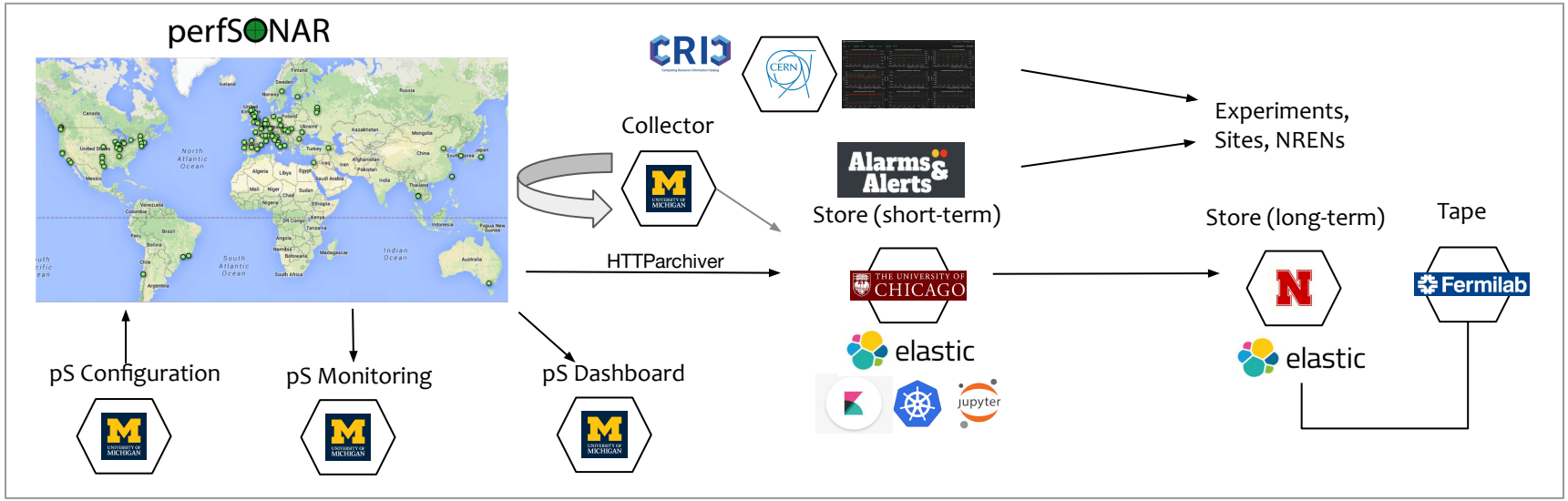
Reminder: Network Measurement Platform Overview

- Collects, stores, configures and transports all network metrics
  - Distributed deployment - operated in collaboration
- All perfSONAR metrics are available via API, live stream or directly on the analytical platforms
  - Complementary network metrics such as ESNet, LHCOPN traffic also via same channels



Network Measurement Platform Evolution

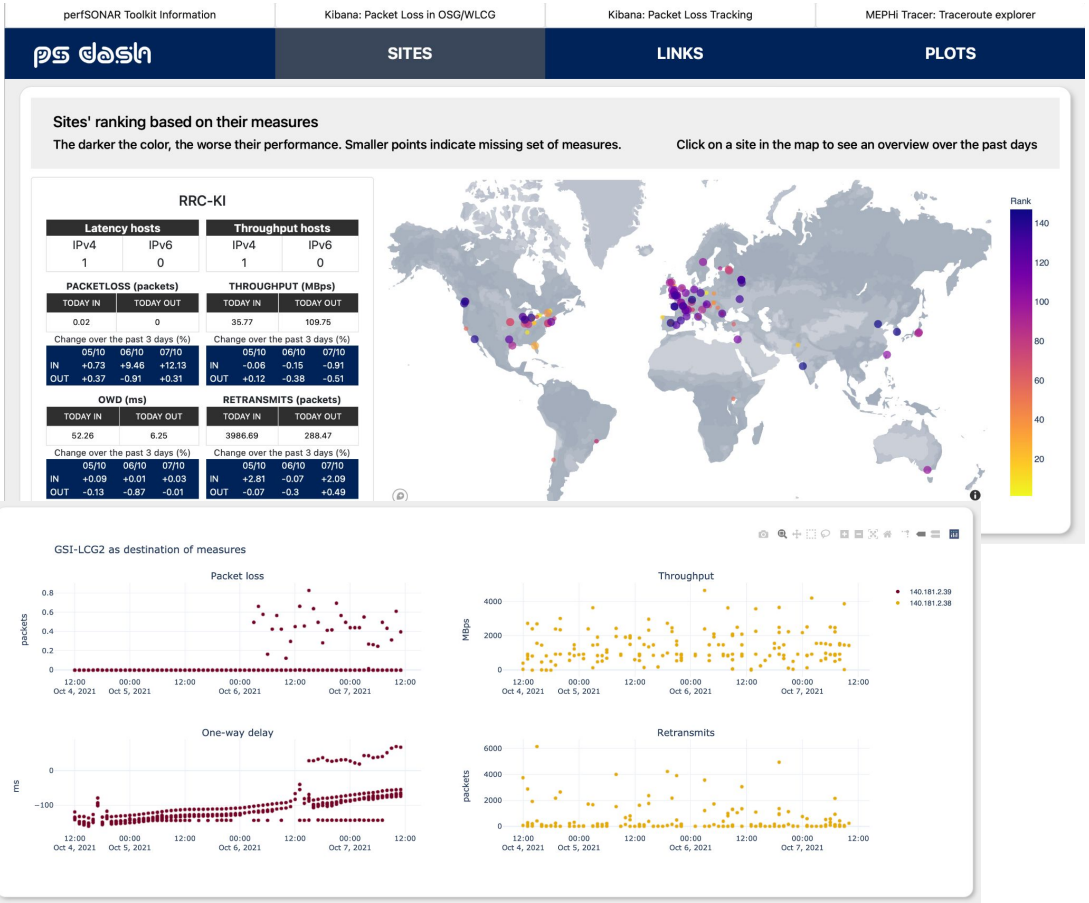
- Collects, stores, configures and transports all network metrics
  - Distributed deployment - operated in collaboration
- Planned evolution based on the perfSONAR 5
  - Directly publishing results from perfSONARs to ES@UC
  - High-level services provided to the experiments/users



Tools and Applications for Network Data

- To organize access to all the various resources we have NEW homepage (https://toolkitinfo-nextjs.vercel.app/)
- We already have Kibana dashboards looking at
  - Bandwidth
  - Traceroute
  - Packetloss / Latency
  - Infrastructure
- With the completion of the SAND project, we have a few prototype tools that help us analyze and utilize our net data
  - We have a new perfSONAR focused dashboard: **ps-dash**
  - We have added a self-subscribe tool for network alarms call **AAAS**
  - ***Next two pages have the details on these two apps***

pS (perfSONAR) Dash



https://ps-dash.uc.ssl-hep.org/

Purpose: provides a user dashboard to explore analyzed and summarized perfSONAR data.

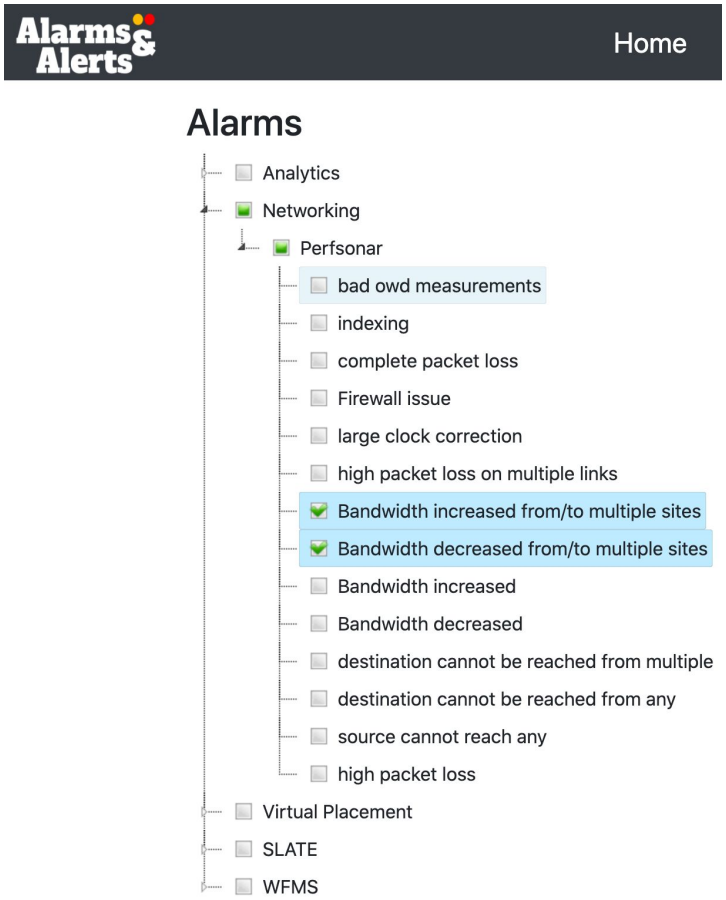
Currently:

- Allows users to monitor their sites
- Provides tools for detecting basic problems

Future plans:

- Add today's Alarms
- Add traceroute data & plots
- Refine ranks
- Deduct possible cause for found issues

ATLAS Alarms & Alerts Service



https://aaas.atlas-ml.org/

Purpose: provides user-subscribable alerting for specific types of network issues found by analyzing perfSONAR data

Currently available:

- Main packet loss issues
- Main throughput issues

Future plans:

- Add traceroute alarms:
  - Destination never reached
  - **Network path changes**
  - Node causes issues with multiple sites

Bandwidth Changes

Detecting changes in measured throughput wrt. 21-day average (ipv4, ipv6)
Currently improving the algorithm by adding topological awareness and fine-tuning thresholds; also working on creating high-level alarms (aggregating multiple alarms and running correlations with latencies and path alarms)
Example: Alarms generated for Sat 26th March

Herewith a list of alarms you subscribed to. You may change preferences by visiting https://aaas.atlas-ml.org.

Sat, 26 Mar 2022 04:08:44 Networking/Perfsonar/Bandwidth decreased from/to multiple sites Bandwidth decreased from/to multiple sites
tags: IN2P3-CC
Bandwidth decreased for ipv4 links between site IN2P3-CC to sites: ['AGLT2', 'UFlorida-HPC'] change in percentages: [-55, -100]; and from sites: ['GLOW', 'IN2P3-LAPP', 'SiGNET', 'UTA_SWT2'], change in percentages: [-72, -69, -27, -96] with respect to the 21-day average.

Sat, 26 Mar 2022 04:08:44 Networking/Perfsonar/Bandwidth decreased from/to multiple sites Bandwidth decreased from/to multiple sites
tags: IN2P3-CC
Bandwidth decreased for ipv6 links between site IN2P3-CC to sites: ['CA-VICTORIA-WESTGRID-T2', 'GLOW', 'SiGNET', 'pic'] change in percentages: [-16, -36, -11, -91]; and from sites: ['BEIJING-LCG2', 'CIT_CMS_T2', 'IN2P3-CPPM', 'IN2P3-LPSC', 'UAM-LCG2'], change in percentages: [-96, -49, -98, -14, -99] with respect to the 21-day average.

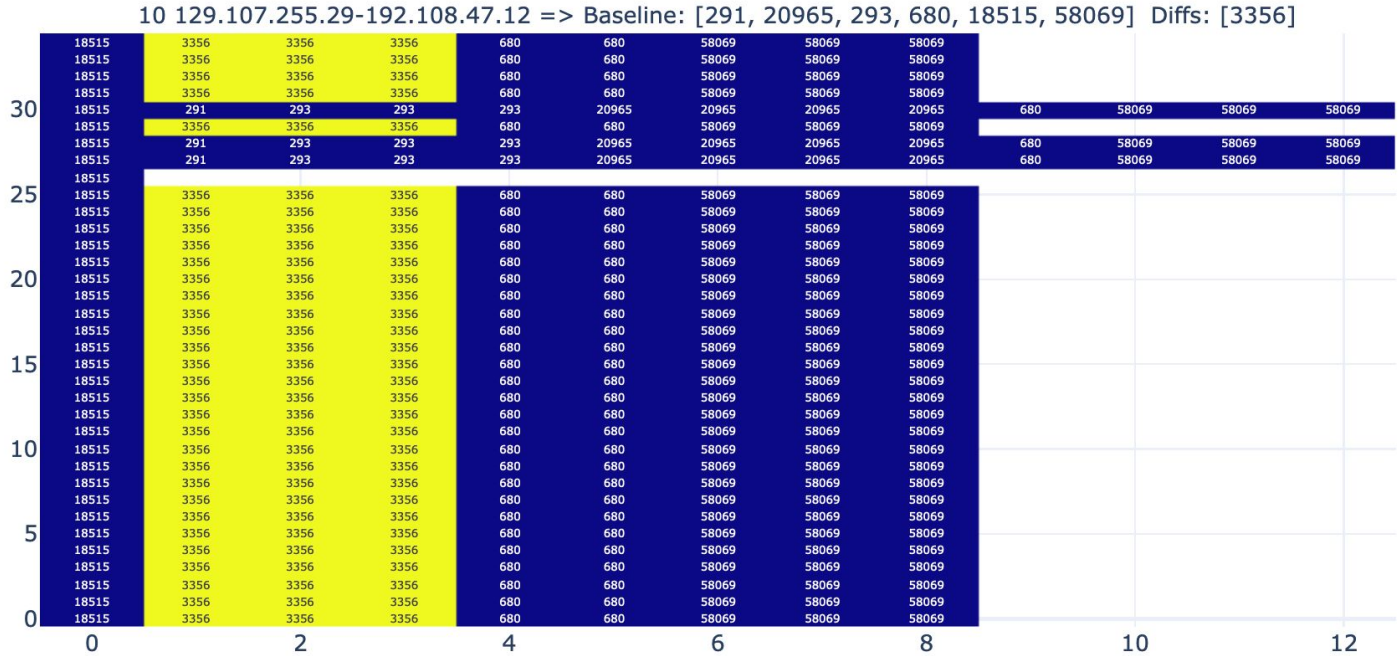
Sat, 26 Mar 2022 04:08:44 Networking/Perfsonar/Bandwidth decreased from/to multiple sites Bandwidth decreased from/to multiple sites
tags: RRC-KI-T1
Bandwidth decreased for ipv4 links between site RRC-KI-T1 to sites: ['BNL-ATLAS', 'IN2P3-LPSC', 'UKI-SCOTGRID-ECDF'] change in percentages: [-12, -30, -13]; and from sites: ['DESY-ZN', 'IN2P3-CPPM'], change in percentages: [-45, -81] with respect to the 21-day average.

Network Path Anomalies Detection

Detection of changes in ASNs sequences across all our traceroutes

Example: UTA_SWT2 -> FZK-LCG2

(each row is a traceroute for this path, traces run every 30 minutes)



Summary

- OSG in collaboration with WLCG operates a comprehensive network monitoring platform
  - Provides data and feedback to LHCOPN/LHCONE, HEPiX, WLCG and OSG communities
- The IRIS-HEP and SAND projects have produced some new tools for exploring and utilizing our network data
- Developing high-level services based on perfSONAR measurements that will help sites, experiments and R&Es receive targeted alarms/alerts on existing issues in the infrastructure
- We have to continue to watch our network monitoring infrastructure as it is a complex system with lots of areas for issues to develop.

Acknowledgements

We would like to thank the **WLCG**, **HEPiX**, **perfSONAR** and **OSG** organizations for their work on the topics presented.

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- OSG: NSF MPS-1148698
- IRIS-HEP: NSF OAC-1836650

Useful URLs

- OSG/WLCG Networking Documentation
  - https://opensciencegrid.github.io/networking/
- perfSONAR Infrastructure Dashboard
  - https://atlas-kibana.mwt2.org:5601/s/networking/goto/9911c54099b2be47ff9700772c3778b7
- perfSONAR Dashboard and Monitoring
  - http://maddash.opensciencegrid.org/maddash-webui
  - https://psetf.opensciencegrid.org/etf/check_mk
- perfSONAR Central Configuration
  - https://psconfig.opensciencegrid.org/
- Toolkit information page
  - https://toolkitinfo.opensciencegrid.org/
- Grafana dashboards
  - http://monit-grafana-open.cern.ch/
- ATLAS Alerting and Alarming Service: https://aaas.atlas-ml.org/
- The pS Dash application: https://ps-dash.uc.ssl-hep.org/
- ESnet WLCG DC Dashboard: https://public.stardust.es.net/d/IkFCB5Hnk/lhc-data-challenge-overview?orgId=1

Backup Slides Follow

WLCG Network Throughput Support Unit

Support channel where sites and experiments can report potential network performance incidents:

- Relevant sites, (N)RENs are notified and perfSONAR infrastructure is used to narrow down the problem to particular link(s) and segment. Also tracking past incidents.
- Feedback to WLCG operations and LHCOPN/LHCONE community

Most common issues: MTU, MTU+Load Balancing, routing (mainly remote sites), site equipment/design, firewall, workloads causing high network usage

As there is no consensus on the MTU to be recommended on the segments connecting servers and clients, LHCOPN/LHCONE working group was established to investigate and produce a recommendation. (See coming talk :))

Importance of Measuring Our Networks

- End-to-end network issues are difficult to spot and localize
  - Network problems are multi-domain, complicating the process
  - Performance issues involving the network are complicated by the number of components involved end-to-end
  - Standardizing on specific tools and methods focuses resources more effectively and provides better self-support.
- **Network problems can severely impact experiments workflows and have taken weeks, months and even years to get addressed!**
- perfSONAR provides a number of standard metrics we can use
  - Latency, Bandwidth and Traceroute
  - These measurements are critical for network visibility
- **Without measuring our complex, global networks we wouldn't be able to reliably use those network to do science**