



perfSONAR Software for LHC Network Measurement

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Disclaimer

- The information in this presentation represents my understanding of the growing consensus within the perfSONAR measurement community.
- It may not represent the views of all of the interested parties (LHC scientists, T[0123] center operators, NRENs, Backbone Networks, Gigapops, Campus network operators, etc.).
- The consensus building process has started, but:
 - It will take a long time to get consensus on the requirements, and even longer on the tools.
 - The LHC community needs measurement infrastructure now

Measurement Infrastructure Scope

- The tools must meet the needs the whole LHC community
 - Tier 0
 - Tier 0 to Tier 1 networks (LHCOPN)
 - Tier 1s
 - Tier 0 to Tier 1 link(s)
 - Tier 1 to other Tier 1 network
 - Tier 1 to Tier 2 & 3 network
 - Tier 2s
 - Tier 1 to Tier 2 network
 - Tier 3s
 - Tier 1 to Tier 3 network
 - Tier 2 to Tier 3 network
- The tools must meet the needs of other application communities
 - The backbone networks expect to use the same tool set for other user communities.
- Not all requirements are satisfied by existing tools.
 - Additional development and a phased deployment will be necessary

High Level Requirements

- **Allow distinguishing between Application and Network problems**
- **Quickly identify network problems, even if they are not currently affecting applications**
- **Identify and react to changes in the underlying network**
 - Allow application managers to understand and react to changes in topology & capacity and re-tune applications as necessary
 - Provide the network data necessary to correlate application performance changes with network topology changes
 - Eventually allow applications to automatically react to network changes (network awareness)
- **The infrastructure & tools used to support the LHCOPN must be able to simultaneously support the Tier 1 centers and other application communities as well.**
- **Provide access to capacity and topology trend data**
 - Support application managers network capacity planning
- **Facilitate identifying and quantifying when the LHC experiment traffic is impacting other users.**

Technical Requirements Circuit Status

1. Monitor up/down status of cross domain circuits

A. What

- Determine the status of a circuit
- Publish status via a web services interface
- Provide tools to visualize state
- Generate NOC alarms when circuits change states

B. Why

- Determine when circuits are available
- Simplify debugging of end to end circuit problems

Technical Requirements Interface Statistics

2. Monitor Link/Circuit Capacity, Utilization & Errors

A. What

- Publish statistics via a web services interface
- Provide tools to visualize the data
- Generate NOC alarms when thresholds are crosses

B. Why

- Allow determining usage patterns
- Simplify throughput problem diagnosis
- Capacity Planning

Technical Requirements Latency

3. Continuously measure end-to-end **delay**

A. What

- Manage multiple sparse meshes of continuous tests and store results in an MA
- Publish results via a standardized web service interface
- Provide a tool to visualize the data
- Provide tools to automatically analyze data and generate NOC alarms

B. Why

- Measure & document actual availability
- Provide time references for when problems occurred and when they were fixed
- Detect & assist in diagnosing common causes of performance degradation
 - a. Packet Loss
 - Congestion related
 - Non-Congestion related
 - b. Queuing & Jitter caused by congestion
 - c. Routing Issues: changes, asymmetry, flapping, etc

Technical Requirements Bandwidth

4. Make regular scheduled **bandwidth** measurements across paths of interest

A. What

- Manage multiple regularly scheduled sparse meshes of tests and store results in an MA
- Publish results via a standardized web service interface
- Provide a tool to visualize the data
- Provide tools to automatically analyze data and generate NOC alarms

B. Why

- Detect performance problems
- Identify when problems appeared
- Document performance delivered

Technical Requirements Topology

5. Measure & Publish Topology of primary and backup paths

A. What

- Publish logical topology via a web services interface
- Provide tools to visualize the data over time

B. Why

- Set user expectations
- Facilitate network problem diagnosis
- Allow correlating logical topology to measurements of the physical topology
- Understand ...

Implementation Details Circuit Status

1. Monitor up/down status of cross domain circuits

A. Tools

- E2Emp or SQLMA
- E2Emon

B. Configuration

- Each Domain publishes the status of their portions of cross domain circuits.
- E2Ecu monitors all LHC circuits?
- Any NOC can run E2Emon to monitor the subset of circuits that they have responsibility for

Implementation Details Interface Statistics

2. Monitor Link/Circuit Capacity, Utilization & Errors

A. Tools

- RRDma, PS-SNMP MA

B. Configuration

- Each domain sets up a Measurement Archive publishing statistics about their network interfaces supporting LHC
 - a. Capacity
 - b. Utilization
 - c. Input Errors
 - d. Output Drops

Implementation Details Latency

3. Continuously measure end-to-end **delay**

A. Tools

- Hades
- OWAMP/AMI
- Pinger

B. Configuration

- Each Domain deploys 1 or more Measurement Points **inside their LHC Center**
 - Hades and/or OWAMP
- Deploy 1 Scheduler & MA for each cluster or community
 - One for LHCOPN
 - One for each Tier 1 that wants to measure their customers
- Deploy a Pinger MA in any community where all of the customers are not able or willing to maintain stable Hades/Owamp MPs.

Implementation Details Bandwidth

4. Make regular scheduled **bandwidth** measurements across paths of interest

A. Tools

- BWCTL & BWCTL MP
- AMI Scheduler & MA

B. Configuration

- Deploy 1 GE connected MP in **inside each LHC center**
- Deploy 1 Scheduler & MA per cluster of MP's
 - a. One for the LHCOPN
 - b. One per Tier 1 that wants to measure their Tier 2 service

Implementation Details Topology

5. Measure & Publish Topology of primary and backup paths

A. Tools Still Under Development

- CNIS
- Internet2 Topology Service

This is not a significant concern for the LHCOPN as long as it continues to be a well defined static topology fully described with the E2Emon tools.

This is an issue when considering Tier 2 traffic which will stress the R&E Networking Infrastructure!

Other Issues

- Implementation Details
 - Additional PerfSONAR services
 - Lookup Service
 - AAA
 - Priorities
 - Schedule
- Implementation Structure
 - Software
 - Service

PerfSONAR Solutions Current Status ■ ■ ■

Attribute	Functionality	perfSONAR Tool(s)	Date
Circuit Up/Down	Measure & Archive	E2E_MP & SQLma	Deployed
	Visualize	E2Emon	Deployed
	Alarm	E2Emon	Deployed
Link Utilization, Errors & Capacity	Measure & Archive	RRDMA Utilization & Capacity RRDMA Input Errors & Output Drops PS-SNMPMA	Done ?? Beta Aug 1, Package Sep 1
	Visualize	perfSONARUI, Visual Traceroute	Done ??
	Alarm	?	?
Round Trip Delay (ICMP) & Traceroute	Measure & Archive	PingerMA Ping MP	Aug 15? Aug 15?
	Visualize	perfSONARUI Plugin?	?
	Alarm	?	?
One way Delay Tests between MPs	Schedule On-demand	AMI MA & Scheduler Hades Owamp MP	Beta Sep 15, Package Oct 1 October Done
	Archive	AMI MA	Oct 1
	Visualize	PerfSONARUI CNM (If same as HADES MA) I2 CGI (Done in Aug, packaged in OCT)	Done ?? October Beta Aug, Package Oct
	Alarm	Being worked on in Internet2. Generate a plan in December 07, implement 08	?
Bandwidth Tests between MPs	Schedule & Measure	BWCTL BWCTL_MP (DFN one) AMI scheduler	Done Dne Beta Sep 15, Package Oct 1
	Archive	AMI_MA DFN MA?	Beta Sep 15, Package Oct 1 ?
	Visualize	PerfSONAR UI Plugin Web CGI scripts	Fall? October
	Alarm	Look at it Spring 08	?