

perfSONAR MDM release 3.0 - Product Brief

In order to provide the fast, reliable and uninterrupted network communication that users of the GÉANT 2 research networks rely on, network administrators must be able to find and fix problems quickly and efficiently. However, while network administrators can identify problems that occur in their local network domains quite easily, methods to track issues across multiple domains are limited and time-consuming. For end-users, this inevitably leads to disruption and dissatisfaction.

The perfSONAR infrastructure provides a multi-domain monitoring (MDM) service that answers the need for cross-domain monitoring capability. For the first time, network administrators are able to access network performance metrics from across multiple domains and can perform network monitoring actions in different network domains. Using out-of-the-box or customised web-interfaces, network problems and performance bottlenecks can be tracked and eliminated quickly, and potential performance issues can be identified and prevented before service disruption occurs.

The perfSONAR MDM service enables users to:

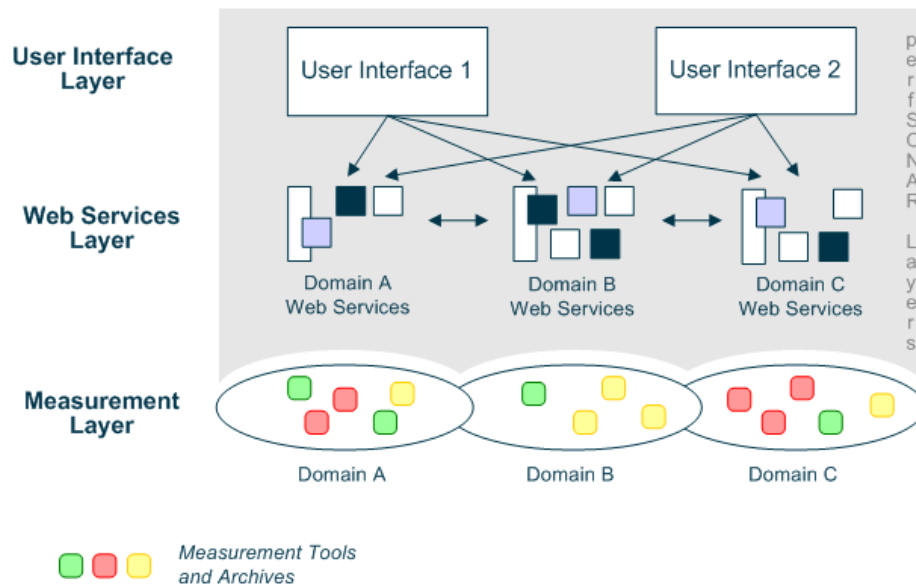
- Access network metrics for their own or any other network in the European REN. The metrics have a universally consistent meaning within the entire European REN.
- Perform network measurements in different networks.

The service comprises:

- Software (the perfSONAR web services and visualisation tools).
- Usage support.
- Software support (deployment and configuration).

Architecture

The perfSONAR project is carried out by a consortium of organisations (GEANT 2, ESnet, Internet 2 and RNP). The perfSONAR infrastructure is constructed as follows:



User Interface Layer

Visualisation tools (user interfaces) that allow users to query and view network information and performance data. The open-source nature of the visualisation tools means that the presentation of performance data can be adapted to the needs of specific user groups.

Web Services Layer

A modular set of open-source perfSONAR web services that enable access to measurement data and network information across administrative domains. Each individual web service is in charge of a specific functionality (for example, authentication and authorisation). Within each domain the set of deployed web services is responsible for the domain control.

The following types of perfSONAR web services are available:

- **Measurement Point web services**
A family of web services which collect and publish the data that the network domains' measurement tools have collected. The measurement data can be collected on demand or in regular intervals according to a defined schedule. The data can be published to a client, transferred to other web services or stored in an archive (a database or a file system).
- **Measurement Archive web services**
A family of web services that read measurement data held in databases or file systems and publish it to clients. The Measurement Archive web services can also be used to write measurement data that other web services provide to data stores.
- **Lookup web services**
Each network domain that joins the perfSONAR infrastructure needs a Lookup web service with which all other web services in this domain register. The Lookup services of multiple network domains communicate with each other and inform clients which web services are available. Clients just need the URL of the Lookup web service.
- **Authentication web services**
Network domains that join the perfSONAR infrastructure can use an Authentication web service to protect resources within their domain. Users are authenticated before they can access the resources required to access measurement data or to carry out measurements).

The modular design and open-source nature of the web services allows domains to implement and combine them according to their individual requirements. Domains can thus create customised domain controls with maximum flexibility.

Measurement Layer

The Measurement Layer of a domain consists of the Measurement Tools (for example, BWCTL, Cricket and MRTG) and Measurement Archives (for example, Hades, SQL and RDD) that are deployed within the domain.

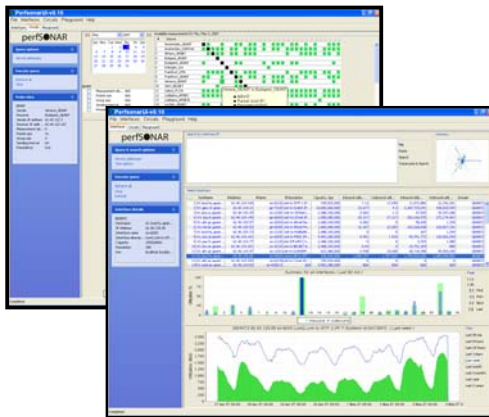
The perfSONAR web services in the Web Service layer wrap the measurement layer's measurement tools and archives, so that relevant network performance information can be exchanged between domains.

perfSONAR Visualisation tools

perfSONAR provides a range of open-source visualisation tools which allow users to query and view network end-to-end performance data in an intuitive, user-friendly way.

perfsnarUI

perfSONAR UI is a Java application that makes network management and performance information from a range of perfSONAR services easily available. Retrieving data from RRD, SQL and Hades Measurement Archive web services as well as SSH / Telnet Measurement Point web services, it provides:

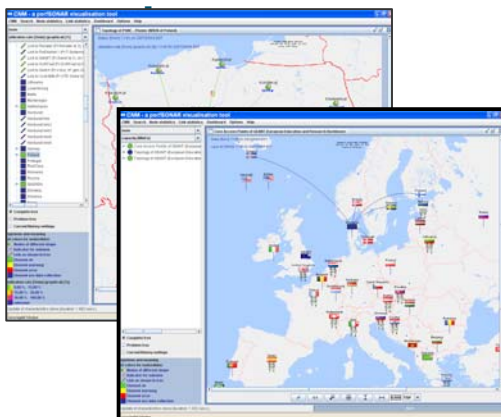


- A utilisation summary for all selected interfaces in tabular and graphical form.
- On-demand TCP throughput tests.
- Visualisation of utilisation details for a chosen interface and a selected time period.
- Graphs, charts, diagrams and figures that represent:
 - One-way delay between measurement points.
 - IP Delay Variation between measurement points.
 - Packet loss between measurement points.
- A Looking glass for retrieving information from network devices in real-time (for example, traceroute, BGP table).

perfSONAR UI is a useful tool for end-users with a basic technical background, NOC staff, PERT staff and projects with demanding network performance requirements.

Customer Network Management (CNM)

The CNM tool is a graphical, map-based interface which displays hierarchical maps of network topologies with performance metrics, including current and historic link utilisation and capacity for network maps and single interfaces. Retrieving data from RRD and Hades Measurement Archive web service, CNM allows users to:

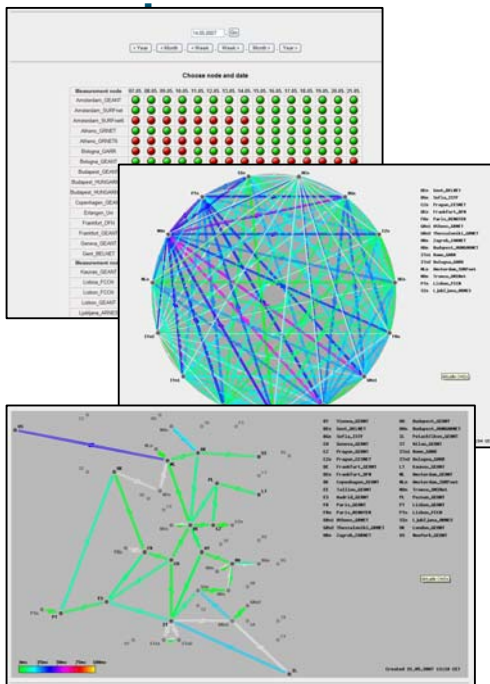


- Gain a current or historic overview of a network.
- Display the network of a participating NREN.
- Easily spot high utilisation, network problems (up / down router and link status).
- Study a statistical graph of a particular link or router over a specific time period.
- View active measurement results:
 - Delay
 - Jitter
 - Loss

CNM is a useful tool end-users, project-team members (project specific maps) and non-technical NREN staff.

Hades Visualisation tool

The Hades visualisation tool is a web-based interface that presents IP Performance Metrics (IPPM – delay based) data and provides:

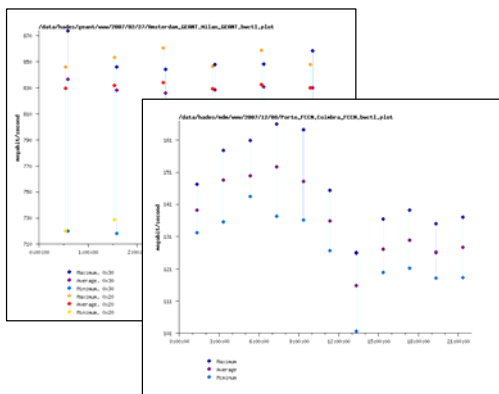


- Domain-based measurement maps
 - A weather map of the measurement network.
 - The GÉANT2 Measurement Circle.
 - The JRA1 Measurement Circle.
- Measurement Host Selection
 - Day-based grid of available measurement data.
 - Selection of measurements per host.
- Visualisation of single measurements per host
 - Selection of available measurement types (OWD, OWDV, PL, traceroute, IPv4, IPv6)
 - Visualisation of data with zoomable graphs, variable timescale.
- Retrieval of network irregularities
 - Measurement maps show information about delay status.
 - If Maps show irregularities, measurement path can be examined using the clickable map or the measurement point selection.
 - Measurements can exhibit reasons for network problems.

The Hades visualisation tool is useful for NOC / PERT staff and end-users.

TCP Throughput Visualisation

A collection of pages which presents historical information about TCP throughput measured between multiple measurement points deployed across EU R&D networks:



- GEANT <http://www.win-labor.dfn.de/bwctl/GEANT/>
- MDM <http://www.win-labor.dfn.de/bwctl/MDM/>.

perfSONAR MDM features

Standardised access to multi-domain network information

The quality of user communication is dependent on smooth interaction of network domains. However, while users expect uninterrupted communication, they do not care about network boundaries. Network administrators on the other hand are primarily focused on their own administrative domain. This leaves a gap where administration of end-to-end service is concerned.

The perfSONAR MDM service bridges this gap by offering a standard means of accessing network information from multiple domains along the end-to-end path. This access allows NRENs to take ownership of user experience and act as a coordinator for their users. By gaining a better understanding of what is happening across the networks, the troubleshooting process can be accelerated, resulting in decreased usage down-time and increased user satisfaction.

Increased efficiency through on-demand troubleshooting tools

Users want quick answers when they encounter a problem and diagnostic confirmation tends to take too long for them. This means that users move on to other projects and that opportunities to gain new users and increase network use are lost.

The perfSONAR MDM service speeds up the troubleshooting process by giving network operators authorised access to multiple information and on-demand troubleshooting tools (for example, BWCTL MP and SSH/Telnet MP). Information that network operators access through perfSONAR has the same meaning across the board. This enables operators to discuss problems which span multiple domain boundaries on a communal basis and to collaborate more successfully.

Easy identification of information sources

While in the past it was quite difficult to find out which monitoring capabilities were available in different networks, perfSONAR includes a built-in discovery mechanism (the Lookup web service) that automatically identifies available services and lists them for quick lookup.

All Measurement Point and Measurement Archive web services that are available within the perfSONAR networks register with the perfSONAR Lookup web service and confirm their availability in regular intervals while they are running, until un-registering when going offline.

Network performance validation

The users' focus on end-to-end application usage makes it difficult for network operators to prove that the network is not responsible for an application's lack of performance.

Using the perfSONAR MDM service, networks operator can provide users with information about causes of application performance degradation. The perfSONAR UI and Hades visualisation tools provide graphs, charts and diagrams that make it easy to keep track of network performance. On-demand tests (for example, TCP throughput tests) can provide additional evidence that the network behaves appropriately.

Optimised network usage through regular TCP throughput tests

While user interest focuses on network usage, network operators are interested in the network itself. However, they cannot optimise network usage if they are unable to see how the network behaves for different applications and transport protocols. If professional users, for example, stretch network performance by attempting to transfer large amounts of data, network operators have little information on how the transfers are affected by their networks.

The perfSONAR MDM service allows network operators to perform regular TCP throughput tests between multiple locations. This enables them to optimise application usage by understanding how a TCP transfer behaves on their network and by observing the effect of a change on a TCP transfer. The perfSONAR UI visualisation tool also includes the capability to trigger on-demand TCP and UDP tests. These require authentication.

Faster problem identification through consistent end-to-end service monitoring

Individual domains use different measurement tools to monitor their network, which produce data that is meaningless to other networks as it cannot be understood by them without being converted first.

The perfSONAR MDM web services wrap the measurement tools of the individual networks and translate measurements into consistent data that can be read across the network. It monitors circuit-based end-to-end services by providing the status of its end-to-end circuit sections for each local domain. This information is used by the end-to-end coordination unit (E2EMon application) to get an overview of the service offered and to allow users to quickly identify where a problem is located.

The perfSONAR MDM service provides a range of consistent measurements for monitoring the network's IP services:

- Link utilisation
The perfSONAR MDM service collects historical information about the IP link utilisation and IP link capacity.
- Input errors and output drops
The perfSONAR MDM service provides interface input errors and output drops information.
- Historical one-way delay, one-way packet loss, IP packet delay variation (IPv4, IPv6, IP QoS configurable)
The perfSONAR MDM service executes scheduled active delay tests between 50 servers distributed across the European REN (not in a full mesh). These are used to identify long term trends and evolution of the network performances.
- Traceroute
The perfSONAR MDM service executes scheduled traceroute tests between 50 servers distributed over the European REN (not in a full mesh). These tests indicate path changes (host list varies, number of hops varies) and asymmetric traffic.

Project control through network monitoring

Large projects like to have the ownership of their network. In reality, however, networks are a collection of elements provided by multiple network operators and by the projects themselves, and this makes it difficult to identify the source of a problem.

Using perfSONAR MDM service tools, projects can monitor their virtual network, and be given access to basic network monitoring information that allows them to identify if events on the network impact their usage.

Secure access

perfSONAR's multi-domain functionality access provides instant access to data from multiple domains. Network domains that join the perfSONAR infrastructure can use an Authentication web service to protect resources within their domain. Users have to be authenticated before they can access measurement data or carry out measurements).

perfSONAR MDM troubleshooting features

The perfSONAR MDM service provides a range of metrics and measurements that make it easier to troubleshoot network IP service problems by providing indications of where issues originate and how they are caused.

Input error monitoring

The perfSONAR MDM service uses input errors to identify if a link along the path is faulty and trace possible causes for performance degradation of user applications.

Output drop monitoring

The perfSONAR MDM service uses output drops to identify long term congestion and congestion that is caused by short timescale traffic bursts.

On-demand TCP/UDP throughput tests

The perfSONAR MDM service provides standby test tools that give perfSONAR users authorised access to perform on-demand TCP/UDP throughput tests (IPv4, IPv6). Tests can be executed between two measurements points to:

- Check if a user transfer performance problem is due to a network problem between backbones.
- Assess small level of packet loss between two MPs.

Router show commands

A consistent set of commands that can be run against any router in perfSONAR network domains (where deployed).

Link utilisation measurements

The perfSONAR MDM service's IP link utilisation and capacity measurements provide information that enables detection of:

- High utilisation and congestion
The perfSONAR UI includes a graph that represents utilisation versus capacity. High utilisation (over 60 %) can have an impact on traffic. A flat line indicates that utilisation has exhausted the available capacity.
- IP packet re-routing
A steep increase or decrease of traffic may indicate packet re-routing.
- Equipment or link faults
A drop in traffic over several hours indicates faults in equipment or links, or abnormal behaviour.

Scheduled traceroute tests

The perfSONAR MDM service executes scheduled traceroute tests between 50 servers distributed over the European REN (not in a full mesh) in regular intervals to trace:

- Path changes (host list varies, number of hops varies).
- Asymmetric traffic.

Scheduled active delay tests

The perfSONAR MDM service executes scheduled active delay tests between 50 servers distributed over the European REN (not in a full mesh) in regular intervals to collect historical one-way delay, one-way packet loss and IP Packet delay variation (IPv4, IPv6, IP QoS configurable) metrics. These indicate:

- High utilisation and congestion.
- IP packet re-routing.
- Asymmetric traffic.
- Where traffic to networks is likely to be affected by incidents.
- Various other network problems.

perfSONAR benefits

Benefits for NRENS

As an increasing number of distributed projects relies more and more on the networks, the perfSONAR MDM service provides efficient tools that allow NRENS to:

- Control access to data in the local network domain.
- Offer a supported edge-to-edge service to your users that is monitored by you and your partners.
- Create a tailored, dedicated network view for your users.
- Increase productivity and self-sufficiency by giving users access to tool sets (for example, using perfSONAR UI) that allow them to troubleshoot problems themselves.

Benefits for NOCs and PERT

The perfSONAR MDM capabilities give NOCs and PERT more control over services that rely on network collaboration, allowing them to provide a better service to their users and increase satisfaction. Authorised, secure access to relevant data and functionalities across all perfSONAR networks makes it easy for network operators to view and act on information that other networks have made available.

- Identify network issues.
- Troubleshoot global network issues.
- Track network performance.
- Supported, reliable monitoring infrastructure and tools.
- Quickly identify and resolve multi-domain network issues.
- Be more in sync with peer network domains.

Benefits for end-users

The perfSONAR MDM service provides an optimised user experience by delivering:

- Faster, more reliable end-to-end network service.
- Quick identification of network-related application issues.
- Minimised waiting time for resolution of network problems.

FAQs

Which MA and MP web services should you run?

Web-services / Things you want to do	RRD MA	SQL MA	Telnet/ SSH MP	BWCTL MP	Circuit Status MP	Hades tool	cNIS	TCMP MP	Lookup Service	Authentication Service
Look at E2E Circuit Monitoring information		✓			✓					
Detect congestion	✓	✓				✓				
Detect path changes	(✓)	(✓)	✓			✓				
Detect abnormal link behaviour/ performance degradation	✓	✓		✓		✓				
Test / verify TCP transfer				✓						
Detect small packet loss				✓						
Assess impact of network configuration changes				✓		✓				
Assess impact of incidents				✓		✓				
Assess the user experience				✓		(✓)				
Access show commands (Looking glass)			✓							
Discover other network monitoring functionalities.									✓	
Authentication the users accessing the tools	✓*	✓*	✓*	✓	✓*					✓+
Access IP topology							✓			
Capture Packet traces in remote locations								✓		
Multi-Domain Monitoring Service (MDM)	✓	✓	✓	✓	✓	✓	tbc	tbc	✓	✓

(✓) indirect observation

* optional functionality

+ mandatory to access authenticated perfSONAR web services

Who is already using the perfSONAR MDM measurements?

The following networks are already benefiting from joining the perfSONAR community:

- Abilene
- ACAD/ISTF
- CARNet
- Cesnet
- Cynet
- ESnet
- FCCN
- Fermilab
- GARR
- GÉANT2
- GRnet
- Hungarnet
- MREN
- PIONIER
- REDIRIS
- RedClara
- RENATER
- RIPE
- RNP
- SEEREN
- SURFnet
- SWITCH
- Telnet
- Uninett

Where can GN2 users find performance measurement results?

You can find links to measurement tools at: <http://stats.geant2.net/>

For support, please email: perfsonar-user@perfsonar.net