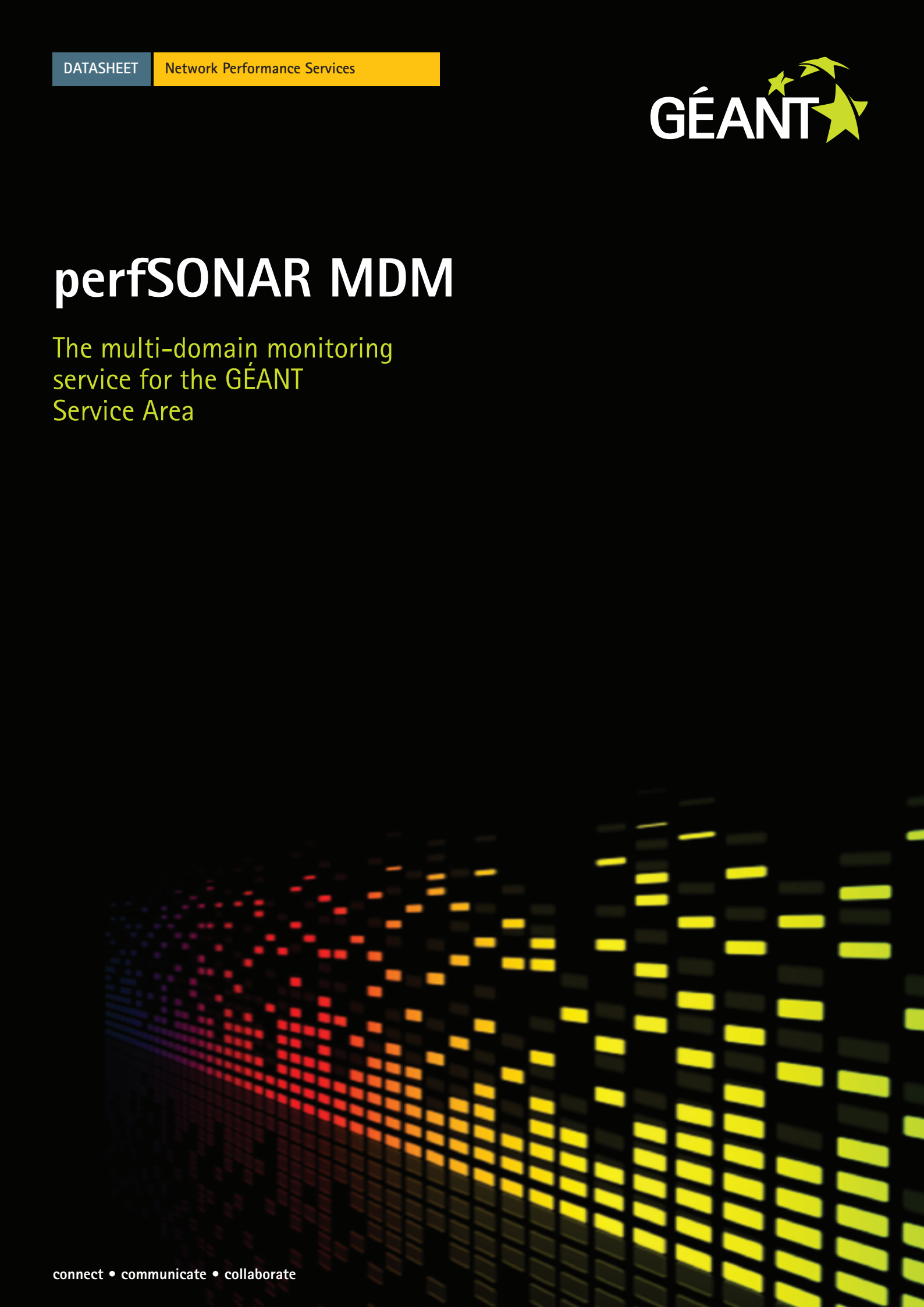
DATASHEET | Network Performance Services

perfSONAR MDM

The multi-domain monitoring service for the GÉANT Service Area



connect • communicate • collaborate

What is perfSONAR MDM?

perfSONAR MDM (Multi-Domain Monitoring) is GÉANT's multi-domain monitoring service, enabling NREN NOCs and PERTs to collaborate, and provide seamless network performance for their users.

The challenge of multi-domain networking

Thanks to the power of communications networks, researchers can increasingly collaborate with colleagues at the forefront of their fields in different parts of the world. This means that the research work is likely to be supported by several separate data networks working together to connect the different locations involved.

Multi-domain networking is technically challenging.
While problems in local network domains can be identified relatively easily, methods to track issues across multiple domains are limited and time-consuming. Monitoring tools are vital for ensuring peak network performance but often proprietary and normally only provide data for only a single domain. Performing monitoring in a multi-domain environment is difficult because the individual networks' monitoring tools do not necessarily work readily together.

The solution: perfSONAR MDM

The re-designed GÉANT perfSONAR MDM service provides its users - Network Operation Centre (NOC) and Performance Enhancement Response Team (PERT) engineers - access to network measurement data from multiple network domains. This can be used to view, analyse and diagnose network behaviour across the entire network path, enabling easy and swift identification of problems with network performance.

While the service primarily benefits members PERTs and NREN NOCs, the ultimate beneficiary of the service is the network user (researchers, scientists & students). By providing a multi-domain monitoring and diagnostics infrastructure, NRENs can better serve international users and projects that rely on dedicated and reliable connectivity with vastly quicker resolution of network issues and fewer performance disruptions.

> **The new GÉANT perfSONAR MDM service enables NOC and PERT engineers to quickly identify the cause and location of network problems, eliminating the issue with minimal down time.**
>
> *Frederic Loui, Network Manager, RENATER.*

perfSONAR MDM at a Glance

- Re-designed GÉANT service for seamless multi-domain monitoring
- Immediate access to monitoring data from multiple domains
- Data presented visually through a web user interface
- Use data to easily identify, solve and prevent problems with network performance

Key Features

Multi-domain
perfSONAR MDM provides a complete picture of network performance across multiple domains allowing NOC and PERT engineers to seamlessly view, analyse and diagnose network behaviour across the entire network path.

Interoperable
With no hardware dependencies perfSONAR MDM is interoperable with similar monitoring services offered by European and international partners.

Federated service
The service is collaboratively delivered by GÉANT and participating NRENs, allowing those NRENs to install, deploy and manage their own monitoring installation.

Dedicated support
PerfSONAR MDM is fully supported by GÉANT, with support from a dedicated deployment team and on-going support from the GÉANT Multi-Domain Service Desk.

User driven
As a part of the GÉANT Service Portfolio perfSONAR MDM is owned by the member NRENs, meaning that its development and implementation requirements are driven by the NREN community.

Why Deploy perfSONAR MDM?

As research and collaboration increasingly spans more than one network, it makes more and more sense to adopt a monitoring service that can view, analyse and diagnose network behaviour across the entire network path.

1. Simple yet powerful

The recently re-designed perfSONAR MDM is more powerful than ever and even simpler to install, deploy and use.

- Simplified structure
- Simplified installation procedure
- No hardware dependencies

2. Open and flexible

PerfSONAR MDM has been designed with its user community firmly in mind with the intention of making the service as open and flexible as possible.

- Active panel of real users
- Interoperability with other perfSONAR deployments
- Growing community of NRENs and research projects in Europe, Latin America and Asia

3. Accessible

perfSONAR MDM makes it easier than ever to access the tools to run performance tests on the network.

- Integrated web-based user interface
- One URL for all metrics
- Run crucial performance tests from smartphones and mobile devices

4. Fully supported

As a federated service owned and operated by GÉANT and participating NRENs, perfSONAR MDM benefits from the support only the GÉANT community can provide.

- Deployment assisted by a dedicated GÉANT team
- On-going support from the GÉANT Multi-Domain Service Desk (telephone and email)
- Support covers deployment, configuration and incident management
- Training events for participants

NREN NOCs & PERT Benefits

- Immediate access to the complete picture of monitoring data across a given network path
- Accurate, quick and efficient detection of bottlenecks, outages and performance issues where problems span multiple domains
- Assistance in the proactive identification and prevention of problems before service disruption occurs, helping to provide fast, reliable and uninterrupted network communication

NREN Core Benefits

- Achieve better network performance and customer service for users, especially those with multiple project partners located in different countries
- No more waiting for other NRENs to provide their network monitoring data that affects your users' experience
- Offer a supported edge-to-edge service to users, monitored by the NRENs and their partners

Network Users Benefits (researchers, scientists & students)

- Improved overall perception of network performance and customer service
- Quicker solutions to network outages
- Fewer disruptions
- Fewer performance issues

perfSONAR MDM in Detail

Driven by users, GÉANT's perfSONAR MDM service has undergone significant enhancements in recent years to become the streamlined service available today.

From research activity to the full service

perfSONAR MDM started out as a joint research activity within the previous GÉANT project (GN2), with the purpose of exploring the possibilities of multi-domain monitoring. It was then transitioned into a service at the start of the current GÉANT project (GN3).

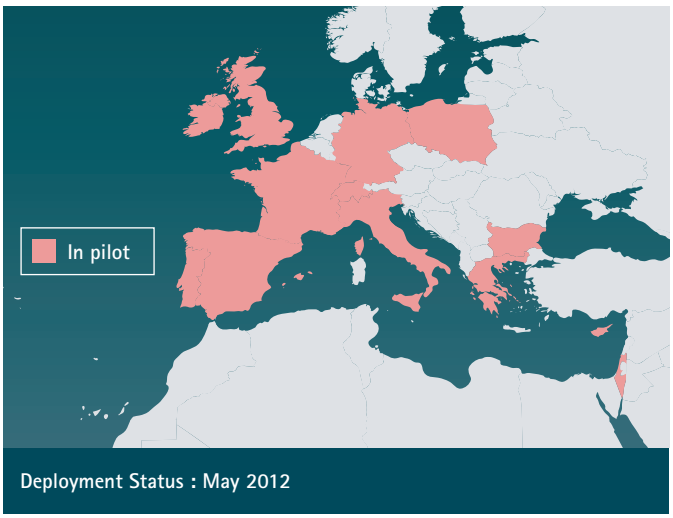
Re-designed from 2010

In 2010 the perfSONAR MDM team began a complete overhaul of the service, working closer with GÉANT/NREN NOCs who were actively using it, to match the service to their needs. A perfSONAR MDM User Panel was established to gather user requirements and to gain on-going feedback from the user community. This has resulted in a better, streamlined service with only the features the users require.

Globally deployed

A growing number of European NRENs are piloting the perfSONAR MDM service for their NOC/PERT engineers including Red IRIS, DFN, PIONIER, SWITCH, HEAnet, GARR, GRnet, RENATER, JANET, FCCN, BREN, CYNET, IUCC and DANTE (for the GÉANT backbone).

With 43 perfSONAR MDM measuring points across the GÉANT Service Area, 8 in ESnet (USA), 9 in Internet2 (USA) and soon Asia, Africa and Latin America, perfSONAR MDM is truly a global network monitoring service.



perfSONAR (without the MDM)

perfSONAR (Performance Service-Oriented Network monitoring ARchitecture) is a protocol, architecture and set of tools which have been developed specifically to address the challenge of monitoring network performance in a multi-domain environment and is the only known system capable of performing this. perfSONAR was produced by an international collaboration between organisations in Europe, North America and Brazil with the collaborating organisations using the perfSONAR concept to develop their own service to their own requirements. perfSONAR MDM is GÉANT's service based on the perfSONAR concept, developed to the needs of the European NREN community.

The difference between perfSONAR MDM and perfSONAR PS

perfSONAR PS is the Internet2/ESnet (North American NRENs) implementation of the perfSONAR monitoring concept and infrastructure. There are similarities between the two as they both use the perfSONAR protocol to exchange data and both share the same overall design goals which include flexibility, extensibility, openness, and decentralization.

Even though they share a common view, the actual software development process, product life cycles, interaction with the users, implementation and deployment are very different. The differences stem mainly from the fact that perfSONAR MDM is designed to provide a service, with federated deployment - centrally monitored and coordinated – and full support. While perfSONAR PS has a distributed support model with the goal of proliferating the number of performance nodes deployed across the community.

Despite the differences, perfSONAR MDM and perfSONAR PS have been committed to being interoperable with each other since March 2010.

Service Architecture

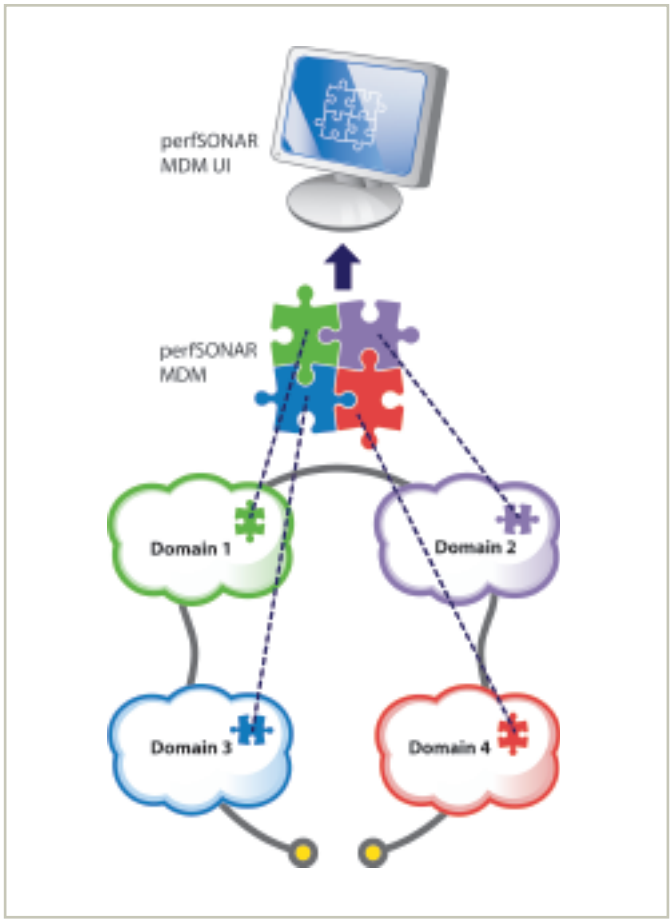
The diagram shows how the GÉANT perfSONAR MDM service operates in a multi-domain environment. The service is collaboratively delivered by participating NRENs, each setting up an instance of perfSONAR MDM in their own domain. Each instance of perfSONAR MDM consists of the following three software components that provide the network monitoring data.

HADES (Hades Active Delay Evaluation System) is used to gather and store data regarding one way delay, jitter, traceroute and packet loss.

BWCTL MP (Bandwidth Controller Measurement Point) is used to perform Achievable bandwidth measurements.

RRD MA (The Round Robin Database Measurement Archive) provides data on link utilization, link capacity, input errors and output drops.

The network information is extracted and collated from each NREN and then presented in a standardised, universally-usable format through the perfSONAR MDM user interface. Network engineers can access network metrics for their own network or for any other perfSONAR MDM-participating network across the GÉANT Service Area, providing the complete picture of the network's status across different domains.



Performance Metrics & Functionality

	HADES One way Delay, Jitter,	BWCTL MP Achievable Bandwidth	RRD MA Link utilisation
Measure network latency in	x		
Detect congestion	x	x	x
Detect path changes	x		
Detects abnormal link	x	x	x
Test/verify TCP transfer		x	
Detect small packet loss	x		x
Assess impact of network	x	x	
Assess incident impact	x	x	
Assess user experience	x	x	x

The perfSONAR MDM User Panel

A user panel of NREN NOC and PERT engineers has been established to represent the views, needs and experiences of perfSONAR MDM users.

The perfSONAR MDM User Panel is GÉANT's first formal user panel and it assists the requirement-gathering process through strong two-way communication between the service development team and its users, ensuring on-going improvement to the service.

The user panel in action

The user panel has regular meetings to discuss the quality of the service, with regards to functionality, security, support and delivery.

Through the user panel, European NRENs have expressed the importance of the security of their data and its use in the perfSONAR MDM service. The perfSONAR MDM development team have listened to these requests and are committed to integrating them in to the service.

This is one of the many examples of the user panel in action. If you want you would like to address any queries to the panel or would like to be involved, contact:

perfsonar-user-panel@geant.net

Support & Training

As perfSONAR MDM is part of the GÉANT Service Portfolio it is fully supported by the GÉANT community. The perfSONAR MDM team realise there is no such thing as a "one size fits all" approach when it comes to network monitoring which is why they offer support at all stages of the service.

Dedicated deployment team

The deployment of perfSONAR MDM is supported by a dedicated GÉANT team lead by a service deployment coordinator. They can offer one-to-one support on all aspects of preparing, planning and deploying the perSONAR MDM service.

For more information on deploying perfSONAR MDM see the section "How is perfSONAR MDM deployed?" (p.11) or to speak to the deployment team directly, email:

perfsonar-info@geant.net

GÉANT Multi-Domain Service Desk

When the perfSONAR MDM service is fully operational the dedicated deployment team will hand over on-going support to the GÉANT Multi-Domain Service Desk (MDSD).

The MDSD provides a single point of contact to NREN NOCs requiring assistance with multi-domain services and tools. Open from 08:00 to 17:00 UK time, Monday to Friday, the MDSD is able to provide prompt support to European NREN NOCs.

For more information on GÉANT's MDSD, go to:

http://mdsd.geant.net

Hands on training

The perfSONAR MDM team understands that knowing how to use the tools at your disposal effectively is important, which is why training is offered to all service participants.

Training is focused on the deployment and operation of perfSONAR MDM. They are hands-on events with practical exercises, led by experienced developers, designed to help NRENs to deploy their perfSONAR MDM infrastructure and effectively configure it.

To register your interest in attending, please email the perfSONAR MDM team:

perfsonar-info@geant.net

Using perfSONAR MDM

With GÉANT's perfSONAR MDM solution users can access all the performance metrics they need to ensure seamless network performance from one URL. Network measurement data is collected and presented as a complete picture to the user using an easy to use web based visualisation tool.

One way delay, jitter, traceroute and packet loss

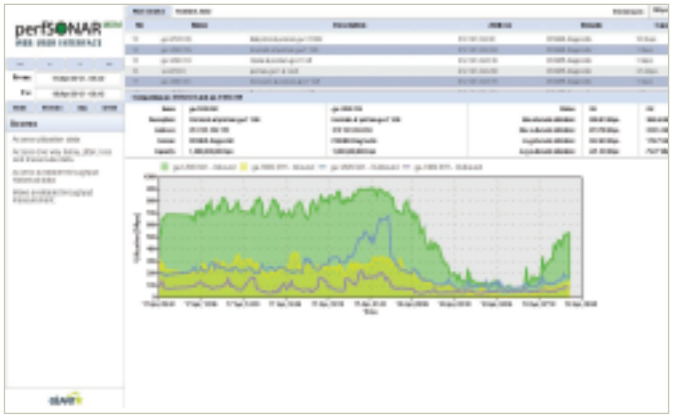
View measurements that help detect network latency, side by side, with three easy to read graphs.

- Jitter (IPDV) – min, med and max values
- One way delay – min, med and max values
- Packet loss/duplicates
- Click graphs for simple route comparison

Link utilisation, input errors, output drops

Access historical measurements from interfaces across the world.

- Maximum and average values displayed alongside link information
- Links displayed in different colours for easy comparison
- Values shown in Mbps or % of capacity
- Graph automatically updates when a new time interval is selected



Achievable bandwidth – scheduled

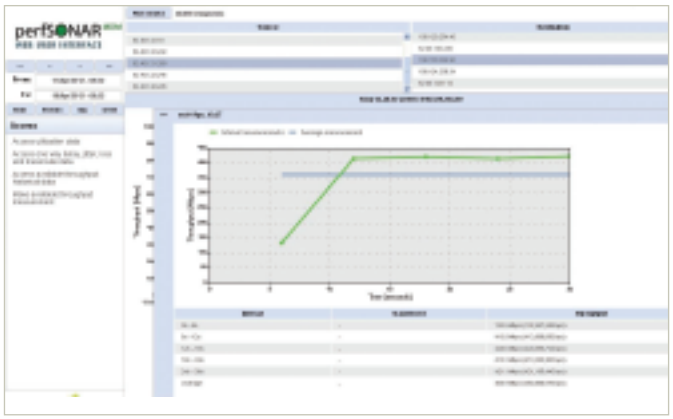
Access historical measurements from scheduled bandwidth tests.

- Set test duration and reporting interval
- Each time measurement is displayed as a green dot on the graph
- Average values displayed in blue
- Click on dot to open test information displayed in chart or table format

Achievable bandwidth – on demand

Unique to perfSONAR MDM, achievable bandwidth measurements tests can be conducted across multiple domains on demand.

- Customise tests and specify parameters
- Results displayed in graph or tabular form
- Support for TCP, UDP, IPv4 or IPv6



New weather map integration

The latest release of perfSONAR MDM is equipped with a new weather map feature catering to the needs of the Large Hadron Collider (LHC) at CERN and its connected tier one and tier two sites.

- At-a-glance measurement of the network performance of all LHC connected sites
- 19 performance metrics
- Fully customisable e.g. different colour codes for different levels of performance

End-to-end analysis

The weather map feature is also a valuable tool for NRENs and can be used to monitor network performance internally as well as across multiple domains.

- View the end-to-end path graphically
- Split the network path in to smaller sections
- Visually compare performance metrics for each section side by side

Accessible from mobile devices

Monitor the network through your smartphone with perfSONAR MDM's new web-based user interface.

- Trigger on demand measurements anywhere
- Respond to issues quicker
- Only need your phone when visiting other NOCs and POPs

perfSONAR MDM in Practice

perfSONAR MDM's main users are NOC and PERT engineers from EU NRENs but there is an increasing interest from other communities such as network research, grid/cloud computing, high-energy physics, arts and the humanities.

Supporting the Arts & Humanities

The power of the perfSONAR MDM service was recently demonstrated at the TERENA Network Performing Arts Production Workshop in Barcelona (June 2011). The event included a successful simultaneous performance featuring dancers in Brasilia and Barcelona performing together in choreographed unison. Video cameras in each venue captured the dancers, with the images and sound then transmitted across high speed academic networks and back projected in real time at the other location. This meant that dancers thousands of miles away could interact on a virtual stage, as if they were all in the same place.

The performers, from the Brazilian e-pormundos afeto dance company and the KONIC group (in Barcelona) were linked by high speed networks, with the performance involving collaboration between NRENs:

- CESCA (Catalan NREN)
- redIRIS (Spanish NREN)
- GÉANT, (pan-European research network)
- redCLARA, (Latin American research network)
- RNP (Brazilian NREN)

Making sure the performance was successful required fast, high capacity and stable network links between the two venues. As part of the collaboration the networks involved used perfSONAR MDM to test the route, monitor for potential problems and solve any issues before the performance began.

Overall the extremely successful performance showed the benefits of international collaboration – not just between the dancers in Europe and South America, but between all networks involved, underpinned by the end to end monitoring of perfSONAR MDM.

The Challenge

Create a successful simultaneous performance featuring dancers in Brasilia and Barcelona performing together in choreographed unison on a virtual stage, as if they were all in the same place.

The Solution

perfSONAR MDM was chosen due to its ability to monitor network performance seamlessly across multiple domains.

Key Benefits

With monitoring points on all key links, engineers from all the networks could log on and access network measurement data from multiple domains in a standardised format. This meant they could work together, identifying potential issues on the intercontinental route that would affect network performance and take action to solve these before the event, confident that they were seeing the same information in a consistent format.

perfSONAR MDM enabled the engineering teams across the domains between Barcelona and Brazil end points to quickly pin-point possible network bottlenecks and ensure the network configuration was adequate to support the dance performance transmission for the TERENA Network Performing Arts Production Workshop in Barcelona.

Fausto Vetter, RNP Research & Development Coordinator

Supporting High Energy Physics

The Large Hadron Collider (LHC) at CERN is the largest scientific experiment in the world, producing over 20 petabytes of data every year. Analysing this data is a truly global collaboration, with a vast optical private network (LHC OPN), created by GÉANT and its NREN partners, distributing information around the world. LHC experimental data is first sent to 11 tier one sites, which then share it with over 140 further tier two locations. Ensuring consistent high performance of the network is critical to the analysis of LHC data.

perfSONAR MDM has been deployed by many of the tier one and two sites across the world, including the tier one centre in Spain, PIC (Port d'Informació Científica: "Scientific Information Port"), and two of the Spanish tier two centres, CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológica) and IFAE (Institut de Física d'Altes Energies) to monitor the end-to-end links that connect them to the LHC OPN.

The experiments carried out at the Large Hadron Collider are fundamental to better understanding the world around us and how it operates. Given the sheer scale of the results created global collaboration between researchers is central to analysing and understanding experimental data. Using perfSONAR MDM enables us to monitor end-to-end performance to ensure that our scientists can receive the vast amounts of data created by the LHC and in turn, share their analysis with colleagues across the globe. Combining ease of use with powerful capabilities perfSONAR MDM is vital to support our research work as part of the LHC community.

Gonzalo Merino, LHC Tier1 Project Manager, PIC

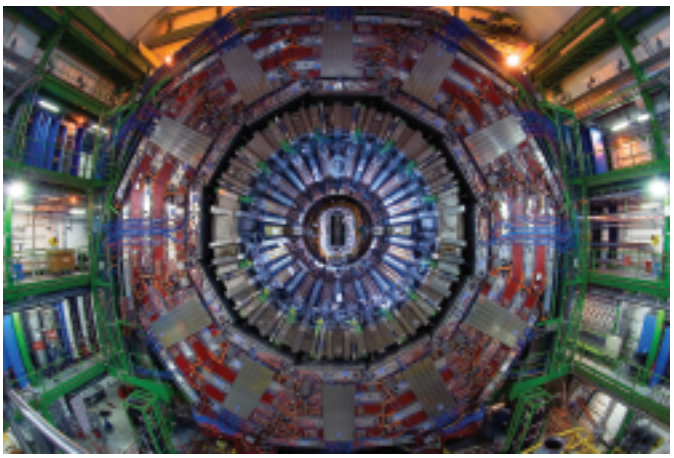


Image source: CERN

Q & A with an LHC Tier 1

Gerard Bernabeu, Production Coordinator at PIC explains how perfSONAR MDM assists him and his team with maintaining the performance of the network.

In general how does perfSONAR MDM help you monitor and maintain consistent high performance of the network at your Tier 1 centre?

We use perfSONAR MDM to debug networking issues whenever an issue involving another site with a working perfSONAR MDM instance is reported to us. Having historical information is very useful to identify what is the root cause of an issue and to properly report it.

What benefits do you gain in having the same instance of perfSONAR (perfSONAR MDM) deployed at all levels of monitoring points in your network, so across the backbone, NREN, Tier 1 and Tier 2?

Having perfSONAR MDM allows us to more efficiently debug network issues, especially to identify overloaded network segments/links. It is a huge advantage to be able to test an end-to-end connection (i.e. T1-T2) segment by segment; it allow us to have 5 times more information in a typical T1-T2 connection (T1-RREN-NREN-GÉANT-NREN-T2).

GÉANT provides dedicated support for its perfSONAR MDM service – how valuable do you find this support and how useful is it that it comes from the same time zone?

GÉANT's perfSONAR MDM support is very useful to us. In particular, having same time zone support allows a better response time whenever necessary.

perfSONAR MDM has a comprehensive web user interface that displays network performance data visually. How does this help you diagnose network problems faster?

Looking at perfSONAR MDM measurements from the web interface is now easier. It is a great improvement from the previous java interface.

How is perfSONAR MDM Deployed?

Free to NRENs, the new streamlined perfSONAR MDM now has only 3 components to install, taking a maximum of a day to set up. With the minimum requirement of providing only one measurement point on the network, perfSONAR is truly simple to be part of.

The initial step for an NREN to become part of the perfSONAR MDM service is to contact the perfSONAR team. At this point each NREN is handed over to the dedicated GÉANT perfSONAR MDM deployment team, where they are guided through the deployment process.

1. Prepare

The first stage is to plan the required actions for implementing the service, such as software, hardware, connectivity, support and policy requirements. The main outcome of this stage is a detailed plan stating the required tasks for all stages of implementing the service. Here the dedicated GÉANT deployment team will work with each NREN to discuss which method of deploying the service is best for them.

2. Deploy

The focus of this stage is to install the main software components and to start developing the monitoring infrastructure within the NREN. NRENs are ultimately responsible for this but GÉANT will provide support and training to NOC and/or PERT engineers on how to install, configure and operate the service.

3. Transition

The GÉANT deployment team will work with NOC and or PERT staff to integrate the software into the NRENs processes and procedures. At this stage all software and hardware components will be configured and tested. Training will be provided at this stage in preparation for the service becoming fully operational.

4. Operate

This is the final stage of deployment. The perfSONAR MDM service will be fully operational at this point and all software elements will be providing consistent delivery of data to the NOC and PERT users. At this point the dedicated GÉANT deployment team will hand over support to the internal support teams and the GÉANT Multi-Domain Service Desk for supporting, assistance and coordination of the day-to-day operations of the service.

Get started with perfSONAR MDM

Service cost
- The service is FREE for NRENs

Equipment
- One Server (no hardware dependencies)
- Two Network interface cards

Staff resources
- Installation requires one systems administrator
- An internal support team will need to be defined for day-to-day operations

Deployment time
- Install the software components in under a day

Service Commitment
- Start with only one measurement point on the network

Further information

For detailed information regarding the software installation requirements and process please consult the installation guides which can be downloaded from the "Resources" page of the perfSONAR website, or contact the perfSONAR team directly.

http://perfsonar.geant.net/resources

perfsonar-info@geant.net

Be part of the perfSONAR MDM community

A growing number of NRENs are currently piloting the GÉANT perfSONAR MDM service for their NOC/PERT engineers. By joining the service pilot you not only experience the benefits of the service but become part of the perfSONAR MDM community.

All NRENs are invited to join the service pilot. Contact the perfSONAR team: **perfsonar-info@geant.net**

Further Information

Want more information? Find out more from these resources:

perfSONAR MDM website
http://perfsonar.geant.net

perfSONAR MDM Twitter
@perfSONARMDM

GÉANT Forge (technical resources)
http://forge.geant.net

Part of the GÉANT Service Portfolio

In collaboration with Europe's NRENs, GÉANT is developing user-focused, multi-domain services aimed at delivering seamless network performance across borders and domains.

The range of services includes IP and dedicated circuits, authentication and roaming, security, monitoring and troubleshooting, advisory and support services.

For more information on the **GÉANT Service Portfolio** please visit **www.geant.net**

Further information:
http://perfsonar.geant.net

This document has been produced with the financial assistance of the European Union. The contents of this document are the sole responsibility of DANTE and can under no circumstances be regarded as reflecting the position of the European Union.

PB/BOD/0512