Network performance event management based upon the perfSONAR framework

M. Giertych, R. Łapacz, P. Pikusa, R. Szuman, S. Trocha

Poznań Supercomputing and Networking Center, ul. Noskowskiego 12/14, 61-704 Poznań, Poland

{mikus, romradz, pikusa, rszuman, szymon.trocha}@man.poznan.pl

Keywords: network performance, event management, network monitoring, multi-domain, perfSONAR

Abstract: Performance problems detection in computer networks is becoming increasingly hard as the monitoring infrastructures built to monitor network metrics and collect monitoring information spread over multiple domains. Typically there could be a lot of abnormal conditions which need to be looked at to identify network performance problems. But only few of them may require a network engineer to follow up. Therefore, it is highly desirable to assist him/her in effective collection and correlation of performance measurement data and detection and prioritization of performance events.

This paper presents an architecture of a network performance event processing tool which is able to utilize the multi-domain measurement framework of perfSONAR. The design of the Transformation Service for alarms serves the increasing demand of the Service Oriented Architecture (SOA) for assistance in handling events resulting from measurements collected in GÉANT and connected National Research and Education Networks.

1 The goal

Today, one of the main functionalities of advanced network monitoring systems is event handling (incident management). The goal of the work presented in this paper is to enrich the perfSONAR (Performance focused Service Oriented Network monitoring Architecture) [1] by adding this functionality, and flexible SOA [2] architecture allows to make it seamlessly.

2 Introduction to perfSONAR

PerfSONAR (figure 1) is a framework for network performance monitoring that supports solving performance problems in the multi-domain network environment. It is built from a set of independent services that provide isolated functions and communicate with each other using a standardised protocol.
The system is dynamic and allows particular components to be added or removed at any time. It is decentralized, and each service is administered in accordance with locally-specified policies and procedures. Described features are realized by the Service Oriented Architecture. The main functionalities of perfSONAR are represented by the following service types:

- Measurement Point (MP) provides measurement data collected directly from physical or virtual network devices and initiates active and passive measurement tests
- Measurement Archive (MA) stores and publishes measurement data
- Lookup Service (LS) collects information about all perfSONAR services available in the network and about measurement data they collect and provide.
- Authentication Service (AS) provides authentication and authorization functionalities in the perfSONAR system
- Transformation Service (TrS) performs transformation functions and analyses of data received from data producers (MAs, MPs) and provides them to data consumers (other MAs, Clients).

All perfSONAR services use a standard way of communication which is defined by the Network Measurement Control Working Group Open Grid Forum (OGF NMC-WG)[3][4].

3 Requirements

The requirements for the event management described in this paper have been gathered from the National Research and Education Networks (NREN) survey, members of GÉANT [5] multi-domain services communities and related work which includes the prototype implementation of alarm processing application [6] developed during the GN2 [7] project for the users of the LHC [8] optical private network. The approach to event correlation and visualization was also found in [10] but it is focused on events received from network elements. Our main requirement is that the events are generated on the basis of data stored and published by perfSONAR services (e.g. interface errors, packet loss, routing path) rather than on notifications sent by equipment (e.g. SNMP traps or syslog messages). Alarm conditions as well as threshold values must be configurable. Because of the distributed nature of multi-domain monitoring the event management solution must be able to access multiple network performance data sources (MAs) and provide alarms to many client instances. Additionally, alarm notifications must be accessible via a well-known and user-friendly graphical interface. Therefore, we used the Nagios [11] application at the client side to display events and notify users.

Our architecture currently considers the following types of alarms:

- RoutingAlarm (sourceSite, destinationSite) – if the path, as determined by traceroute output, changes and there are no light-paths down between the source and destination, then raise an alarm.
- InterfaceCongestionAlarm (router, interface) – if a router interface output drops is above the threshold, and the router interface utilisation is below the threshold, raise an alarm. The cross-check of interface utilisation value can suppress alarms caused by output drops which are expected when the utilisation is high.
- RoutingOutOfNetworkWarning (sourceSite, destinationSite) – if the route changes, and it includes a hop not in the user-defined list, raise an alarm
- InterfaceErrorsAlarm (router, interface) – if a router interface input errors is above the threshold, raise an alarm.

4 Architecture

The service architecture makes use of the concept of Transformation Service (TrS) described in the perfSONAR General Framework Design [12]. It constantly collects measurement data from one or multiple MAs which are further analysed and processed according to user-defined rules. The outcome from the service is provided as a collection of raised alarms. All generated alarms are stored in a dedicated MA. Figure 2 depicts the functional relationship between TrS and other perfSONAR services.
The Transformation Service depends mostly on two types of perfSONAR services: LS and MAs. The workflow between services is as follows:

- **LS registration** – like every perfSONAR service TrS registers or updates periodically its presence with the information about the implemented transformation function.
- **Alarms detection** – this is a regular process of raw data analysis. TrS queries MAs with raw measurement data in order to detect the characteristics defined by user rules (e.g. exceeding a threshold for metric value). If specified conditions are met and/or thresholds are exceeded, then the service generates a new alarm.
- **Storage** – all alarms are stored in a dedicated MA to archive a complete history of the reported alarms.
- **Alarms presentation** – a client application retrieves alarms from a dedicated MA.

## 5 Implementation

The proposed solution required implementation of the following three elements:

- **TrS service**,  
- an extension to the existing MA service in order to support storage of alarms,  
- a plugin for the Nagios [13] client application in order to support the NMC-WG protocol.

TrS is written in Java 1.6 and based on the common libraries for GN3 [9] perfSONAR services included in GN3 MDM release – pSBase2 and WebAdmin. The first one is a framework which offers the NMC-WG protocol message handling, uniform service configuration and many other reusable features for perfSONAR MDM services. The latter library eases the process of service configuration for end users through the Web interface.

The new event management functionality in perfSONAR required some extensions to the NMC-WG protocol schema. New schema elements do not disrupt any existing structures.

Alarms storage is accomplished by the use of the existing SQL MA service. Only minor extensions (information and data models of alarms) had to be implemented.

The graphical user interface (GUI) has been implemented in the form of a plug-in module for Nagios. This component is responsible for dealing with the perfSONAR communication (support of the NMC-WG protocol).

## 6 Conclusions

This paper presents the events management architecture which utilizes the advantages of already existing performance monitoring products and improves the perfSONAR MDM implementation. perfSONAR is a framework offering standardized functionality of performance data collection and storage, service discovery, authorisation and authentication and uniform access to these resources in a multi-domain environment. Nagios gives the advanced, well-known graphical user interface. When a user still wants to use the tools s/he is familiar with, then our approach is a perfect choice for deployment and integration into operational procedures. The current solution supports four kinds of alarms selected in the requirements but is extensible to provide additional ones when necessary.
Acknowledgement

The research leading to these results has received funding from the European Community’s Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 238875 (GÉANT).

References


[7] GN2 project, available online: http://www.geant2.net/

[8] Large Hadron Collider homepage, available online: http://lhch.web.cern.ch/

[9] GN3 project activities, available online: http://www.geant.net/About_GEANT/Activities/Pages/home.aspx


Vitae

Michał Giertych received the M.Sc. degree in Computer Science from the Adam Mickiewicz University in 2004. After graduating he has worked for Poznań Supercomputing and Networking Center as a software developer and he is currently involved in the GN3 project. His main areas of interest are design, implementation and testing applications for distributed network environments.

Roman Łapacz is a network specialist at Poznań Supercomputing and Networking Center (PSNC, Poland). He graduated from Poznań University of Technology (Institute of Computing Science, Intelligent Decision Support Systems Laboratory) in 2000 and completed postgraduate management studies (Poznań University of Economics and Poznań School of Banking). He also studied at Université Paris-Dauphine within the Socrates/Erasmus programme. The current main work area is the network monitoring systems. Roman has been deeply involved in the perfSONAR project from the beginning of the initiative. Now he leads Joint Research Activity 2 (JRA2) Task 3 (Network Monitoring) group in the GN3 project and works on new innovative extensions for the multi-domain monitoring perfSONAR framework.

Piotr Pikusa received his M.Sc. degree in Computer Science from Poznań University of Technology in 2009. Since March 2009, he has worked as a software developer for Poznań Supercomputing and Networking Center. Currently he develops applications for perfSONAR in the GN3 project. His main fields of interest are object-oriented architectures, Java language programming and artificial computing.

Robert Szuman graduated from Poznań University of Technology in 2000 and got the M.Sc. degree in Computer Science (Databases and Networks Designing). Since 1999, he has been co-operating with Poznań Supercomputing and Networking Center (PSNC), where he started work in the Network Department as a Network Management Systems Administrator. Now he is working as a Network Specialist in PSNC. His main fields of research interests are network management systems administration and configuration, broadband and optical networks monitoring, Quality of Service in computer networks, traffic analysis and measurement technologies, network management protocols, tools and procedures used by the Network Operation Center (NOC).

Szymon Trocha received his M.Sc. degree in Computer Science from Poznań University of Technology (Poland) in 1998. He is the Head of the Management Unit in PSNC. He is mainly involved in the network management applications planning and implementing. He is also responsible for traffic analysis and measurement technology research and implementation. Since 2009, he has been leading the performance monitoring service activity in GN3 EU-funded project.