Grid Management: Data Model Definition for Trouble Ticket Normalization

Dimitris Zisiadis[1], Spyros Kopsidas[1], Matina Tsavli[1], Leandros Tassiulas[1], Leonidas Georgiadis[1], Chrysostomos Tziouvaras[2], and Fotis Karayannis[2]

[1] Center for research and Technology Hellas, 6th km Thermi-Thessaloniki, 57001, Hellas
[2] GRNET, 56 Mesogion Av. 11527, Athens, Hellas

Abstract. Handling multiple sets of trouble tickets (TTs) originating from different participants in today's GRID interconnected network environments poses a series of challenges for the involved institutions. Each of the participants follows different procedures for handling trouble incidents in its domain, according to the local technical and linguistic profile. The TT systems of the participants collect, represent and disseminate TT information in different formats. As a result, management of the daily workload by a central Network Operations Centre (NOC) is a challenge on its own. Normalization of TTs to a common format for presentation and storing at the central NOC is mandatory.

In the present work we provide a model for automating the collection and normalization of the TT received by multiple networks forming the Grid. Each of the participants is using its home TT system within its domain for handling trouble incidents, whereas the central NOC is gathering the tickets in the normalized format for repository and handling. Our approach is using XML as the common representation language. The model was adopted and used as part of the SA2 activity of the EGEE-II project.

Keywords: Network management, trouble ticket, grid services, grid information systems, problem solving.

1 Introduction

Modern telecommunications networks are aimed to provide a plethora of differentiated services to its customers. Networks are becoming more sophisticated by the day, while their offering spans a wide variety of customer types and services. Quality of Service (QoS) [1] and Service Level Agreement (SLA) [2] provisioning are fundamental ingredients.

Multiple interconnected institutions, targeting a common approach to service offering, along with a unified network operation scheme to support these services, form Grid networks. Network Management is crucial for the success of the Grid. Problem reporting, identification and handling as well as trouble information dissemination and delegation of authority are some of the main tasks that have to be implemented by the members of the Grid.

P. Primet et al. (Eds.): GridNets 2008, LNICST 2, pp. 105 – 112, 2009.

GÉANT2 [3] is an example of a Grid. It is the seventh generation of pan-European research and education network successor to the pan-European multi-gigabit research network GÉANT. The GÉANT2 network connects 34 countries through 30 national research and education networks (NRENs), using multiple 10Gbps wavelengths. GÉANT2 is putting user needs at the forefront of its plans for network services and research.

Usually a central Network Operations Centre (NOC) is established at the core of the network for achieving network and service integration support. Ideally, a uniform infrastructure should be put in place, with interoperating network components and systems, in order to provide services to the users of the Grid and to manage the network. In practice though, this is not the case. Unfortunately, different trouble ticket (TT) systems are used by the participating networks.

There is a wide variety of TT systems available, with differentiated functionality and pricing (respectively) among them. Examples are Keystone [4], ITSM [5], HEAT [6], SimpleTicket [7], OTRS [8]. Moreover, in-house developed systems, as is the case for GRnet [9], is another option. The advantages of this option are that it offers freedom in design and localization options and that it meets the required functionality in full. It has though the disadvantage of local deployment and maintenance. Nevertheless, it is adopted by many Internet Service Providers (IPSs), both academic and commercial, as the pros of this solution enable service delivery and monitoring with total control over the network.

The current work evolved within the specific Service Activity 2 (SA2) activity of the EGEE-II European funded project [10]. A central NOC, called the ENOC [11] is responsible for collecting and handling multiple TTs received by the participating institutions TT systems. Various TT systems are used by each of them, delivering TTs in different formats, while TT load is growing proportionally with the network size and the serviced users. TT normalization, i.e. transformation to a common format that is reasonable for all parties and copes with service demands in a dynamic and effective way, is of crucial importance for successful management of the Grid.

In the present work we define a data model for TT normalization for the participating institutions in EGEE-II. The model is designed in accordance with the specific needs of the participants, meeting requirements of the multiple TT systems used. It is both effective and comprehensive, as it compensates for the core activities of the NOCs. It is also dynamic as it allows other options to be included in the future, according to demand.

This paper is organized as follows: section 2 outlines related work on TT normalization. In section 3 we present our data model in detail, whereas in section 4 we provide a prototype implementation of the proposed solution. Finally in section 5 we discuss conclusions of this work.

2 Related Work

Whenever multiple organizations and institutions form a Grid, or some other form of cooperative platform for network service deployment, the need arises to define a common understanding over network operations and management issues. Trouble incidents are recorded in case a problem arises, affecting normal network operations or services. Typical problems are failures in network links or other network elements (i.e. routers, servers), security incidents (i.e. intrusion detection) or any other problem that affects normal service delivery (i.e. service overload). The incidents are represented in specific formats, namely TTs. ATT is issued in order for the network operators to record and handle the incident.

RFC 1297 [12], titled NOC Internal Integrated Trouble Ticket System Functional Specification Wishlist, describes general functions of a TT system that could be designed for NOCs, exploring competing uses, architectures, and desirable features of integrated internal trouble ticket systems for Network and other Operations Centres.

Network infrastructure available to EGEE is served by a set of National Research and Education Networks (NRENs) via the GÉANT2 network. Reliable network resource provision to Grid infrastructure highly depends on coherent collaboration between a large numbers of different parties both from NREN/ GÉANT2 and EGEE sides, as described in [13]. Common problems and solutions as well as strategies for investigating problem reports has been presented in [14] [15]. The concept of the Multi-Domain Monitoring (MDM) service, which describes the transfer of end-to-end monitoring services in order to serve the needs of different user groups is discussed in [16].

The OSS Trouble Ticket API (OSS/J API) [17] provides interfaces for creating, querying, updating, and deleting trouble tickets (trouble reports). The Trouble Ticket API focus is on the application of the Java 2 Platform, Enterprise Edition (J2EE), and XML technologies to facilitate the development and integration of OSS components with Trouble Ticket Systems. The Incident Object Description Exchange Format (IODEF) [18] constitutes a format for representing computer security information commonly exchanged between Computer Security Incident Response Teams (CSIRTs). It provides an XML representation for conveying incident information across administrative domains between parties that have an operational responsibility of remediation or a watch-and-warning over a defined constituency. The data model encodes information about hosts, networks, and the services running on these systems; attack methodology and associated forensic evidence; impact of the activity; and limited approaches for documenting workflow.

The EGEE project is heavily using shared resources spanning across more than 45 countries and involving more than 1600 production's hosts. To link these resources together the network infrastructure used by EGEE is mainly served by GÉANT2 and NRENs. NRENs are providing link to sites within a country while GÉANT2, the seventh generation of pan-European research and education network, connects countries. To link Grid and network worlds the ENOC [17], EGEE Network Operation Centre, has been defined in EGEE as the operational interface between the EGEE Grid, GÉANT2 and the NRENs to check the end-to-end connectivity of Grid sites. Using daily relations with all providers of the network infrastructures on top of which EGEE is built it ensures the complex nexus of domains involved to link Grid sites are performing efficiently. The ENOC deals with network problems troubleshooting, notifications from NRENs, network Service Level Agreement (SLA) installation and monitoring and network usage reporting. The ENOC acts as the network support unit in the Global Grig User Support (GGUS) of EGEE to provide coordinated user support across Grid and network services.

In the next section we describe the Data Model that was adopted by the EGEE parties for TT normalization.

3 Definition of the Data Model

There has been a long discussion on the functionality of the emerging data model. We examined thoroughly the various fields supported by the numerous ticketing systems in use. There has also been a lot of effort to incorporate all critical fields that could ease network monitoring and management of the Grid.

We consolidated all experts' opinions regarding the importance of each field and its effects on the management of both the individual NRENs as well as the Grid.

The goal was to define a comprehensive set of fields that would best fit to the network management needs of the EGEE grid. As a result of this procedure, we provide below the definition of the Data model that aims to achieve the required functionality for the management of the Grid.

3.1 Terminology

The Trouble Ticket Data Model (TTDM) uses specific keywords to describe the various data elements. These keywords are Defined, Free, Multiple, List, Predefined String, String, Datetime, Solved, Cancelled, Inactive, Superseded, Opened/Closed, Operational, Informational, Administrative, Test and they are interpreted as described in Section 3.5 and 3.6.

3.2 Notations

This section provides a Unified Modelling Language (UML) model describing the individual classes and their relationships with each other. The semantics of each class are discussed and their attributes are explained. The terms "class", and "element" will be used interchangeably to reference a given UML class in the data model.

3.3 The TTDM Attributes

The Field Name class has four attributes. Each attribute provides information about a Field Name instance. The attributes that characterize one instance constitute all the information required to form the data model.

- **DESCRIPTION:** This field contains a short description of the field name.
- **TYPE:** The TYPE attribute contains information about the type of the field name it depends on. The values that it may contain are: Defined, Free, Multiple, List.
- **VALID FORMAT:** This attribute contains information about the format of each field. The values that it may contain are: Predefined String, String, Datetime.
- **MANDATORY:** This attribute indicates if the information of each field is required or is optional. In case the information is required the field MANDATORY contains the word Yes. On the contrary, when filling the information is optional, the field MANDATORY contains the word No.

3.4 The TTDM Aggregate Classes

The collected and processed TTs received from multiple telecommunications networks are adjusted in a normalized TTDM. In this section, the individual components of the TTDM are discussed in detail. The TTDM aggregate class provides a standardized representation for commonly exchanged Field Name data.

We provide below the field name values that are defined in our model. For convenience, as most names are self explained, and for readability reasons, we only provide the values : Partner_ID, Original_ID, TT_ID, TT_Open_Datetime, TT_Close_Datetime, Start_Datetime, Detect_Datetime, Report_Datetime, End_Datetime, TT_Lastupdate_Time, Time_Window_Start, Time_Window_End, Work_Plan_Start_Datetime, Work_Plan_End_Datetime, TT_Title, TT_Short_Description, TT_Long_Description, Type, TT_Type, TT_Impact_Assessment, Related_External_Tickets, Location, Network_Node, Network_Link_Circuit, End_Line_Location_A, End_Line_Location_B, Open_Engineer, Contact_Engineers, Close_Engineer, TT_Priority, TT_Status, Additional_Data, Related_Activity_History, Hash, TT_Source, Affected_Community, Affected_Service.

3.5 Types and Definitions of the TYPE Class

The TYPE Class defines four data types, as follows:

- Defined :The TTDM provides a mean to compute this value from the rest of the fields
- Free : The value can be freely chosen
- Multiple : One value among multiple fixed values
- List : Many values among multiple fixed values

3.6 Types and Definitions of the VALID FORMAT Class

The VALID FORMAT Class defines three data types, as follows:

- Predefined String : A predefined value in the data model
- String : A value defined by the user of the model
- Datetime : A date-time string that indicates a particular instant in time

The predefined values are associated with the appropriate Field Name class. The values are strict and should not be altered. The values defined in our model are the following:

- TT_Type with accepted predefined values: Operational, Informational, Administrative, Test.
- Type with accepted predefined values: Scheduled, Unscheduled.
- TT_Priority with accepted predefined values: Low, Medium, High.
- TT_Short_Description with accepted predefined values: Core Line Fault, Access Line Fault, Degraded Service, Router Hardware Fault, Router Software Fault, Routing Problem, Undefined Problem, Network Congestion, Client upgrade, IPv6, QoS, Other.
- TT_Impact_Assessment with accepted predefined values: No impact, Reduced redundancy, Minor performance impact, Severe performance impact, No connectivity, On backup, At risk, Unknown.

– TT_Status with accepted predefined values: Solved, Cancelled, Inactive, Superseded, Opened/Closed.
– TT_Source with accepted predefined values: Users, Monitoring, Other NOC.

4 Implementation

XML [19] was the choice for the implementation schema, due to its powerful mechanisms and its global acceptance. The implemented system operates as depicted in Fig.1, below.

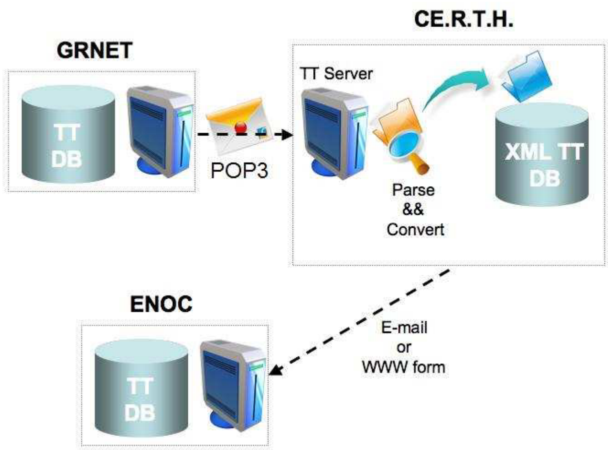

Fig. 1. The Implemented System

Our system connects to GRnet ticketing system and uses POP e-mail to download the TTs. Following, it converts the TTs according to the data model presented, stores them in a database and finally sends them to ENOC via e-mail to a specified email address. More options are available:

– TTs can be sent via http protocol to a web service or a form.
– TTs can be stored to another database (remote).
– TTs can be sent via email in XML format (not suggested since the XML format is not human readable).

An SMS send option (to mobile phones) is under development, since this proves to be vital in case of extreme importance. For this option to work, an SMS server needs to be provided. Linguistic issues are also under development, in order to ease understanding of all fields in a TT, i.e. Greek to English translation needs to be performed for some predefined fields, like TT Type.

Our system offering improves security: most web forms use ASP, PHP or CGI to update the database or perform some other action. This is inherently insecure because the database needs to be accessible from the web server. Our system offers a number of advantages:

- The email can be sent to a completely separate and secure PC.
- Our system can process the email without ever needing access to the web server or be accessible from the Internet.
- If a PC or network connection is down the emails will sit waiting. Our system will 'catch up' when the PC or network is back up.

Moreover we offer increased redundancy: when using web forms to update back-end databases, the problem always arises about what to do if the database is down. Our system resolves this problem, because the email will always get sent. In case the database cannot be updated our system will wait and process the email later.

5 Conclusions

In the present work, a common format for normalizing trouble tickets from the various NRENs participating in the Grid, implemented in the EGEE project framework, has been designed and implemented. XML was used to represent the common format. The adopted transformation schema is lightweight yet effective and is accepted by all participating partners. The solution has passed beta testing and it is already in use for the GRNET TTs. The other NRENs are migrating to the solution gradually.

Acknowledgments

This paper is largely based on work for TT normalization in SA2 Activity of EGEE. The following groups and individuals, contributed substantially to this document and are gratefully acknowledged:

- Jeannin Xavier, Goutelle Mathieu, Romier Genevieve, UREC/CNRS
- Cessieux Guillaume, CNRS-CC IN2P3
- Rodwell Toby, Apted Emma, DANTE
- Allocchio Claudio, Vuagnin Gloria, Battista Claudia, GARR
- Schauerhammer Karin, Stoy Robert, DFN

References

1. Quality of Service (QoS) of service, `http://en.wikipedia.org/wiki/Qualityofservice`
2. Service Level Agreement (SLA) Level Agreement, `http://en.wikipedia.org/wiki/ServiceLevelAgreement`
3. GÉANT2, `http://www.geant2.net/`
4. Keystone, `http://www.stonekeep.com/keystone.php/`
5. ITSM, `http://www.bmc.com/products/products_services_detail/0,0,19052_19426_52560284,00.html`
6. HEAT, `http://www.frontrange.com/ProductsSolutions/SubCategory.aspx?id=35&ampccid=6`

7. SimpleTicket, http://www.simpleticket.net/
8. OTRS, http://otrs.org/
9. GRnet, http://www.grnet.gr/
10. Service Activity 2 (SA2), http://www.eu-egee.org/
11. ENOC, http://egee-sa2.web.cern.ch/egee-sa2/ENOC.html
12. RFC 1297, http://www.ietf.org/rfc/rfc1297.txt
13. EGEE-SA2-TEC-503527- NREN Interface-v2-7
14. PERTKB Web, http://pace.geant2.net/cgi-bin/twiki/view/PERTKB/WebHome
15. GÉANT2 Performance Enhancement and Response Team (PERT) User Guide and Best Practice Guide, http://www.geant2.net/upload/pdf/GN2-05-176v4.1.pdf
16. Implementing a Multi-Domain Monitoring Service for the European Research Networks, http://tnc2007.terena.org/core/getfile.php?file_id=148
17. The OSS Trouble Ticket API (OSS/J API), http://jcp.org/aboutJava/communityprocess/first/jsr091/index.html
18. The Incident Object Description Exchange Format (IODEF), http://tools.ietf.org/html/draft-ietf-inch-implement-01
19. XML, http://en.wikipedia.org/wiki/XML