# gSLM: Challenges in Service Delivery Management and Service Level Management in Grids

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**Abstract**

In today's information technology infrastructures Service Level Management (SLM) is considered a vital discipline of IT Service Management. Only by having a framework for establishing a common understanding of services and the manner in which they are used and provided, can next generation IT infrastructures (e-Infrastuctures) maintain a sufficient "customer satisfaction" on a sustainable level. However, SLM has not been successfully implemented and deployed in any of today's e-Infrastuctures. To remedy this situation, Grid environments are seen as a very promising starting point. In this paper we outline the challenges when adapting SLM from traditional infrastructures for the use in Grid environments and how the gSLM project will help in adopting SLM to Grids.

## 1 Introduction

IT Service Management (ITSM) aims at providing high quality IT services meeting customers' and users' expectations by defining and installing management processes covering all aspects of managing the service lifecycle: planning, roll-out and delivery, operational support, changing and improving as well as decommissioning. Service Level Management (SLM) is considered a vital discipline of ITSM. The widespread and commonly approved international standard for IT Service Management, ISO/IEC 20000, describes the objective of Service Level Management as follows: To define, agree, record and manage levels of service. All of these aspects are crucial when bringing the new e-Infrastructure technologies, processes and services to new user communities. Only by having a framework for establishing a common understanding of these four aspects of the services provided and used, can the e-Infrastructure maintain a sufficient "customer satisfaction" on a sustainable level.

However, SLM has not been successfully implemented and deployed in any of the next generation IT infrastructures (e-Infrastuctures). To remedy this situation, Grid environments are seen as a very promising starting point.

In Grid computing many Grid providers place their resources at disposal of Grid users, which are organised in virtual organisations (VO). Resources belong to resource owners (RO), who have full control over them. Grid uers that are members VOs may use resources for their purposes, but users never attain full control over resources in terms

of management and allocation. Accessing and leveraging Grid resources thus means consuming (Grid) services offered by one or many providers.

By establishing grid-wide service catalogs and service agreements between customers and a central virtual Grid provider, Grid services can be delivered in a more deterministic fashion. As the cross-organisational collaboration models are evolving rapidly in the Grid domain through for example the EGI initiative, the gSLM project can act as a crucial enabler for the application of Grid technology and the Grid concept. In general this approach can also work in all environments where predictable service utility and warranty are seen as significant requirements.

The gSLM project is supported and funded by the Seventh Framework Programme of the European Commission (FP7). The main objectives of the gSLM project regarding the superordinate goals of FP7 are set to support policy development for e-Infrastructures. This project aims to establish a "platform" fostering the cross-disciplinary scientific exchange between the Grid and the IT Service Management communities. A major part of this platform are regular meetings and public workshops on management of e-Infrastructures and the service delivery problem in Grids.

## 2 Challenges in adopting SLM to the Grid

Today, there are many Grid infrastructures offering services "as is", meaning lack of the ability to guarantee service levels. Service interruptions and disturbances mostly originate from management problems, rather than technical problems. A study by Gartner in 2001 shows that 80% of all service outages originate from "people and process issues" [3]. ITSM and especially SLM can help reduce this kind of outages and allow providers to guarantee service levels.

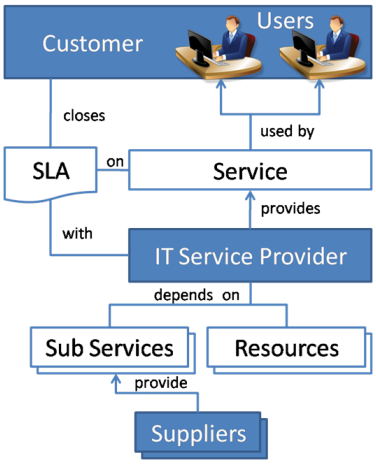


**Figure 1:** An SLA defines the service and its associated quality requirements between a customer and a provider

Service levels are measured with a set of performance indicators that all have to be within a defined range. In traditional customer/provider business relations services and service levels are laid down in Service Level Agreements (SLA) between customers and IT service providers as shown in figure 1. A customer and a provider close an SLA on a service which is used by the customer and provided by an IT Service provider. While IT service providers may employ sub services from others (suppliers) besides their own resources for service provisioning, services are offered as a whole, where the composition of resources and sub services is hidden from the customer. Hence, from a customer's point of view the IT service provider alone is responsible for providing services under the terms specified in the SLA.

In ITIL (see section 4) a service is defined as: a means of delivering value to customers by supporting them in achieving their goals without the customer being responsible for the specific costs and risks associated with the service [5]. In the case of using Grid resources "value" contains two important aspects: utility and warranty. *Utility* is the actual use to which users/customers intent to put Grid resources in order to achieve their goals, while *warranty* targets the providers' duties to offer services within specified parameters.

Representing the customer's *utility* value in an SLA is mainly accomplished by defining the services to be provided. When it comes to providing a service with a certain quality (i.e. service level) the capabilities of the IT service provider, especially of the provider's infrastructure, have to be taken into account. Quality requirements are specified along with strategies to measure and enforce their fulfillment in order to provide *warranty* on service levels to the customer. To that end measurable values and allowed ranges for these values are specified, forming a metric for evaluating requirement fulfillment. By agreeing upon named specifications, SLAs serve as a contractual framework for mutual obligations and responsibilities between customers and providers.

Figure 2 sketches the relationship between consumer and IT service provider in a Grid environment., where the setup is quite different. The only real entities are Resource Owners and their resources. Resources usable through a Grid infrastructure are mostly subsets of the resources available to the ROs, making them "virtual resources". The organisational structure in a Grid infrastructure is a set of equal VOs. As a result, the customer is a VO in Grid environments. For the same reason the only organisational unit for many resource providers to appear as one is VOs as well. The IT service provider is replaced by the abstract "Grid", as (virtual) resources may be spread out across many ROs.

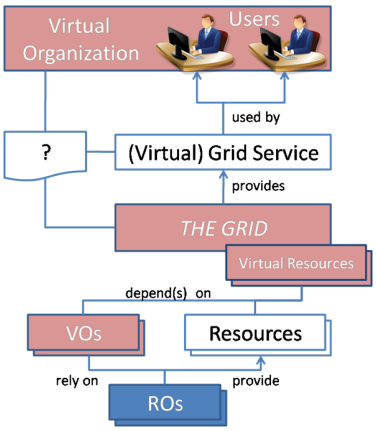


**Figure 2:** In a Grid environment VOs take the place of customers but there is no clearly defined "provider" to close an SLA with

There are a few problems when applying the concept of SLAs in Grid infrastructures, as collaboration in Grids cannot be represented in a customer-provider relationship.

**Close a contract with whom?** In figure 2 "the Grid" is neither a company nor at least a defined IT service provider. It is merely a collection of virtual resources available to VOs, operated by VOs. So there isn't any clear counterpart with which a contract similar to an SLA can be closed. All Grid providers are peers and nobody can close contracts on behalf of another provider. So whenever resources from many providers are involved it becomes impossible to identify contract partners. Another aspect related to this problem is that different providers may have different understandings of terms and metrics. This poses additional problems when formalising contracts.

**Who is responsible?** Grid environments lack a single central authority with control over service delivery, service levels and operations procedures. In a regular business relationship all these tasks would be carried out by the IT service provider and maybe delegated to sub contractors. However, there isn't any hierarchic service chain in Grids. So even if a (virtual) service was formalised with some dedicated instance, it would remain unclear how tasks and responsibilities are delegated to ROs and possibly VOs. Often services depend on each other. For example simulations that depend on the input of massive amounts of saved data. In this case the speed of the simulation depends on the speed of incoming data. A degradation in the data providing service implies degradation the simulation service. To resolve such issues all providers must coordinate their efforts to identify the root cause for a problem and resolve it. However there are no such instances in Grid environments, that allow for named coordination.

**What resources?** Another problem is the voluntary basis on which ROs commit resources to the Grid. When committing, ROs do not need to specify performance attributes or a time for how long this resource will be available within the Grid. This makes it difficult to assess available resources and to guarantee resource allocations. Finally, as services and resources are loosely committed by different institutions in different Grid environments, there aren't any sophisticated formal agreements on service functionality and quality. This greatly impedes the formalisation of SLAs as understandings of specifications and metrics may vary between Grid members.

For all the above mentioned problems a suitable replacement for an SLA in figure 2 cannot be found. However, to implement Service Delivery Management and Service Level Management in Grid infrastructure an equivalent to SLAs is necessary.

## 3 The gSLM project

The main objective of the gSLM project is to explore today's main hindrances of ITSM in Grids to determine constraints and conditions that must be met in order to successfully deploy ITSM in Grids. While it is likely that many Grid participants have already implemented ITSM concepts within their own infrastructures to some extent, we assume processes spanning across more than one institution are rare and probably not implemented yet. The questions of responsibility, accountability, availability always arise quickly when discussing the employment of remote hosted services. Today's e-Infrastructures cannot meet any requirements in these areas. Therefore it is impossible to establish grid-wide service catalogs and service agreements between customers and a Grid providers.

**Figure 3:** gSLM logo

In the gSLM project the first step towards resolving these issues and implementing ITSM in Grids is bringing together the Grid and service management communities. To reach this goal two public workshops will be organised. The goal of each of these workshops is to collect contributions that address specific topics related to the gSLM project, and thus to open the gSLM project to the communities of Grid computing/management

and IT service management. Through these activities the project gains knowledge and insight into common scenarios and use-cases which allows for the development of viable new scenarios and use-cases implementing ITSM in Grids.

Without precluding any other classification that may be deemed more appropriate in the course of the project, we currently understand that use-cases for SLM can be seen in a three-dimensional space where the axes are: the Services Portfolio, the Service Level Agreements within the involved parties and finally, the contract-based SLM of services deployed in VOs. From the Services Portfolio point of view, relevant use cases will deal with the creation, change and terminations of IT services and the composition of service catalogues. Relevant use-cases concerning SLAs will illustrate the creation, change and terminations of SLAs. From contract-based SLM in virtual organizations we understand that relevant processes to illustrate will be the negotiation, deployment and enforcement of contracts. Further steps will derive a requirements catalogue from known and generated use-cases, identifying criteria for the development of ITSM in Grids.

As for the area of Service Delivery and Service Level Management the problems mentioned in section 2 need to be resolved in a manner that allows for binding contracts, but at the same time leaves resource owners in control of their infrastructures, including a relatively easy way to take resources from the Grid. As it is likely that one SLA binds resources from many resource owners a federated SLM system is required in order to enforce, measure and of course guarantee service levels. The main effective long-term contribution of gSLM will be a scientific roadmap forming a basis for future developments and research efforts to establish ITSM in Grids.

## 4 The big four in IT Service Management

IT Service Management can be seen as a process-oriented approach to IT Management in general. From this follows that a wide variety of processes is required to cover all relevant aspects of service management. Blueprints for processes can be found in best practice manuals, that can be instantiated to serve the providers' needs when installing ITSM.

The *Information Technology Infrastructure Library* (ITIL) is the most popular and widespread framework for ITSM. The most recent release is ITLv3, which is structured into core publications (ITIL Core), complementary publications (ITIL Complementary Guidance) and ITIL Web Support Services. ITIL Core is released as a collection five books [5, 7, 6, 1, 8] describing a comprehensive lifecycle model, covering service strategy, design, transition, operation and continual improvement. ITIL also includes SLA frameworks with multi-level SLAs which may serve as a basis and guide in developing SLAs for Grids.

Another important source is the *Microsoft Operations Framework* (MOF). Based on ITIL, MOF aims to be a practical guidance for everyday IT practices and activities, helping users establish and implement reliable, cost-effective IT services [2]. It includes operational guidance to ITSM and provides operational "job aids" in support of service delivery. Instead of aiming to be generic, the MOF is tailored for environments using

Microsoft solutions. The current version is MOF 4.0, which is of great assistance, as it includes templates and demonstrates how generic concepts can be refined to serve infrastructure and operations specific needs.

A sophisticated multi-level process model, supported by an object-oriented information model, can be found in the *Enhanced Telecom Operations Map* (eTOM) [9]. As it is designed to serve the needs of telecommunications providers the processes and data model are very specific but offer a good insight of how to align processes across customers and providers to use/offer services transparently.

The most important standard regarding ITSM and SLM is *ISO/IEC 20000* [4]. While it does not describe processes in detail, ISO 20000 names processes and requirements on processes that are "necessary" for ITSM. ITSM in accordance with ISO 20000 is auditable in process installment and operation, allowing for continuous evaluation and improvement. Another aspect is that ITSM installations can be ISO 20000 certified, when fulfilling all requirements posed in this standard. When adopting SLM to Grids ISO 20000 can serve as an independent metric for evaluating concepts and processes.

## 5 Conclusion

In this work we have shown, that the traditional customer/provider relationship is not applicable for Grid services. As the Grid idea of having many Resource Owners contributing varieties of resources and services to the Grid makes it impossible to generally identify a singular service provider. As a result no singular provider to close a Service Level Agreement with can be found. Without Service Level Agreements and a clear assertion of responsibilities Service Level Management is not feasible in today's Grid Environments. However, through a series of sophisticated guides, standards and best practices the goals and requirements on Service Level Management are sufficiently documented so that there is a clear understanding of what needs to be accomplished in order to install SLM in Grid infrastructures. The gSLM project aims at becoming a platform to support ongoing activities to adopt SLM to today's e-Infrastructures. From that we expect to create a viable roadmap containing all milestones and necessary developments when enabling SLM in Grids.

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