Modeling of grid monitoring systems

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Grid systems play an increasingly significant role in many scientific areas and are also being used in commercial systems. Grids provide enormous computing power for a relatively low price. The cost is the increased complexity. Different components of a grid system must be able to communicate with each other and must have up-to-date view of available resources. The need of interoperability between different components often results in "black box" designs where the internal working of components is completely hidden for others. While this makes building a grid easier it provides obvious difficulties for users and system administrators who want to diagnose problems on remote resources. The need for timely information in grids is therefore evident.

Information can have many properties. This research focuses on monitoring, where the basic charasteristics of information include limited validity period, low latency and usually small size of individual pieces of data.

Over the years several grid monitoring solutions were created. Some of them were designed to solve very specific problems only while others were meant to be generally usable. While many characteristics of existing monitoring systems differ, there are several features that all of them share. The Grid Monitoring Architecture (GMA, [1]) specification created by the Global Grid Forum tried to collect the commonalities of the existing systems and create a recommendation for the architecture of future systems. The main goal of the GMA was to help in creating interoparable monitoring systems, but unfortunately it did not contain enough specifics to be really useful for that.

The research presented here considers the same problem but from a different point of view. Instead of the informal nature of the GMA, a formal model of grid monitoring systems is described. The model is created by abstracting and formalising the common features of existing systems. The model gives a formal specification of the components involved in grid monitoring (traditionally called *producer*, *consumer* and *registry*) by utilising methodologies like abstract state machines and temporary logic. The required interactions between the monitoring components are also studied and a formal definition of a minimalistic producer-consumer protocol is given.

Real monitoring systems usually target specific application areas and therefore have specific extra requirements that are not neccessarily suitable for other monitoring systems. A few examples are provided to demonstrate how this formal model can be extended and refined to support such extra requirements while still maintaining the properties of the original model. The examples include the introduction of actuators and the modeling of aggregation services that can be used for building complex monitoring hierarchies.

In the future the model can be used both for the verification of existing systems as well as the base of new monitoring system designs. Using a formal approach may help system integrators to better understand the differences and similarities of existing systems.

References

[1] B. Tierney, R.A. Aydt, D. Gunter, W. Smith, V. Taylor, R. Wolski, and M. Swany. A grid monitoring architecture. *Informational Document* GFD-I.7, Global Grid Forum, January 2002.