

Preface

Accessing remote instrumentation worldwide is one of the goals of e-Science. The task of enabling the execution of complex experiments that involve the use of distributed scientific instruments must be supported by a number of different architectural domains, which inter-work in a coordinated fashion to provide the necessary functionality. These domains embrace the physical instruments, the communication networks interconnecting the distributed systems, the service oriented abstractions and their middleware. Indeed, high-speed networking allows supporting sophisticated, bandwidth-demanding applications to an unprecedented level. However, the transport and access networks are not the only components that enable such applications. An equally important role is played by the distributed system middleware enabling Grids and cloud computing for data intensive applications.

Physical instrumentation lies at the bottom of these environments, but in many cases it represents the primary source of data that may need to be moved across networks and processed by distributed systems. It would be very helpful to deal with instruments that appear just as manageable resources like storage and computing systems. There have been and there are many attempts and progresses in this sense. However, given the large amount of different instruments and their application domains, understanding the common requirements, the user needs, the adaptation and convergence layers (among other aspects), is not a straightforward task. This is the objective of Remote Instrumentation Services (RIS), and this book, along with its predecessors in the same collection, tries to address some of the most relevant related aspects.

Involving user communities in this process is very important, as the diffusion and adoption of a specific service ultimately depends on the favor of the users it is addressed to. Quite a few software developments have failed to reach widespread diffusion among scientific users (just to cite a category), because of the lack of friendliness and easiness of use in dealing with the specific problems of a particular application domain. This aspect has been recognized in many ongoing projects and development efforts. In the European scenario, the DORII (Deployment of Remote Instrumentation Infrastructure) project, within which many contributors of this book operate, has focused its activity around the needs of the different user communities, directly involved in the project.

The chapters in the book are grouped into five areas, each addressing a specific aspect of remote instrumentation.

The first group, *Remote Instrumentation Services*, includes contributions dealing with the two main middleware components that continue to be developed in relation with the tasks of exposing instrumentation to the distributed computing environment and with offering a unified and multifunctional user interface. These are centered on the concepts of the Instrument Element (IE) and the Virtual Control Room (VCR), respectively. The contributions by F. Lelli and C. Pautasso and by K. Bylec et al. concern aspects of the IE, whereas that of R. Pugliese et al. discusses the implications of the Software as a Service paradigm in the context of a synchrotron radiation facility.

In the second group, *Support of Grid Functionalities*, we have included six chapters representing different features of Grid resource management and operations that are relevant in the context of RIS. The topics addressed comprise: data streaming optimization in interactive Grids (L. Caviglione et al.), interconnection of service and desktop Grids (P. Kacsuk et al.), automation of Service Level Agreements (C. Kotsokalis and P. Wieder), storage and analysis infrastructure for high data rate acquisition systems (M. Sutter et al.), visualization tools in support of resource discovery (A. Merlo et al.), and scheduling in a multi-broker Grid environment (A. Di Stefano and G. Morana).

Contributions in the third group are devoted to *Networking*, one of the key supporting technologies that enable the interconnection of data sources and the transport of data. The first three chapters concern higher-layer aspects of networking, namely: analyzing the design of overlay network topologies (D. Adami et al.); the use of peer-to-peer paradigms for file transfers in a Grid filesystem (N. Kasioumis et al.); the context-aware management of heterogeneous autonomic environments (A. Zafeiropoulos and A. Liakopoulos). The last two chapters in this group describe the status, evolution and research aspects of two National Research and Education Networks (NRENs) in Italy (M. Reale and U. Monaco) and Poland (A. Binczewski et al.), respectively.

The fourth group of chapters touches application environments in various user communities. These include eVLBI (electronic Very Large Baseline Interferometry) and its exploitation of high-speed networks, by M. Leeuwina, oceanographic applications (D. R. Edgington et al., and A. Cheptsov et al.), and road traffic data acquisition and modeling (L. Berruti et al.).

Finally, the last two chapters belong to the category of learning environments, where Remote Instrumentation plays a key role of increasing importance. S. Jeschke et al. describe the main features and demonstrator scenarios of BW-eLabs (networked virtual and remote laboratories in the Baden-Württemberg region of Germany), whereas M. J. Csorba et al. report on a distributed educational laboratory that is part of the “Wireless Trondheim” initiative in Norway.

All contributions in this book come from the selection and extension of papers presented at the 4th International Workshop on Distributed Cooperative Laboratories – “Instrumenting” the Grid (INGRID 2009), held in Alghero, Italy, in April 2009, which focused on the theme of RIS and their supporting eInfrastructure. We

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Applications and Tools

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