Chapter IX

Architectural Foundations of WSRF.NET

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Abstract

State management has always been an underlying issue for large scale distributed systems, but it has only recently been brought to the forefront of Grid computing with the introduction of the Web services resource framework (WSRF) and its companion WS-notification. WSRF advocates standardized approaches for client exposure to and potential manipulation of stateful services for Grid computing; however, these arguments and their long term implications have been difficult to assess without a concrete implementation of the WSRF specifications. This chapter describes the architectural foundations of WSRF.NET, which is an implementation of the full set of specifications for WSRF and WS-notification on the Microsoft .NET framework. To our knowledge, the observations and lessons learned from the design and implementation of WSRF.NET provide the first evaluation of the WSRF approach. A concrete example of the design, implementation and deployment of a WSRF-compliant service and
its accompanying WSRF-compliant client are used to guide the discussion. While the potential of WSRF and WS-notification remains strong, initial observations are that there are many challenges that remain to be solved, most notably the implied programming model derived from the specifications, particularly the complexity of service-side and client-code and the complexity of WS-notification.

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There is probably no single best approach with regard to state management in distributed systems. The fundamental issue is not whether state exists in the services that comprise the distributed system (most people believe that the description of a non-trivial distributed system must include some representation of state), but rather what a client can assume about the state of the particular service with which the client wants to interact. For years, architects and system designers have compared the relative virtues of stateful services and stateless services. Simplistically, on one hand, it is argued that stateless services scale better and are more fault-tolerant, while on the other hand stateful services support terser messages that are hence more efficient, can be more intuitive to design, and can indeed scale well due to recent advances in software support for services. The general theme regards the notion of conversation—specifically, what can and should a client say in its next request to the service?

Until recently, state management in Grid computing was not a first-class architectural concern. The Grid community largely relied on the Globus toolkit (Globus Project, 2006), which is a collection of tools for wide area, cross-domain computing. Prior to 2002-2003, Globus was not constructed as a collection of services, rather Globus was a collection of semi-independent tools that individually facilitated remote job execution, remote file transfer, and so forth. The Globus toolkit lacked a single architectural principle with regard to state management.

In 2002-2003, the open Grid services infrastructure (OGSI) (Tuecke et al., 2003), under the broader umbrella of the open Grid services architecture (OGSA) (Foster, Kesselman, Nick, & Teucke, 2002), synergized the traditional approach of performing Grid computing via Globus (Globus Project, 2006) or Legion (Grimshaw, Ferrari, Knabe, & Humphrey, 1999) with the emerging commercial approach of Web services. Web services would provide much of the underlying XML-based protocols for communication between services, while OGSI would provide a canonical rendering of such services. That is, OGSI constrained the appearance (to potential consumers) and behaviors of services, arguing that such constraints would make the overall service composition and subsequent execution more predictable and easier to assess and manage.

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