SERVICE ORIENTED ARCHITECTURE AND GRID

A distributed system consists of a set of software agents that all work together to implement some intended functionality. Furthermore, the agents in a distributed system do not operate in the same processing environment, so they must communicate by hardware/software protocol stacks that are intrinsically less reliable than direct code invocation and shared memory. This has important architectural implications because distributed systems require that developers of infrastructure and applications consider the unpredictable latency of remote access, and take into account issues of concurrency and the possibility of an unplanned partial failure (Kendall, Waldo, Wollrath, & Wyant, 1994).

A service-oriented architecture (SOA) is a specific type of distributed system in which the agents are "software services" that perform some well-defined operation (i.e., it provides a service), and this type of architecture can be invoked outside of the context of a larger application. By this, we can infer a service is acting as a user-facing software component of a larger application. This separation of functionality helps the users of the larger application to be concerned only with the interface description of the service.

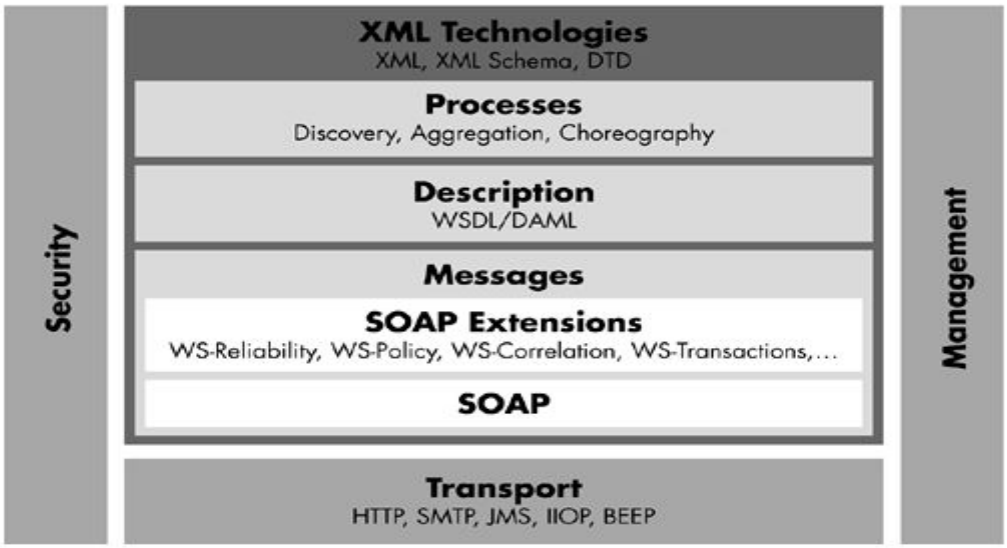
In addition, the SOA stresses that all services have to be a network-addressable interface that communicates via standard protocols and data formats called messages. The major functionality of an SOA is the definition of the messages (i.e., its format, content, and exchange policies) that is exchanged between the users and the services. The Web architecture[4] and the Web Services Architecture[5] are instances of a service-oriented architecture (SOA).

Grid is a distributed system for sharing of resources among participants. As we have seen in the first paragraph of this chapter, grid, being a distributed architecture, has to deal with problems of the distributed computing grid, including latency, concurrency, and partial failures.

We have discussed in earlier chapters of the grid architecture section that the current Grid Computing architecture is built upon the existing distributed technologies with a major focus on resource sharing, interoperation, and virtual organizational security. The SOA is a distributed architecture with more focus on the service interoperability, easier integration, and extensible and secure access.

The Web services architecture is gaining the most attention in the industry as an open, standards-based architecture with a main focus on interoperability. The W3C is leading this initiative. The core components of the Web service architecture are shown in Figure 2.5.

Figure 2.5. Web services architectures are a key enabler in the overall computing discipline of Grid Computing.



From a closer look at the above figure we can infer that XML and related technologies (XML, DTD, XML Schema) form the base technologies of the Web services. Web services are invoked and results are provided via messages that must be exchanged over some communications medium, where a communication medium can be a low-level networking services transport protocol (e.g., telecommunications protocol [TCP]), and/or a high-level communication protocol (HTTP), and/or a combination of both.

The message format can be specified through the Simple Object Access Protocol (SOAP) and its extensions, but this capability is not just limited to SOAP. The SOAP functionality provides a standard way for exchanging the messages.

Interoperability across heterogeneous systems requires a mechanism to define the precise structure and data types of the messages that has to be exchanged between a message producer and a consumer. The Web Service Description Language (WSDL) is another desirable choice to describe the message and exchange pattern.

The SOAP specification provides the definition of the XML-based information that can be used for exchanging structured and typed information between peers in a decentralized, distributed environment. SOAP is fundamentally a stateless, one-way message exchange paradigm, but applications can create more complex interaction patterns (including request/response and request/multiple responses). SOAP is silent on the semantics of any application-specific data it conveys. At the same time SOAP provides a framework (SOAP header) by which application-specific information may be conveyed in an extensible manner. Also, SOAP provides a full description of the required actions taken by a SOAP node on receiving a SOAP message. In short, a SOAP message is a SOAP envelope with a SOAP header and a SOAP body where the header contains semantic and metadata information about the contents of the SOAP body, which form the message. Most of the Web service vendors today uses SOAP as their message payload container.

The WSDL provides a model and an XML format for describing Web services. WSDL enables one to separate the description of the abstract functionality offered by a service from concrete details of a service description.

Grid Computing is all about resource sharing by integrating services across distributed, heterogeneous, dynamic virtual organizations formed from disparate sources within a single institution and/or external organization. This integration cannot be achieved without a global, open, extensible architecture agreed upon by the participants of the virtual organization.

The OGSA achieves these integration requirements by providing an Open Service Oriented model for establishing Grid Computing architectures. The OGSA is described in detail in the "physiology" paper (Foster, Kesselman, Nick, & Tuecke). The OGSA is aligned with the service-oriented architecture as defined by the W3C and utilizes a Web service as its framework and message exchange architecture. Thanks to the valuable and innovative concepts of the OGSA, and the open nature of the standard, the GGF formed an architecture work area to discuss the OGSA and its programming model.

The basic approach the OGSA has taken is to integrate itself with the Web services architecture and define a programming model using this emerging architecture. The Open Grid Service Infrastructure (OGSI) uses WSDL as its service description mechanism and Web service infrastructure for the message exchange.