

Toward a Business Process Grid for Utility Computing

Liang-Jie Zhang, Haifei Li, and Herman Lam

Existing grid computing technologies take advantage of underused computing capacity to solve business problems and provide IT-level infrastructure to support business applications. A business grid's ultimate goal, however, is to apply the utility model of grid computing

in a coordinated manner. It must also be able to build a business solution from multiple grid services and resources. For emphasis, we use the term business process grid for this sort of infrastructure.

BUSINESS PROCESS GRIDS

The scope of Business Process Grids covers business process provisioning and outsourcing; integration; collaboration; monitoring; and management infrastructure. So research in this area is at the business process level, rather than the IT level. Our vision is that, in the near future, business process grids will become the backbone for next-generation business applications. Eventually, grids could enhance the performance of systems for enterprise resource planning. They might also eventually support systems that manage customer relationships, supply chains, partner relationships, and product lifecycles. Figure 1 shows the components and evolution of a business process grid.

Example business process grid

To better understand the concept of a business process grid, consider the following scenario involving a chip manufacturer. The manufacturer's designers might create a layout in Silicon Valley, while the data design comes from the UK. Hardware testing might take place in India; the simulations, in Canada; and,

finally, the manufacturing, in China. In this scenario, each task is an integrated part of a business process for electronic design. Without the concept of grid-enabled design collaboration, today's design team must synchronize design versions by phone, e-mail, or instant messaging.

In our view, a business process grid should help automate collaboration. The basic idea is to treat each design task as a Web service in a grid environment, and use a service flow description language such as Business Process Execution Language for Web Services (BPEL) to model the flow among different design tasks. The application programming interface of the example uses Java interfaces, Web Services Description Language (WSDL), and BPEL for creating customized data entities, collaboration protocols, and dynamic scenario configurations. Grid Services Flow Language (GSFL) is another attempt to model the business process flow in grid environment.

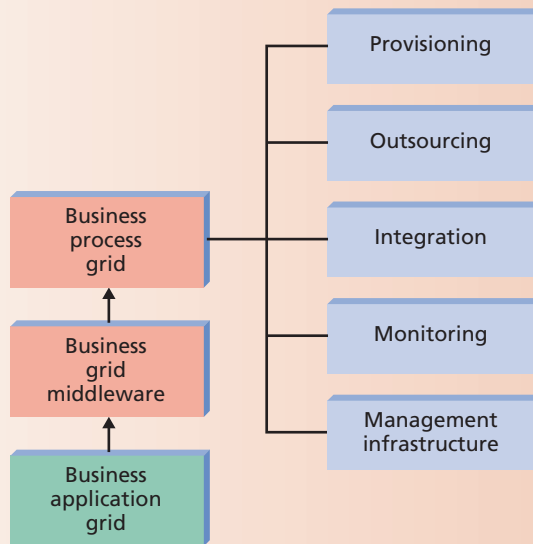
We described another example business grid in a hub-style environment; the application was for service outsourcing (L.-J. Zhang, Q. Zhou, and J.-Y. Chung, "Developing Grid Computing Applications, Part 2," IBM, 3 Dec. 2002; <http://www-106.ibm.com/developerworks/grid/library/gr-grid2/>).

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Eventually, business process grids could facilitate collaboration, making it easy to knit together disparate applications to serve a particular business need.

to business applications; that is, provide support services for charging users on a pay-per-use basis, much as a utility company charges for electricity. That way, the vendor takes the responsibility for application maintenance and upgrade. Thus, a business grid will provide a virtualized infrastructure to support the transparent use and sharing of business functions on demand and do so in an orches-

Figure 1. Business process grid components.

The remainder of this column briefly describes some works and activities that could contribute to the foundation of the envisioned business process grid.

Workflow in a business process grid

Traditional workflow technology is

a good candidate for supporting a grid services flow. However, traditional workflow is typically static, unable to exploit the dynamic information available in the grid. For the grid, it is necessary to develop a flow technology capable of adapting to the dynamic grid environment and the changing requirements of grid applications.

Most existing work in this area is implementation specific, tailored to a particular grid application; almost every major grid project or system has its own flow language. Today, the Global Grid Forum is working to develop a GSFL that will provide a standard, platform-independent way to specify a grid services flow. GSFL is an attempt to integrate efforts from the grid computing, Web services, and workflow areas. Currently, it consists of four components: service providers, and activity, composition, and lifecycle models.

With the introduction of the Web Service Resource Framework (WSRF), the integration of grid computing and Web services has reached a new level. Its developers intend WSRF as the foundation for the next generation of grid services implementations. As a result, much of the work in Web services flow will greatly influence grid services flow and the business process grid. Early work on Web services flow—such as IBM's Web Service Flow Language (WSFL) and Microsoft's XLANG—paved the way for current activities, such as the Business Process Execution Language for Web Services, which combines and replaces WSFL and XLANG specifications.

The GGF is one of several groups helping to develop the infrastructure for business process grids. The "Global Grid Forum Standards Activities" sidebar describes some of this work.

The business process grid is an emerging area, and it's clear that significant research and development will be necessary to make it a reality. When the research results mature, the proposed recommendation will primarily cover business process integration and how to bridge the gap between business goals and IT implementations. We are in the process of investigating a common approach to address the interoperability issue between two state management frameworks—one in grid services and another in business

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Global Grid Forum Standards Activities

The Global Grid Forum (GGF, <http://www.gridforum.org>) consists of various working and research groups. Working groups focus on a very specific technology to provide specifications, guidelines, and recommendations. Research groups work on long-term problems. Major working groups include those in areas such as applications and programming models environments, architecture, data, grid security, information systems and performance, peer-to-peer computing, and scheduling and resource management.

Working groups are still basically focused on low-level grid infrastructure. The GGF group that relates grid services flow is the Workflow Management Research Group. This group's purpose is to explore, evaluate, and propose workflow representation and mapping techniques that enable the high-level description of application workflows and their execution in a grid environment. The group will investigate workflow issues pertaining to the entire lifecycle, starting from the reuse of generic idioms for composing groups of tasks. This work will eventually extend to tracking the progress of a complex task or workflow from the initial formulation of end tasks or data products through to execution, including refinement and repair.



There is also a proposal to form a GGF research group for the business process grid. It's clear that research on the grid services flow is still in the early stage, but it is attracting more attention.

Several publications cover the emerging components necessary to build a business process grid; the GGF has played a significant part in many of them:

- "GSFL: A Workflow Framework for Grid Services," S. Krishnan, P. Wagstrom, and G. von Laszewski, <http://www-unix.globus.org/cog/papers/gsfll-paper.pdf>.
- "Grid Services for Distributed System Integration," I. Foster and colleagues, *Computer*, vol. 35, no. 6, June 2002, pp. 37-46.
- Web Service Resource Framework, <http://www.globus.org/wsrf/>.
- "Web Services Flow Language (WSFL 1.0)," F. Leymann, <http://www-4.ibm.com/software/solutions/webservices/pdf/WSFL.pdf>.
- "XLANG," http://www.gotdotnet.com/team/xml_wsspecs/xlang-c/default.htm.
- "Business Process Execution Language for Web Services (BPEL4WS)," <http://www-106.ibm.com/developerworks/webservices/library/ws-bpel>.

processes. Topics of interest toward this goal include

- business grid philosophy,
- business grid solution architecture,
- grid service flow specification for business process composition and execution,
- federated grid service and business grid flow discovery,
- business process provisioning at process level, activity level, and service level,
- extended business collaboration pattern between two business grids,
- autonomic features such as self-configuring, self-adjusting, and self-healing of a business process driven solutions, and
- security and privacy within the business grid environment. ■

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