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*The presence of middleware in software systems and their architectures makes it possible to distinguish, compartmentalize, and separate concerns at higher and lower levels. This in turn promotes a clearer and simpler architecture for systems as a whole and a better opportunity for such positive features as interoperability,*

*portability, standardization, reusability and reuse, ease of testing, and management of change. The cover suggests such an architectural layer between two other systems layers. Two papers and both Technical Notes in this issue touch on aspects and capabilities of middleware.*

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# Technical note

## WebEntree: A Web service aggregator

by Y. Zhao

*This technical note introduces IBM's WebEntree, a single-log-in Web service aggregator. WebEntree provides an aggregated Web service on top of distributed Web service systems (as components) with a centralized access control and content customization facility. Each service system can have its own access control facility and provide its own independent service. WebEntree implements a flexible and dynamic component-bundling mechanism, and can provide personalized service with user-selected component sets. WebEntree offers a convenient way for new components to be "plugged in" and "played." The owner of the aggregated Web service can keep each component's original branding, add more information, filter out certain content, or customize the presentations. WebEntree also provides a single user registration and authentication interface for all of its user-selectable service components. WebEntree currently accommodates Web service components invoked via HyperText Transfer Protocol (HTTP, i.e., under a Web server) and service components invoked directly from local or remote application programming interfaces. Other component interfaces are planned.*

Web service commercialization and personalization usually involve user access control. This means that users must register to obtain a service, and they must be authenticated each time to access the services, e.g., by providing user identification and password. With a growing number of Web services, each with its own authentication facilities, Web users have been inconvenienced. For example, a user's identification (ID) in one system may not be acceptable for another system because of ID conflicts. Also the password validation policy (e.g., time period, character restrictions, etc.) in one system may differ

from another. Consequently, a user must have multiple user IDs and passwords, and must be authenticated several times to access different services. Multiple user IDs and passwords are inconvenient to use and difficult to manage. WebEntree solves this problem by providing one common entrance for a user to access all Web service systems, identified as *Web service components* in this note. A user can register and be authenticated only once at entrance; WebEntree then handles user registration and authentication to Web service components. WebEntree also provides the convenience of consolidating the user's Web services in one place, saving exploration time.

In addition, WebEntree assists a Web aggregation service provider by not only providing a single log-in entrance for users, but also the ability to change the Web service components' original branding, customize the presentation, filter out certain content, and add the service provider's own advertisements. Contents from the different Web service components are made accessible by WebEntree prior to sending them to end users, which allows the aggregation service provider to customize the content.

Through WebEntree, the aggregation service provider can also provide personalized services. Customers can select the prebundled Web service component groups they want via initial registration, and they can change their selections at any time. With the use

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of WebEntree's graphical user interface (GUI)-based administration subsystem, an aggregation service provider can add or remove a Web service component easily. Also, the service provider can dynamically bundle the service components into different groups, and manage user information and access to the different groups. The administration activity will not interrupt customer service.

Some WebEntree application scenarios follow:

- *Web service center as a virtual Web site:* WebEntree enables the separation of Web service from Web contents, greatly reducing complexity for the Web service provider. Thus, a Web service provider can create a service Web site without hosting the actual contents, offering a variety of popular Web applications and services from many locations.
- *Existing Web publication service provider enhancements:* A publisher with an existing Web site can add other interesting Web sites. This broadens the contents and colors of the site and adds to its appeal. WebEntree also enables the integration of multiple Web service systems that the service provider may have.
- *Service site in a company's intranet:* In a company's intranet, there may be a need to construct a Web service site that aggregates a variety of Web services from outside as well as inside the company. By using WebEntree, employees do not need to individually pay registration or service fees for the services provided because these items are handled in one place. The single registration and log-in interface and personalized home page also provide employees with access convenience. In addition, the company can customize and filter the Web contents.
- *Service site for an extranet:* An extranet is a network among partners. There may be access control involved with each partner's Web site. WebEntree makes it easier for a user to access the participating Web sites.

The *Web content* mentioned earlier is information that is representable by a Web browser. It can be compound documents or business data. It can be dynamically generated from database query and computation or from static files. The *Web service* is to provide Web content from a Web server to Web browsers. *Web service aggregation* provides collective Web services from involved Web services systems (or components). It is different from integration,

which tends to provide a more tightly coupled system.

Single registration and authentication efforts (or single sign-on) for non-Web environments have been around for a long time. A survey can be found in Hursti.<sup>1</sup> IBM's Global Sign-On product is one example.<sup>2</sup> More can be found in the documents from The Open Group.<sup>3,4</sup> These solutions usually are based on DCE (Distributed Computing Environment) or LAN (local area network) architecture, and for multiple hosts in an affiliated environment. In a Web environment, the most popular service systems are based on HyperText Transfer Protocol (HTTP),<sup>5</sup> or so-called Web servers, although Common Object Request Broker Architecture (CORBA<sup>\*\*</sup>)-based IIOP (Internet Inter-Orb Protocol) servers are beginning to be considered now as well. These Web service systems usually are operated in a nonaffiliated environment. The problem of single registration and authentication must be solved for Web service systems operated across all different protocols.

In HTTP, the response to a request must come from the server to which the request was sent. This makes it difficult for requests to different HTTP servers to go through a single aggregator gateway. Proxy servers<sup>6</sup> can be a solution. HTTP-based proxy servers have been implemented by Netscape,<sup>7</sup> IBM, and other companies. Services available via proxy servers include firewall, cache,<sup>7</sup> and content filtering and selection.<sup>8</sup> The problem with this solution is that the proxy server must be specified on the Web browser. Most corporate Web clients use a proxy server to go through their firewalls and to get Internet access. Obviously, different proxy servers are used by different corporate firewalls. Since only one proxy server entry is allowed for each Web browser (although proxy server relay is allowed from the entry proxy server), it is difficult for a common service proxy to reach all users inside different firewalls (each firewall proxy has to be configured separately to use the common service proxy). It will be more complicated when multiple common service proxies are involved through different Web service providers. WebEntree has been designed to solve this problem in an alternative way.

WebEntree adopts object-oriented architecture and design. It is based on the object-oriented Java<sup>\*\*</sup> Web servers (Web servers that support Sun Microsystems' servlet application programming interfaces) and is implemented purely in the Java language; therefore, it is platform-independent.

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