Gartner

Who's Who in Middleware, 1Q04

For many, the term "middleware" is ambiguous and, therefore, requires definition before discussion. Gartner's definition of middleware provides a comprehensive taxonomy of middleware functionality and middleware products.

Management Summary
This is a summary-level introduction to middleware functionality and products. This *Strategic Analysis Report* is intended to help IS architects, managers and developers understand the purpose and categories of middleware, and to serve as a reference to help them find relevant vendors and products.

This document is divided into two sections: Middleware Functionality and Middleware Products. The Middleware Functionality section outlines the different features and capabilities of middleware. The Middleware Products section outlines the different available middleware product bundles and offerings. These topics are tightly related, so, for example, when reading about transformation in the Middleware Functionality section, you will learn that this functionality is included in integration suites, EDI tools and several other middleware products. On the other hand, when reading about integration suites in the Middleware Products section, you will learn that this product includes transformation, adapters and several other types of middleware functionality.

This *Strategic Analysis Report* is an overview of middleware functionality and products – it is not a detailed explanation of how middleware products are built or used. This research includes a "who's who" listing of selected middleware vendors, but it is not a comprehensive "telephone directory" of all the middleware vendors active in the market. It does not attempt to provide a detailed analysis of middleware vendors or products, nor is it meant to serve as the sole mechanism for making the final selection between competing middleware. This research references more than 200 products, yet it is not all-inclusive. Our goal was to include all of the large vendors (that is, those with more than $10 million in annual software license revenue from middleware software) and a sampling of smaller vendors that are interesting or potentially important for the future because of some product feature or vendor characteristics.

Any survey of a broad and dynamic market will inevitably miss some vendors that meet the criteria for inclusion. Gartner clients using this research should contact the Gartner inquiry center via phone (+1 203 316 1233) or e-mail (inquiry@gartner.com) if they are interested in a particular vendor or product that is not included. Gartner tracks numerous vendors that are not reported here, and its ongoing research process guarantees that this research will already be partially obsolete by the time it is distributed. It would not be safe to assume that a product is unimportant or problematic simply because it is not listed here.

Finally, certain whole categories of software products were omitted from this Strategic Analysis Report simply to make it more manageable to develop and use. These types of products are covered in other Gartner research documents and presentations. Some of these are middleware, some combine middleware with other functions, and others are not middleware, but have a purpose that is somehow related to middleware use.

The following are examples of product categories that are not included in this research:

- Networking software.
- Terminal emulators, screen scrapers and other tools that programmatically emulate a workstation or browser (although some products that internally include such capabilities are covered in this research).
- Application development tools, although some of these incorporate runtime middleware in their products. Many enterprise application development (EAD) vendors are becoming more active in the area of application integration than in the past.

- Message switches, from vendors such as LogicaCMG and Oasis Technology, although their products are an effective form of middleware.
- Packaged applications and their embedded middleware of all types.
- System management, network management and application management facilities.
- Database gateways and enterprise information integration (EII) tools, although some of the products in this research include such gateways as part of a larger set of functions.
- Data extraction, transformation and load (ETL) tools, which are not, strictly speaking, middleware in their most common use because they are used more offline than at runtime (although these can be relevant to application integration).

In the next section of this *Strategic Analysis Report*, we define middleware and introduce the major categories of middleware functionality. In the succeeding section, we describe middleware products and list some of the vendors that offer such products.

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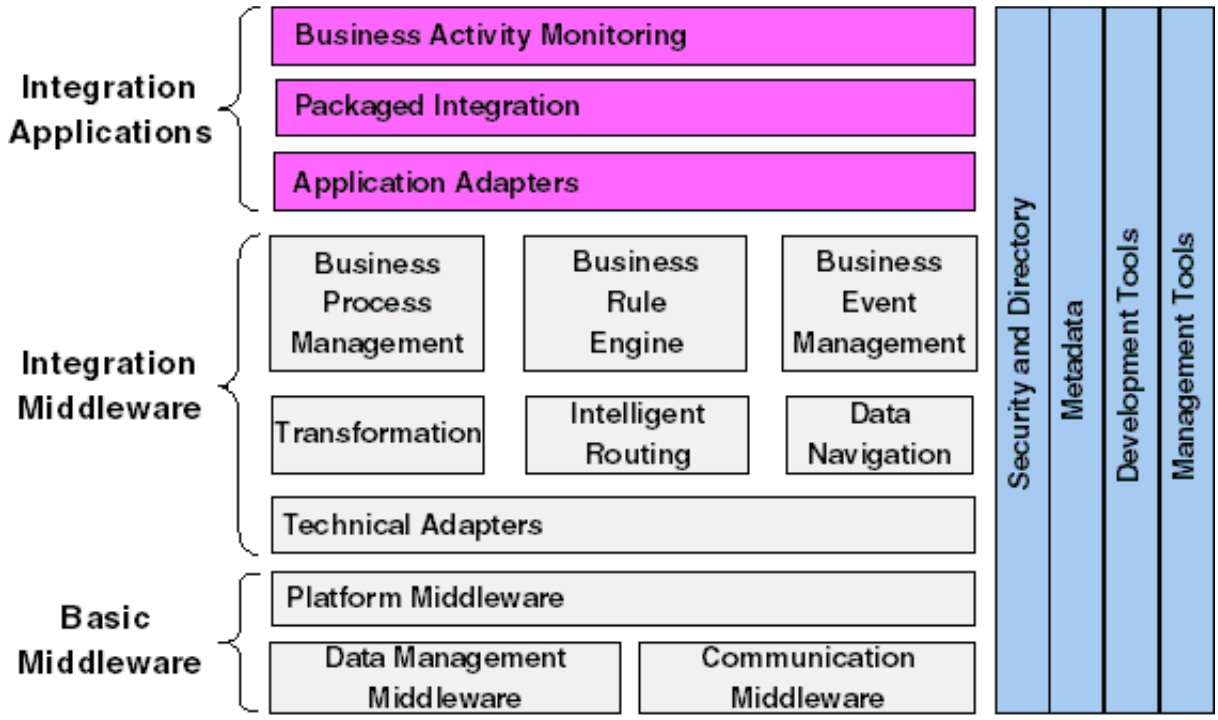
FIGURES

1.0 Middleware Functionality

Distributed middleware is the software "glue" that helps programs and databases running on different computers work together. We formally define distributed middleware as:

- "Runtime system software that directly enables application-level interactions among programs in a distributed computing environment."

In this case, "system software" means software that is positioned between an application program and lower-level operating system, data management and networking services. A computing environment is physically distributed when its programs or databases are spread across two or more computers. Middleware is also useful when programs or databases are logically distributed, even if they run on the same computer. Note that a database management system (DBMS) is a set of programs, so both distributed data and distributed application code are covered by the wording of this formal definition. Application-level interactions are those that transfer business, personal or other data about real things (not just technical computer "housekeeping" data) to or from an application program. Development tools that have no runtime component and most system management utilities are not middleware because their impact is offline or indirect, that is, they are not directly involved in the transfer of application information between programs. A major question is how middleware performs its task, that is, exactly what functionality can be found in the middleware that directly enables application-level interactions among programs in a distributed computing environment? The answer is outlined in the taxonomy of middleware functionality in
Figure 1.



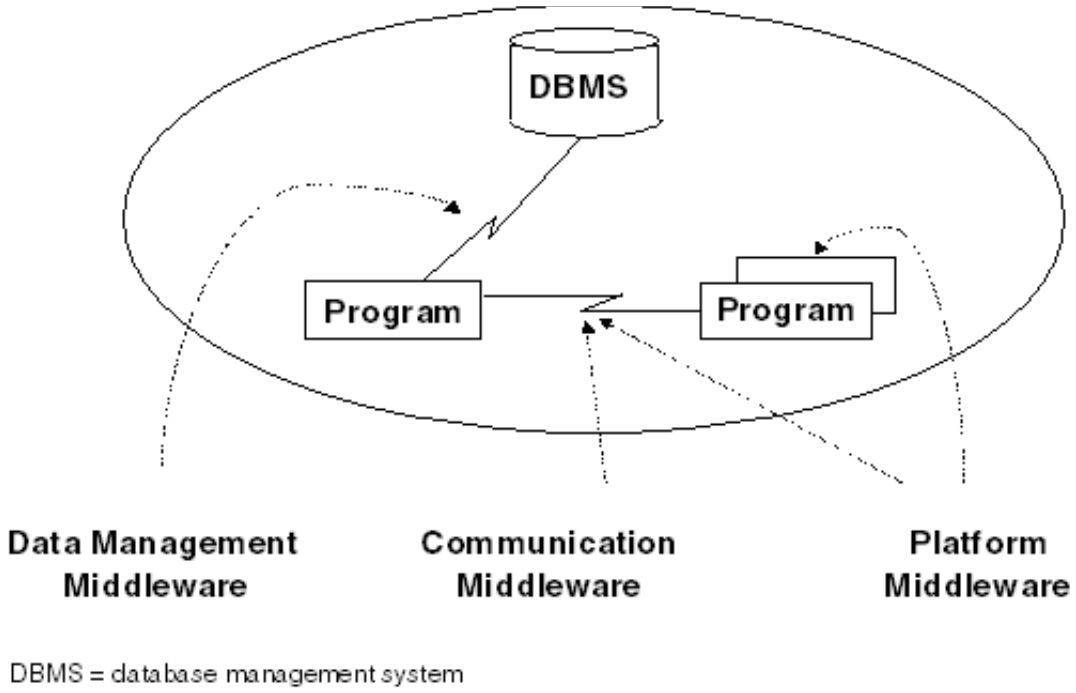
Source: Gartner Research (March 2004)

Figure 1: Taxonomy of Middleware Functionality

In this taxonomy, we have identified more than a dozen different functions that can be performed by middleware. Note that this taxonomy does not categorize middleware products – that is done in the next major section of this *Strategic Analysis Report*. However, there are products, for example, integration suites and application platform suites, that incorporate many of these different middleware functionalities. On the other hand, other products support only one of these middleware functions. Therefore, in the next major section of this document, we describe and list examples of vendors that provide middleware products that offer middleware functionality in many various combinations. To make it easier to understand the product descriptions, we first – in the following subsections – describe the purpose and role of each middleware functionality illustrated in the taxonomy.

1.1 Basic Middleware Functionality

Basic middleware is generally capable of meeting all of the middleware requirements that appear within the domain of a single application system or a set of related applications (that is, where all components follow the design guidance from a single architect or development team). Even if the application is spread across many different locations, perhaps using a mix of different operating systems and running over the Internet, basic middleware is usually sufficient because there is an internally consistent information model (for example, the message formats, method signatures, protocols and data semantics generally agree). Basic middleware is most often intraenterprise in scope, but it can also be used for interenterprise – for example, business-to-business (B2B) – purposes as long as the software on both sides was developed by one organization (or by developers who cooperated in their design choices). In Figure 2, we introduce the three categories of basic middleware that are described in the following subsections of this *Strategic Analysis Report*.



Source: Gartner Research (March 2004)
Figure 2: Three Categories of Basic Middleware

1.1.1 Data Management Middleware
Data management middleware functionality helps programs (including application programs and DBMSs) read from and write to remote databases or files. Examples of this kind of middleware include remote file systems, such as those embedded in NetWare, Network File System (NFS) and Windows, and also include the remote data access middleware – for example, Open Database Connectivity (ODBC) or Java Database Connectivity (JDBC) libraries – that is bundled into DBMSs such as DB2, Oracle and SQL Server.

This *Strategic Analysis Report* does not cover basic data management middleware products because they are usually a feature that is embedded almost unnoticed in a larger product. There are relatively few decisions to make regarding the selection of such features. All modern DBMSs, for example, automatically include some form of redirector middleware (for example, an ODBC, JDBC or OLE database provider, or proprietary middleware library) that enables remote read and write access.

1.1.2 Communication Middleware Communication middleware helps programs talk to other programs. It is software that supports a protocol for transmitting messages or data between two points as well as a system programming interface (SPI) to invoke the communication service. More-advanced communication middleware (such as message-oriented middleware [MOM]) also provides for the safe (for example, using strong security) and reliable (for example, guaranteed once and only once) delivery of messages. Protocols and SPIs used in communication middleware can be proprietary (for example, IBM WebSphere MQ or Microsoft MSMQ) or based on industry standards such as ASN.1, Distributed Computing Environment (DCE) remote procedure call (RPC), CORBA/IIOP, Java Message Service (JMS) or Web services (based on Simple Object Access Protocol [SOAP]).

Communication middleware is essential to reliably deliver data and messages between application systems and trading partners. Today's communication middleware generally runs on Internet-based protocols such as FTP, HTTP and Secure-HTTP (S-HTTP), IP, SMTP or TCP. It may implement higher-level protocols, including industry standards (for example, ebXML messaging, AS2 and Web services), and proprietary protocols (for example, in IBM WebSphere MQ, Microsoft MSMQ and Oracle AQ), and it may run over the Internet or private networks such as ANX or Society for Worldwide Interbank Financial Telecommunication (S.W.I.F.T.).

Although simple forms of communication middleware (for example, Web services) don't inherently provide them, a variety of services are provided by more sophisticated forms of communication middleware. Such features include reliable delivery (for example, assurance that messages will be saved until their delivery is confirmed), transactional support (for example, two-phased commit in conjunction with an application), message queuing (for example, for deferred delivery), offline message handling (for example, for portable applications or for when a target application is not connected), once-and-only-once delivery (that is, eliminating duplicate messages) as well as first-in, first-out and other message-ordering

variations. As more integration occurs between increasing numbers of distributed application systems, trading-partner security is increasingly essential and should address authentication, authorization, message integrity and privacy. End-to-end tracking and management are also essential to operate and manage communications consistently and predictably. Although communication middleware is an essential requirement for application integration projects, no single solution or industry standard can address requirements for every integration problem or scenario.

Communication middleware is available in the form of stand-alone communication middleware products such as MOM, and also often bundled within other middleware products such as application servers, integration suites, enterprise service buses, application platform suites, Web services management software and transaction delivery networks.

The following sections focus on a few important forms of communication middleware functionality.

1.1.2.1 Web-Based Services

If the interface proxy for communication middleware "listens" or speaks to the Internet using a uniform resource identifier (URI) and common Internet protocols (for example, HTTP or SMTP), and is structured as a service according to the principles of the service-oriented architecture (SOA), then the communication is considered a Web-based service. Typically, the message encoding in these transmissions is also based on Internet standards, such as HTML or XML. During the past three years, many applications have been developed and deployed in production that receive processing requests as XML-encoded messages or documents over the Internet.

The design of non-Web services and Web-based services is typically the same; the difference is in the implementation of the interface proxy. Most services can be easily converted to Web-based services by simply generating an Internet-oriented version of the interface proxy. However, Web-based services are accessed through the loosely coupled Internet transport mechanism. Some services designed for tightly coupled access – such as services based on CORBA – may have to be partly redesigned to work well as loosely coupled Web-based services.

1.1.2.2 Web Services

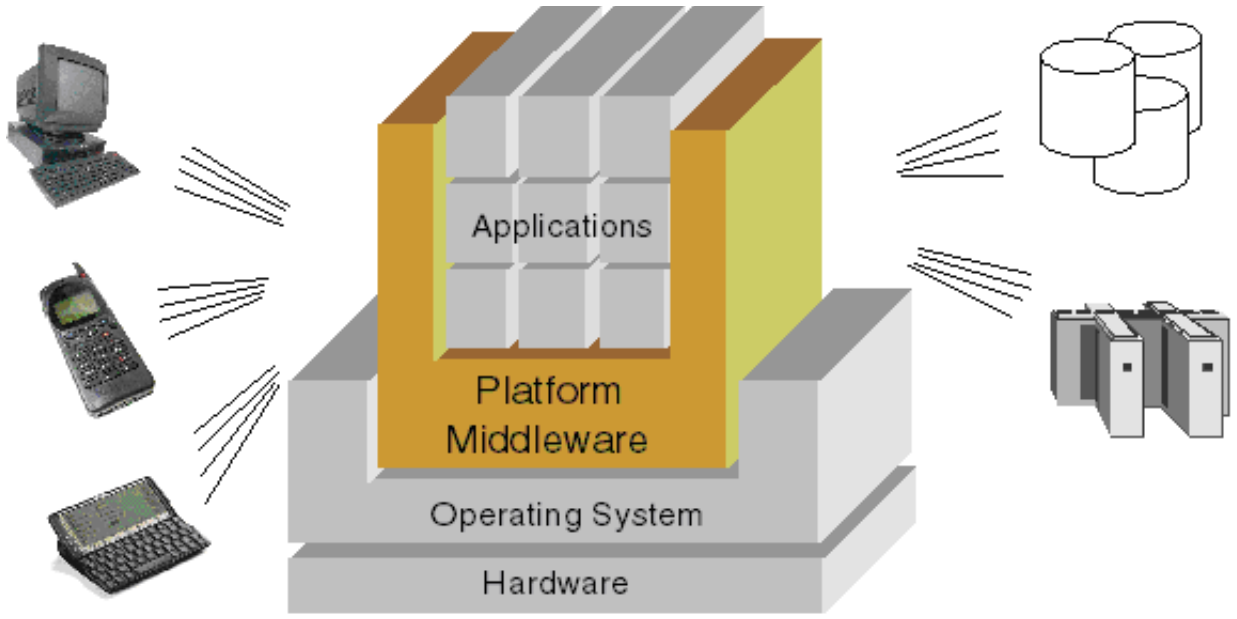
Web services are Web-based services that use any one or more of three related XML-based standards including SOAP, Web Services Description Language (WSDL) or Universal Description, Discovery and Integration (UDDI).

- SOAP is a simple wire protocol for interprogram communication
- WSDL is an interface-definition syntax
- UDDI defines how a directory is used to register Web services

The initial intent of Web services was for HTTP-based access to applications. However, Web services can be run over other, non-HTTP transports, such as those implemented in MOM or e-mail systems (SMTP). Enterprises should not assume that all Web services (software using one or more of the Web services standards) will use Internet protocols. However, well-designed Web services should use either SOA or event-driven architecture (EDA) rather than being monolithic in design.

1.1.3 Platform Middleware

Platform middleware provides the runtime hosting environment (a container) for application program logic (see Figure 3). It uses embedded or external communication middleware to help programs interact with other programs. It also provides resource management services for hosting application program logic at runtime (for example, managing memory, operating system processes and threads, loading programs from disk as needed, starting, stopping and multiplexing programs, load balancing, fault tolerance, access security, monitoring and management, distributed transaction processing, and remote distributed and optimized access to application programs from the outside clients and servers). Platform middleware also provides interfaces to one or several forms of communication middleware (one-way messaging and request/reply).



Source: Gartner Research (March 2004)
Figure 3: Platform Middleware

The full collection of all interfaces provided by a platform middleware product represents a programming model. J2EE, CORBA, .NET/COM+ and CICS are all represented by a distinct programming model. Thus, platform middleware defines the style and the capabilities of the applications that are developed for it. Platform middleware's programming model can also define the style and behavior of add-on management and extension tools and middleware. Some middleware products are built using (on top of) general-purpose platform middleware; others are developed for use directly with the operating system or embed their own exclusive platform technology. Another definition for platform middleware can be "the enabling technology for a programming model." Essentially, all programmable environments carry a programming model and thus carry at least elements of platform middleware.

Platform middleware is well-known today as "application servers" (J2EE or .NET Framework/COM+). However, historically, many other product categories have served as then-prevailing platform middleware. Examples include mainframe transaction-processing monitors (TPMs), Unix distributed TPMs, extended RPC implementations, extended object request brokers (ORBs) and object transaction monitors (OTMs), DBMS stored procedures platforms, proprietary platforms underlying some more advanced packaged applications and fourth-generation languages (4GLs), and programmable Web servers. All are examples of platform middleware, layered between the application and the operating system and serving as a hosting container and the access medium for the application components.

As the prevailing application architecture for platform middleware evolves from a monolithic form to the service-oriented and event-driven architectures, the platform is likely to evolve in this direction as well. We expect next-generation platform middleware, application platform suites, will combine functionality of the traditional application server with some functionality of integration middleware and multichannel user interaction middleware (portals). Application servers, as we know them today, are neither the first nor the final form of platform middleware.

Platform middleware is evolving further in part because of the growing interest in "portal" services such as personalization, multichannel access and content management. Numerous vendors offer portal services as separate (portal) products that are meant to complement Web servers and application servers. Most of the portal products now bundle application servers. These are essentially specialized application servers: programmable environments, specialized in supporting user-facing application styles. This is another example of convergence in platform middleware markets. Although the two product types (portal products and application servers) are not equally strong in their different dimensions, both are programmable platform middleware with partly overlapping functionality. Analogous convergence trends apply to the evolution of application servers and integration broker suites as well. Extended-function application servers are enterprise application servers. Suites that incorporate the full functionality of application servers, portal products and integration broker suites are application platform suites.

Examples of platform middleware products include (but are not limited to) enterprise application servers, programmable Web servers, TPMs, ORBs, portal products and application platform suites.

1.2 Integration Middleware Functionality

Integration middleware is usually appropriate when the business problem requires connections between independently developed application systems – even if they happen to run on the same computer or use the same software technology. Integration middleware offers features that help reconcile the technical and application design differences that inevitably occur in a heterogeneous environment. Integration middleware may be intraenterprise – as in application-to-application (A2A) integration – or interenterprise – as in B2B – in scope.

Products that perform integration middleware functions usually also embed some basic middleware, such as communication middleware, platform middleware and data management middleware. Integration middleware functions are found in various products including (but not limited to) adapter suites, integration servers, enterprise service buses (ESBs), integration suites, portal products and application platform suites.

1.2.1 Adapters

Adapters are some combination of design tools and runtime software that act as glue to link applications, which are considered "sources" or "targets" (or both), to other applications or other integration middleware. When interfacing with a source or target application, an adapter generally deals with a group of "touchpoints," that is, one or more entry/exit points, collectively called an "interface." Adapters can be deceptively complex, with "thick" adapters performing a variety of functions that include recognizing events, collecting and transforming data, and exchanging data with platform, integration suite or other middleware. On the other hand "thin" adapters may only "wrap" a native application interface, exposing another more standard one for application access. Adapters can also handle exception conditions, and can often dynamically (or with minor reconfiguration changes) accommodate new revisions of source or target applications.

Adapters are generally bundled with integration middleware products such as ESBs, integration suites or portal servers or offered as a stand-alone product such as an adapter suite. While there are many different categories of adapters, high-level categories include technical and application adapters.

1.2.1.1 Technical Adapters

Technical adapters may connect into DBMSs (for example, DB2, Oracle or SQL Server), communication middleware (for example, MOM or Web services platforms), TP monitors (for example, CICS or Tuxedo), ORBs (for example, COM+ or CORBA) or other software environments. By definition, technical adapters (in contrast to application adapters, which we discuss in the next section) are not inherently configured to be business process- or document-aware.

A superservice is one form of technical adapter that provides a common programming interface (or "superAPI") to a common function, such as directory, transaction management or security, across two or more operating systems, application servers, ORBs, TP monitors, MOMs or networking layers. The local environments may each provide their own respective directory, transaction management or security, but the superservice superimposes a layer of coherence among multiple environments. The superservice is "super" in the sense that it goes above or beyond one or more lower-level services in the underlying software, effectively masking or superseding the API exposed by other software layers.

1.2.1.2 Application Adapters

Application adapters interface to packaged application modules (for example, Oracle Financials, SAP Procurement) or vertical-industry protocols (for example, RosettaNet or S.W.I.F.T.). By definition, application adapters (in contrast to technical adapters, discussed in the prior section) are inherently configured to be business process- and document-aware, that is, the adapter is designed to interact with a source or target interface and read or write specific business documents or messages such as a purchase order or invoice. Many application adapters include technical adapters within them.

For example, an application adapter that is used to import or export purchase orders from a procurement application can leverage a technical adapter, which accesses the application at the database or low-level API level. While the technical adapter could be licensed and used by itself, the value of the application adapter is that it eliminates the need for complex logic that is often necessary to navigate what are often complex database or low-level interfaces. Application adapters generally expose access to application data via a message (for example, for communications middleware such as WebSphereMQ or MSMQ), a component (for example, via .NET or J2EE) or another medium.

1.2.2 Transformation

Transformation tools provide syntactic or semantic data conversion for business documents, messages, files and parameter strings that flow between application systems. Syntactic conversion reconciles simple, mechanical differences, such as ASCI to EBCDIC encoding, field lengths and data types.

Semantic transformation is more involved because it requires knowledge of the specific application. Powerful transformation tools can combine data from multiple sources, sum or average data fields from different input records, perform conditional logic on individual records or sets of records, and import metadata from various outside data sources such as COBOL copybooks, database schemas, data-modeling tools and packaged-application metadata repositories.

An emerging innovation for transformation is vocabulary management, which is sometimes called "taxonomy-based" or "ontology-based" transformation. This includes advanced forms of information representations that can, for example, automatically recognize data element synonyms and translate between them.

Several product categories have transformation functionality bundled within, including integration servers and integration suites. Two categories of stand-alone transformation products include electronic data interchange (EDI) tools and transformation tools.

1.2.3 Intelligent Routing

Basic middleware sends data to a destination that is specified by the sender. For example, a simple Web service will be directed to a particular business component (service) based on its URI. Similarly, a MOM determines the destination for a message by looking at the queue name, subject, property or topic information that is placed in the message header by the sender. This level of routing is useful because it accomplishes simple location independence, but it is, nevertheless, fairly rudimentary. By contrast, integration middleware may be capable of intelligent routing based on the contents of the message, file or Web service argument list. The middleware parses the message contents and applies logical rules to determine where to send the message. The rules may be defined statically in advance of runtime or they may be input by an administrator at runtime. A third alternative is the publish-and-subscribe model in which the destinations (subscribers) can dynamically initiate participation in the communication process at runtime. The integration middleware will begin sending messages to a new subscriber when the next message that conforms to the appropriate subscription rules is received from any sender (publisher).

Note that intelligent routing is stateless – it does not understand the idea of a multistep business process. After it has routed a message, it forgets about it, unlike a business process management (BPM) engine, which is stateful and can track a business process instance for the duration of its life. BPM engines can be considered a form of very intelligent routing because they may be capable of routing based on content in addition to their other services, that is, the rules to control micro- and business-level changes can also be used to route messages.

Products that support some form of intelligent routing include (but are not limited to) enterprise service buses, integration servers, integration suites and Web services management software.

1.2.4 Data Navigation

Some of the more sophisticated data integration middleware products provide a federated or virtual database view across heterogeneous data resources. They can join tables from multiple databases, including those managed by disparate DBMS products. The client software generally uses SQL or XML Query as the API to access a single coherent view of the data as a virtual database. Although some features, particularly updates, generally only work on relational database resources, these products are improving the range of data sources over which federated queries can be accomplished. Some of these products can navigate, parse and extract information from semistructured ("content") data sources, such as e-mail, text files and Web sites, as well as other non-DBMS sources, including XML, message queues and Web services.

The ability to provide a federated database view to interactive clients is available in stand-alone data navigation tools and sometimes packaged with other data middleware functions such as limited heterogeneous replication and update capabilities. These products are used mostly by large, sophisticated enterprises willing to make the effort to create a systematic view of heterogeneous data. The field of enterprise information integration (EII) is mostly a renaming of previous virtual data access approaches. EII tools can extract data from heterogeneous application systems ("data in place") through either SQL or program-to-program interfaces. Most can also cache a version of a composite (or "virtual") data object in memory and/or on disk to reduce the latency of repeated reads of the same data and reduce network overhead.

1.2.5 Business Process Management

BPM is a general term describing a set of services and tools that provide for explicit process management (for example, process analysis, definition, execution, monitoring and administration), including support for human and application-level interaction. BPM has emerged from many sources:

workflow, applications, collaborative tools, integration suites, Web integration servers, application servers, development tools, rule engines and commerce offerings.

BPM leverages tools to analyze and model processes, using a graphical process designer targeted for business analysts who extract process flow and develop new business process flows. A runtime execution engine (underlying state machine) executes the defined process flow. As the process flow is executed, applications (for example, legacy, packaged, external B2B and Web services) may be invoked, as will tasks that humans have to complete. The runtime environment maintains the status (state) of each process instance. As the many instances of multiple process types execute, they can be monitored (for example, process performance, degree of completion and out-of-bounds conditions) and administered (for example, for process termination, load balancing or rerouting). Post-completion analysis is also possible, as the state data is archived for business intelligence potential.

Business process managers track and direct each instance of a business process, such as each individual order or medical insurance claim, through a life cycle that may consume seconds, minutes, hours, days or weeks. Unlike simpler forms of flow automation, a business process manager "remembers" (maintains in memory or a persistent file or database) context information for the duration of a process that potentially spans many individual activities. Business process managers are called by many names, including "workflow systems," "businessware," "enterprise work management systems" and "business process automation managers." BPM may be a feature in a larger product or it may be the primary role of a particular product.

Obvious product categories that include business process managers include integration suites and business process managers, but BPM is also found in (but not limited to) other product categories such as application platform suites, packaged integrating process offerings, portal products and Web application servers.

1.2.6 Business Rule Engines

A business rule engine (BRE), in its simplest form, takes the essence of business or technical rules and records them in an easy-to-understand and easy-to-change format to allow for fast time to implement changes of software behavior that affect business and technical outcomes. In their most complex form, they can support goal-directed flows, point to probable outcomes and suggest patterns in decision making. Today, there is resurgence in the use of BREs for both points on this spectrum as well as between. We expect BREs to be under the covers of many software offerings in the future, although often unnoticed.

BRE functionality is measured on several attributes including ease of use, performance, rule management, logic complexity and ability to integrate well in other technologies. The major functionality going forward, in addition to allowing for the easy and quick change of business/technical logic, will be the ability to manage business policies throughout heterogeneous business applications/services, as well as across the "enterprise nervous system" (ENS).

Some form of BRE can be found in several product categories. Integration suites use a limited form of rule processing in their transformation and routing engines. BPM products also leverage some form of rule engine to manage business processes. General-purpose BREs that can implement a wide range of business logic are also available as stand-alone products.

1.2.7 Business Event Management

The growing interest in business activity monitoring (BAM) and event-driven applications in general is creating market opportunities for new kinds of software that can assist in other aspects of BAM, that is, the analysis and management of events after they have been captured from the application systems, and the display of BAM information to end users via desktop dashboards, browsers, e-mail or pagers. These capabilities have a natural synergy with the information collection and storage capabilities of basic integration middleware. Data and events collected, transformed, routed and transported by integration middleware, MOM and other mechanisms can supply input to BAM event management and presentation tools.

Products that support business event management include, of course, stand-alone business event managers, but this functionality is also found in BAM tools and integration suites.

1.3 Integrating Application Functionality

The following categories of functionality are not pure middleware, but a combination of middleware and business-process-specific application logic.

1.3.1 Packaged Integration

Packaged integration is to integration what packaged applications are to applications – off-the-shelf solutions for IT problems, or at least something that approaches an "off the shelf" solution. Like packaged applications, packaged integration is designed to solve integration problems for specific business processes – for example, synchronizing purchase orders between an order entry and an order management system.

At a minimum, packaged integration solutions should provide native connectivity for each participating application (for example, SAP) and should come pre-configured to support specific documents (for example, purchase orders) and specific process activities (for example, approve purchase order). Packaged integrating processes (PIPs; called also "packaged processes") are one form of packaged integration that is typically implemented as a point-to-point integration directly between two or more applications. These solutions do not cause data to persist (it remains "in-flight," flowing between applications) and do not include user interfaces or complex business rules (these remain in the participating applications). Packaged composite applications (PCAs), on the other hand, are another form of packaged integration that do everything that a packaged process does but also include application logic (which may include user interfaces and complex business rules) and maintain their own application data (written to persistent storage outside of the participating applications).

Packaged integration is, in some cases, delivered specifically as PIPs or PCAs, but also from vendors of packaged applications, adapter suites, integration suites, providers of integration as a service (for example, traditional and Internet value-added networks [VANs]) and from external service providers (ESPs) as part of their consulting services.

1.3.2 Business Activity Monitoring "BAM" is a Gartner term that defines the concept of providing real-time access to critical business performance indicators to improve the speed and effectiveness of business operations. At its broadest level, BAM is the convergence of operational business intelligence (BI) and real-time application integration aimed at business goals, but enabled through advances in IT.

Unlike traditional real-time monitoring – that is, features within closed applications – BAM draws its information from multiple application systems and other internal and external (interenterprise) sources, enabling a broader and richer view of business activities. BAM infrastructures often include agents as part of their architecture for tracking and filtering events. Agents are relevant to the direct approach, connecting straight into the application databases and programs, and the indirect approach, eavesdropping on the integration traffic that was already put in place for other purposes.

Although BAM depends heavily on advanced infrastructures, technology is just the required pipeline to move business-level information to the decision makers. The real potential for BAM is at the business level: enablement of new business strategies, reduced operating costs, improved process performance and other areas of management interest. Early BAM ventures in transportation (for example, airline operations) and logistics (for example, package shipment) are showing the benefits of reduced latency in decision making.

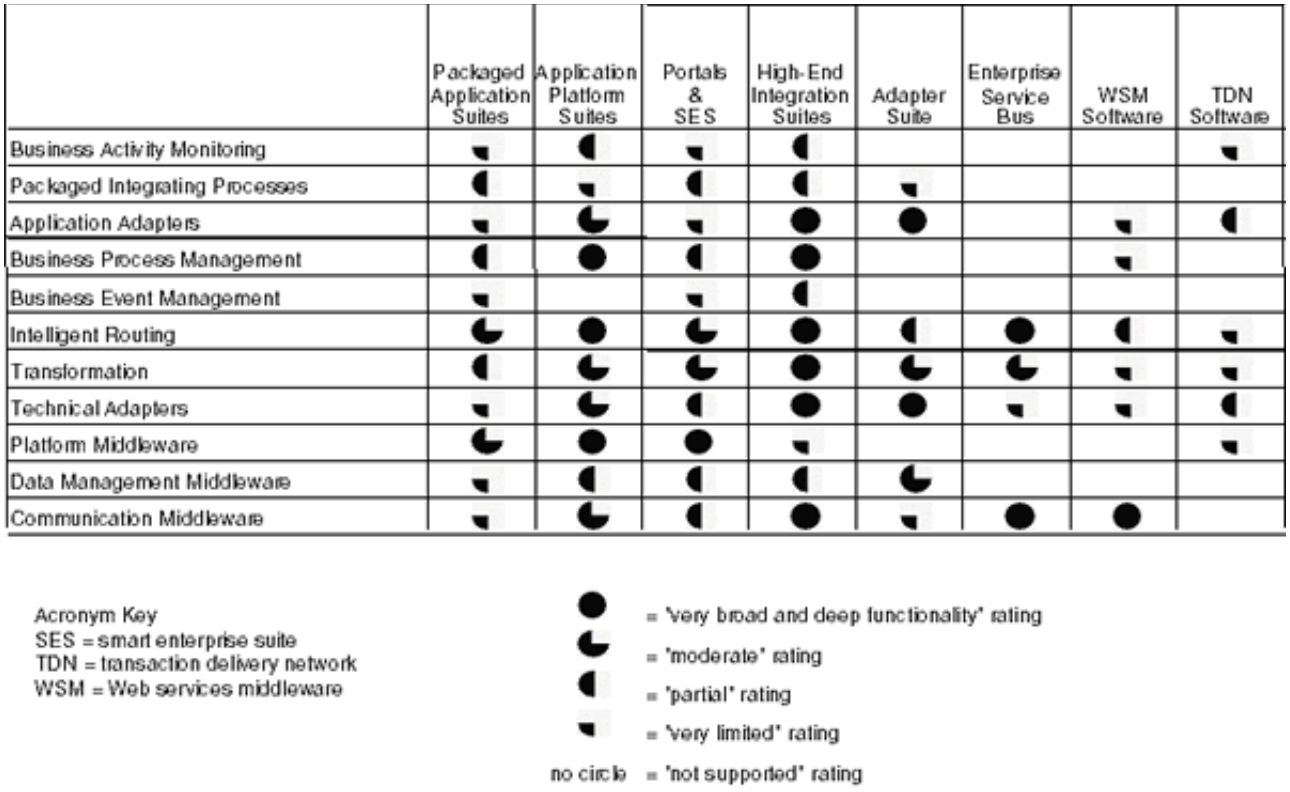
BAM capabilities are available in stand-alone BAM tools and are also often bundled as part of integration suites and vertically focused business applications.

2.0 Middleware Products

In the previous section, we focused on middleware functionality. In this section, we focus on middleware products. We do this by identifying and defining the various middleware product categories as well as providing a "who's who" list of vendors that offer solutions in these various product categories.

2.1 Comparing Products to Integration Middleware Functionality

Part of the confusion associated with understanding the "sweet spot" and proper positioning for different middleware products is that there is extensive product overlap and specialization, which makes it difficult to focus on a middleware product category that is a good fit for your particular IT project requirements. To help solve this problem for integration projects, we have produced a middleware-product-to-middleware-functionality map (see Figure 4). This map provides a rough assessment of how well various middleware products address the various middleware functionality.



Source: Gartner Research (March 2004)

Figure 4: Middleware-Product-to-Middleware-Functionality Ratings

For each row in Figure 4, we rate the relative breadth and depth of one form of middleware functionality – for example, BAM – for each of the middleware product categories. Ratings in this map range from a "very broad and deep" functionality rating (a full circle) to a "very limited" rating (a quarter of a circle) as well as a "not supported" rating (blank).

Note these ratings are intentionally coarse, and implementations vary substantially from vendor to vendor. The ratings should be used only as a rough guide to help you establish which category of middleware might be the best starting point for product selection based on your particular middleware functionality requirements. At this time, we have not rated all of the middleware product categories defined in this document – not being included in this graphic does not suggest that the category of middleware product is worse or better than another for a particular application.

In the following sections, we define each of the various different forms of middleware products and offer examples of vendors that offer products in that particular category. If a vendor is not listed in our document, it does not mean that its product is inferior and should not be considered for your own IT projects – on the other hand, being included in these lists does not guarantee that a vendor or product is superior to any other.

2.2 Communication Middleware Products

2.2.1 Remote Procedure Calls

RPCs were the first significant form of communication middleware used for program-to-program communications on nonmainframe platforms. However, RPCs never became prevalent in business applications, and they did not endure as a major middleware product category in their own right. Few new applications are written directly to RPC middleware today. However, they are widely used as a layer of functionality embedded in other products. RPCs are also significant as the forerunner of ORBs, application servers and SOAP RPC in Web services platforms.

The original "RPC" was Sun Microsystems' NFS RPC, which is also called Open Network Computing (ONC) RPC or Transport-Independent (TI) RPC in its various incarnations. It is still available on most operating systems, along with NFS, as an extension of the TCP/IP stack, although its commercial use is gradually fading. The other well-known RPC was The Open Group's DCE RPC. It is still available from IBM and some other major vendors as an embedded system software layer used by a few high-level subsystems. Microsoft's MS-RPC, a proprietary version of the DCE RPC, serves as the foundation for many other layers of Microsoft middleware, including Distributed COM (DCOM) and COM+.

Gartner is not aware of any actively marketed independent (unembedded) RPC products aimed at new applications.

2.2.2 Message-Oriented Middleware

MOM products provide connectionless program-to-program communication services for intra-application and interapplication (that is, integration) purposes. Interactions implemented with MOM may be fully asynchronous (one-way, store-and-forward) or partially synchronous (immediate, one-way delivery or two-way request/reply exchanges). MOM strengths are in connectionless (loosely coupled) communication, "store-and-forward" (queuing), guaranteed delivery, broad platform support (run on many operating systems) and, in some cases, content- or subject-based addressing (for example, publish-and-subscribe). Unlike RPCs, MOM products also support one-to-many (1:n), many-to-one (m:1) or many-to-many (m:n) delivery.

MOM products complement application servers by providing features that are missing or not well-supported through RPC and other connection-oriented communication mechanisms such as COM+, CORBA and SOAP RPC. All major Java application servers and most integration suites now include a bundled MOM service, often based on the JMS standard, but stand-alone (unembedded) MOM products are also still sold. The popular stand-alone (unembedded) communication middleware products on the market today are MOM or a combination of messaging and other forms of middleware.

Examples of unembedded MOM include:

- IBM's WebSphere MQ (general purpose)
- Fiorano Software's FioranoMQ (designed for JMS)
- IIT's SwiftMQ (designed for JMS)
- Microsoft Message Queue (MSMQ) Services (general purpose)
- Oracle's Advanced Queuing (AQ) (general purpose)
- Sonic Software's SonicMQ (designed for JMS)
- Softwired's iBus (designed for JMS)
- TIBCO Software's Enterprise JMS, Rendezvous and SmartSockets (real time, highly scalable)
- webMethods' JMS+

2.2.3 Multifunction Communication Middleware

Multifunction communication middleware products are a blend of MOM and related services. They generally support synchronous and asynchronous communication, in some cases including queuing, and in some cases including conversational styles. An example of such a commercially available product is:

- Software AG's EntireX Message Broker and EntireX DCOM

2.3 Platform Middleware Products

2.3.1 Transaction Processing Monitors

The earliest form of platform middleware were the mainframe TPMs. Products such as IBM's CICS and IMS, and Unisys' TIP have been used on mainframes since the late 1960s. Unix-based distributed TPMs such as BEA Systems' Tuxedo, then NCR's Top End and IBM's Encina originated in the 1980s. Over the years, these products added support for distributed servers, intelligent desktop clients (rather than dumb terminals) and Web browser clients, and component support using CORBA or J2EE architecture – the programming models of these products were proprietary (a few attempts to standardize them did not receive industry support). Examples of TPM products include:

- BEA's Tuxedo
- Hitachi Computer Products' Open TP1
- Honeywell/Bull's TP8
- IBM's CICS, IMS, TPF and TxSeries
- Siemens' openUTM
- Unisys' TIP

2.3.2 Object Request Brokers

ORBs are platform middleware, an enriched platform, compared to their predecessors, RPC middleware, including program activation, which most RPCs did not offer. Full-featured CORBA ORBs are TPMs with a special affinity for the object-oriented programming model, including the activation and communication

services that are particularly geared to the object-oriented software model. During 1994 through 1998, ORB vendors as diverse as IONA Technologies, Inprise, IBM and Microsoft (COM) added transaction management and other features traditionally found in TPMs to their ORBs to enable demanding, production applications. Most ORB products thereby evolved into object transaction monitors (OTMs), just as TPMs added component interfaces and also evolved into OTMs from a separate starting point. OMG CORBA emerged as the widely shared standard programming model for ORBs and OTMs. Examples of object-oriented platform middleware (ORBs) include:

- BEA Tuxedo 8 (includes the former M2 CORBA ORB)
- Borland's Enterprise Server, VisiBroker edition
- Hitachi's TP Broker
- IONA Technologies' Orbix
- Microsoft's COM/COM+ and .NET Framework/Enterprise Services
- Sybase's EAServer (formerly Jaguar, includes a CORBA ORB)

2.3.3 Application Servers

An application server is a modern form of platform middleware. It is system software that resides between the operating system on one side, the external resources – such as DBMS, communications and Internet services – on the other side, and the users' applications on the third side. At runtime, the application server is to act as host (or container) for the user's business logic while facilitating access and performance of the business application. The application server must perform despite the variable and competing traffic of client requests, hardware and software failures, the distributed nature of the larger-scale applications, and potential heterogeneity of the data and processing resources required to fulfill the business requirements of the applications.

An application server also supports multiple application design patterns, according to the nature of the business application and the practices in the particular industry for which the application has been designed. It typically supports multiple programming languages and deployment platforms, although most have a particular affinity to one or two of these. Some application servers implement standard application programming models, such as J2EE, and others are entirely proprietary. Some proprietary application servers are built into packaged applications (for example, SAP BASIS), portals, e-commerce solutions and other software products – and are not offered as stand-alone products. These application servers are not tracked in this research. A high-end online transaction processing (OLTP)-style application server – called an "enterprise application server" – delivers the business applications with guaranteed levels of performance, availability and integrity via features such as clustering, fault tolerance, multiplexing, flow control, transformation and others – many delivered by way of nonstandard extensions to a J2EE foundation. A "basic application server" tends to be bundled with other products and does not include many features beyond the core J2EE set of APIs, oriented to smaller single-instance deployment.

Modern application servers generally include MOM and limited remote database access middleware. Support of MOM in the context of application servers is likely to grow in the next five years, both in support of user applications and in the effort to increase overall quality of service of the application server middleware, itself.

The following vendors offer some form of enterprise application server:

- BEA
- Borland
- Fujitsu
- Fujitsu Siemens
- Hitachi
- IBM
- IONA
- Ironflare
- JBoss Group
- Macromedia
- Microsoft
- Novell
- ObjectWeb Consortium
- Oracle

- Pramati
- SAP
- Sun
- Sybase

2.3.4 Web Servers and Web Application Servers
As Web servers evolved from static pages and CGI extensions to programmability, they became hosting platforms for simple business logic and, thus, simple platform middleware. The industry has referred to these as Web application servers. Over time, the application server functionality has grown beyond the confines of a Web server, and application servers became separate products, distinct from Web servers. Today, most deployed Web servers are extended to be programmable, and most application servers include a bundled-in Web server. "Web application server" is a loosely defined industry term referring to programmable Web servers or Web-enabled application servers. Gartner does not track Web application servers as a separate category.

Examples of programmable Web servers include:

- Apache Software Foundation HTTP Server with Tomcat
- Microsoft IIS
- Sun Java System Web Server

2.3.5 Portal Products
A portal product is used by enterprises to build a user-facing gateway that provides personalized access to and interaction with relevant information, applications, business processes and human resources for select targeted audiences, delivered in a highly personalized manner. A modern portal product is programmable and thus performs platform middleware functions. Increasingly, it also includes integration middleware functions such as transformation and intelligent routing – that is, it can include some form of basic integration broker.

- Art Technology Group (ATG)
- BEA
- BroadVision
- Citrix Systems
- Computer Associates International
- Hummingbird
- IBM
- Microsoft
- Novell
- Open Text
- Oracle
- PeopleSoft
- Plumtree Software
- SAP
- SeeBeyond
- Siebel Systems
- Sun Microsystems
- Sybase
- TIBCO Software
- Vignette
- webMethods

2.3.6 Application Platform Suites
Most modern enterprise application projects have a requirement for portal, integration, and BPM and business component engineering within the context of the same project. Application platform suites (APSs) are composite products, designed to meet this new reality of software engineering. Vendors of application servers, integration suites and portal products have recognized the benefits (and the growing user requirement) for a synergy between these now-fundamental software infrastructure technologies. An APS consists minimally of:

1. An application server
2. An integration suite
3. A portal product

Most application server vendors have an APS offering. Most portal vendors and some integration suite vendors are also moving in this direction, adding the "missing pieces" to their initial flagship offerings.

The competitive distinction between an APS and a best-of-breed assembly of component products is the degree of integration and ease of use an APS can potentially offer. Three areas of technology will be the source of integration for most APSs:

- The integrated development framework (spanning the development process of the application from coding to development of new software components, to integration and BPM, to development of Web services and multichannel user interfaces). Integration at this level offers potentially significant improvements in productivity and overall quality of the software-engineering process. Manageability and ease of maintenance of software projects will potentially improve as well.
- The shared underlying middleware (messaging transport, Internet communications technology, basic ORB and basic J2EE infrastructure) may all be part of the shared middleware foundation for an APS. Shared underlying middleware potentially improves the platform's resource utilization and ease of administration.
- An integrated systems management platform (including deployment, configuration, version control, security, monitoring and tuning). This level of integration potentially improves the ease of administration for the software infrastructure. It also potentially provides easier system diagnostics, error recovery and optimized resource utilization.

Through 2008, the APS products will not eliminate the best-of-breed products (0.8 probability). On the contrary, an APS will be more attractive if its component parts are leading solutions in their respective markets. However, the availability of an APS will begin to influence the sales of stand-alone products as well, since many users will value the option of potentially buying into the APS incrementally, by acquiring one component part at a time.

The degree of acceptance of an APS will be dictated by the degree of integration between the component parts and, to some degree, by the financial advantage of the APS over the one-at-a-time acquisition strategy.

The APS vendors include most of the leading software industry names:

- BEA
- Fujitsu
- Fujitsu Siemens
- IBM
- Microsoft
- Novell
- Oracle
- SAP
- SeeBeyond Technology
- Sun
- Sybase
- webMethods

2.3.7 Database Management Systems
Platform middleware is often embedded within DBMSs. Relational DBMSs began offering stored-procedure facilities, a software platform, in the second half of the 1980s. Originally, these were only suitable for low-volume, two-tier client/server applications, and were programmed in a proprietary 4GL. However, these have matured into relatively scalable and efficient runtime environments that support a choice of programming languages (in some cases including Java and JavaBeans) and Web browser clients. Again, the distinction between a stored-procedure service and other types of platform middleware

has diminished.

While mentioned here for completeness, DBMS products are not tracked in this research.

2.3.8 Object-Oriented Database Management Systems

Object-oriented DBMSs and similar object-relational platforms are another form of middleware that mixes DBMS capabilities with platform middleware capabilities in the same product. A variation on this is delivered by some modern ORBs that perform transparent object-relational mapping between the in-memory object state and a relational DBMS. As in a pure object-oriented DBMS, the task of issuing data manipulation language (DML) statements to read and write data is removed from the application code because it is managed by the middleware environment.

Examples of object-relational databases/application platforms include:

- CA/Jasmine
- InterSystems' Cache and Ensemble
- Objectivity
- Poet
- Progress' ObjectStore (acquired from eXcelon)
- Versant

2.3.9 XML Database Management Systems

XML database management system (XDBMS) products support the storage of XML documents in their native format. This is usually achieved via a proprietary database structure in which XML documents or fragments form the foundation of the database. Knowledge of the complete physical structure of the XML document is maintained in the database, enabling the document to be retrieved in its original state. In addition, no predefined knowledge of the document structure is required to store it – the self-describing nature of XML allows creation of the database "schema" on the fly. This enables the database to store XML documents of varying and dynamic formats, and can potentially reduce the administration and support effort. Access to XML data in the database (storage and retrieval) is achieved via XML-standard interfaces (for example, XPath, the Document Object Model [DOM] or other XML-based APIs).

Key attributes of XDBMS products include:

- Data is stored in native or near-native XML format.
- Storage, access and manipulation of data are accomplished via XML-standard mechanisms, such as XPath queries or DOM.
- Fidelity of XML documents stored in the database is maintained (a document can be retrieved in exactly its original structure).
- XML documents of dynamic and varying structure can be stored without modifications to the database schema.
- Optimal performance is achieved by granular indexing of data, at the element and attribute level.

Vendors/products that offer some form of XDBMS include:

- Cincom (Socrates)
- Coherity (Coherity XML Database)
- Ipedo (Ipedo XML Database)
- Ixiasoft (TEXTML Server)
- Software AG (Tamino)
- Sonic (eXtensible Information Server)
- X-Hive (X-Hive DB)
- Xyleme (Zone Server)

2.4 Integration Middleware Products

There are many kinds of integration middleware, but they all provide functions that are specifically related to solving the problem of integration: making independently designed application systems work together.

Categorizing integration middleware products is complicated because there are so many different ways to combine and package the various types of integration middleware functionality such as (but not limited

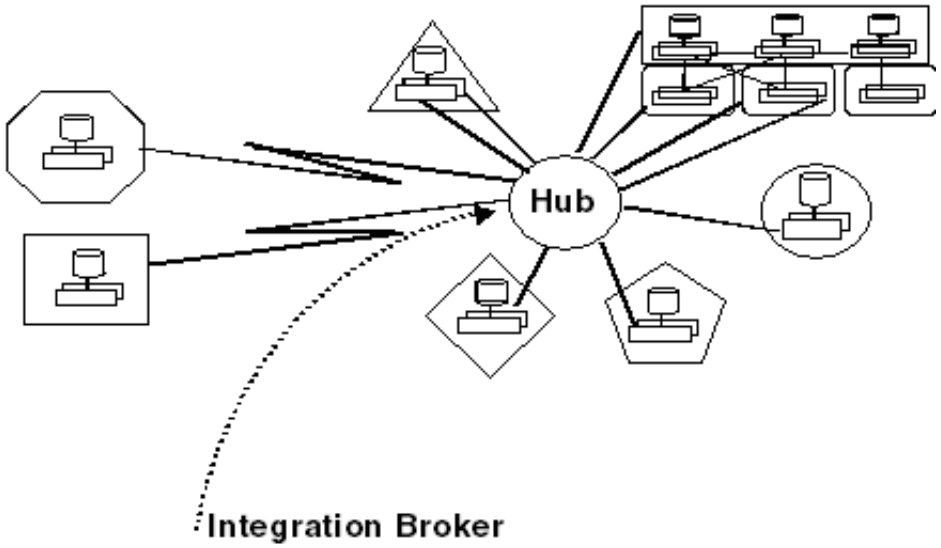
to) adapters, communication, transformation and BPM. Some products are just adapters, while others embed application servers and portal services along with adapters, transformation and more. Integration middleware products are maturing, but vendors and product functionality are still dynamic and volatile as vendors and users continue to experiment on how to best package and deliver the middleware functions needed to accomplish application integration.

Vendors of integration suites initially concentrated most of their work on intraenterprise A2A integration problems, but they later enhanced their solutions to do B2B application integration. B2B integration using XML was first addressed by a different class of product – that is, integration servers. More recently, new classes of integration middleware vendors such as Web services middleware (WSM) software, ESBs and transaction delivery network (TDN) software vendors have emerged with solutions focused primarily on solving B2B application integration. The products that support B2B and internal A2A integration converged rapidly as vendors and enterprises understood that these are two aspects of the same business processes. More than half of new "internal" A2A integration processes involves some interaction with external trading partners or outsourcers to initiate or participate in the process. Similarly, the richer forms of B2B inherently involve tying into enterprise applications in some way. The integration suite vendors have responded to this convergence by adding B2B capabilities, sometimes by joint marketing with a transaction delivery network software vendor and other times by acquiring or building their own B2B Web integration serverlike capabilities.

In the following sections, we describe a wide variety of integration middleware products.

2.4.1 Integration Suites

An integration suite (or sometimes "integration broker suite") is a broad integration middleware product that always includes a MOM or ESB and an integration broker. Commercially available integration suites also have adapters, an adapter development kit (ADK), security features and management tools. Many also support other options such as monitors, message warehouses, event management engines and BAM tools. The broker itself is just one component of such a suite of related middleware tools. The integration broker is an engine that provides transformation and intelligent routing. An integration broker (see Figure 5) is a third-party intermediary or "hub" (hence, the term "broker") through which messages and content flow and upon which the broker provides transformation and some type of intelligent flow automation, such as content-based routing. The early brokers were described with labels such as "message broker," "integration engine," "interface engine," "data broker" or "integration hub."



Source: Gartner Research (March 2004)

Figure 5: Integration Broker

Integration suites must have a repository for metadata descriptions of the input/output message formats (that is, a message dictionary) and transformation/routing rules. They also include development tools for defining transformation rules and routing flows. An integration broker may run directly on the operating system or be hosted by platform middleware (for example, an application server).

The following vendors offer integration suites that include a broker:

- Axway (including Sopra)
- BEA

- CMA Small Systems
- Connextive (formerly Glotech Solutions)
- CSK
- Fiorano Software
- Fuego
- Fujitsu Siemens Computers
- Global eXchange Services
- Hewlett-Packard
- i2 Technologies
- IBM
- Inovis
- Intersystems' Ensemble
- IONA
- iWay Software
- iWork Software
- Microsoft
- Netik.com
- Novell
- Oracle
- PRL Scotland
- Quovadx
- SAP
- Scribe
- SeeBeyond Technology
- Skyva International
- Software AG
- Sonic Software
- Sterling Commerce
- Sun
- SunGard Data Systems (Mint)
- Sybase
- Systematic Software Engineering
- TIBCO
- Vignette
- Vitria
- webMethods

2.4.2 Integration Servers

In many moderately complex integration projects, custom (or "composition") application logic is deployed to "glue" together the user interfaces of two or more applications. Often, this is done using an integration server along with a new, unified user interface (whether a Web page, an XML feed, a SOAP call or a traditional graphical user interface) and composition logic that maps, transforms and consolidates data from two or more back-end application systems. Integration servers are a hybrid combination of selected integration broker features (for example, flow control, message transformation and adapters), lightweight application servers (for example, load balancing, clustering), and integrated development tools. They are a viable alternative to more-sophisticated platforms such as application platform suites, enterprise application servers and integration suites for online transaction integration and simple composite applications.

Integration servers come in two forms: programmatic and presentation.

2.4.2.1 Programmatic Integration Servers

Programmatic integration servers aim at enabling encapsulation of back-end systems into component-oriented interfaces; as such, they can be considered low-end integration brokers. Some vendors offer "pure" programmatic integration servers focused on integration with legacy systems such as IBM's zSeries (S/390) and iSeries (AS/400), Fujitsu-Siemens' BS2000/OSD, Unisys' 2200, HP's openVMS and Himalaya, and so on, including:

- Attachmate
- ClientSoft
- CommerceQuest
- Fujitsu Siemens Computers
- GT Software
- HostBridge Technology
- Jacada
- IBM
- InnerAccess Technologies
- Microfocus
- Mitem
- NEON Systems
- NetManage
- Progeny
- Red Oak
- SabreTech Software
- Seagull Software
- Software AG
- SEEC
- WRQ

Some vendors offer programmatic integration servers focused on Web services, enabling CORBA or J2EE applications, such as:

- Cape Clear Software
- PolarLake

2.4.2.2 Presentation Integration Servers

Presentation integration servers focus on supporting Web (multichannel) integrated user interfaces. These products can be categorized as low-end application platform suites as they provide user interface management, light application serving, integration features and rich-development tools. Most of these vendors also provide programmatic access interfaces in their products. Vendors that offer presentation integration server products include:

- Advanced Business Link
- Attachmate
- ClientSoft
- Fujitsu Siemens Computers
- GT Software
- IBM
- Jacada
- Microfocus
- NetManage
- Seagull Software
- SEEC
- WRQ

2.4.3 Enterprise Service Buses

A new form of integration middleware that combines Web services, messaging, basic transformation and content-based routing first came to market in 2002. These low-cost, application-server-neutral enterprise service buses (ESBs) are well suited to be the backbones for service-oriented architectures (SOAs) and basic "enterprise nervous systems" (ENSs). An ESB is more functional than MOM because of its support for Web services, transformation and content-based routing. But it is not as complete as an integration suite because it does not include a BPM engine, sophisticated forms of transformation, B2B features such as trading-partner management, an ADK, PIPs or packaged composite applications (PCAs). However, some vendors, such as Fiorano and Sonic, offer such features as options on top of their ESBs, thus building the ESB into a full integration suite.

Leading-edge development projects are already putting ESB products from small, pioneering vendors into production. ESB use will explode when the products from larger venders are delivered. In August 2003, IBM announced its intent to ship a new "services integration bus" by the second half of 2004. In October 2003, Microsoft presented details of its upcoming Indigo "service-based infrastructure," which combines full ESB features with backward compatibility for COM, COM+, MSMQ and .NET remoting in a well-layered, extensible architecture.

ESBs are appropriate in projects that will mix heterogeneous application servers (for example, Microsoft or Java portals with disparate Java or Microsoft server back ends) within one collection of application services. ESBs are also attractive to those that want to start with a basic SOA and add other features later. Enterprises that want to assemble their own best-of-breed comprehensive integration suites can use an ESB backbone and mix and match off-the-shelf adapters, BPM, B2B and BAM tools from other vendors. However, an enterprise that wants a full, integration-capable ENS, not just an ESB, from the start should usually buy a comprehensive integration suite (based on either MOM or an ESB) from one vendor to get consistent management facilities and avoid the work of combining disparate products.

There are two types of ESBs:

- ESBs based solely on SOAP – Web services brokers (WSBs)
- Multiprotocol ESBs that support Web services and other communication mechanisms

2.4.3.1 Web Services Brokers

WSBs are Web-services-only ESBs (sometimes called "fabrics") as well as being one of two types of Web services middleware – see Section 2.4.4 on Web services middleware. WSBs were originally created to work specifically with SOAP/HTTP messages. WSBs still use SOAP, but some also support alternatives to HTTP as a transport now. It was clear from the early days of SOAP that the value-added services that were used with CORBA, DCE and MOM also would be needed for Web services. For many applications, it is not enough to simply convey a SOAP message from a client directly to a server. Plain, unbundled Web services platforms, such as Apache's Axis or Systinet's Web Applications and Services Platform, or similar platforms that are bundled into Microsoft's SOAP Toolkit or a Java application server, are sufficient only for simple applications. ESBs turn Web services into a distributed computing environment by intercepting messages within the local SOAP runtime or in an intermediate proxy server to provide value-added services. Many of the ESB vendors also supply Web services development tools and some management capabilities. Most of these value-added services and tools are not specified by a Web services standard and never will be.

Examples of SOAP-centric ESBs (that is, WSBs) include:

- Blue Titan's Network Director
- Cape Clear's 4 Server
- Digital Evolution's DE Management Server
- Primordial's Web Services Network
- Systinet's Web Services Bus
- webMethods' Fabric

2.4.3.2 Multiprotocol ESBs

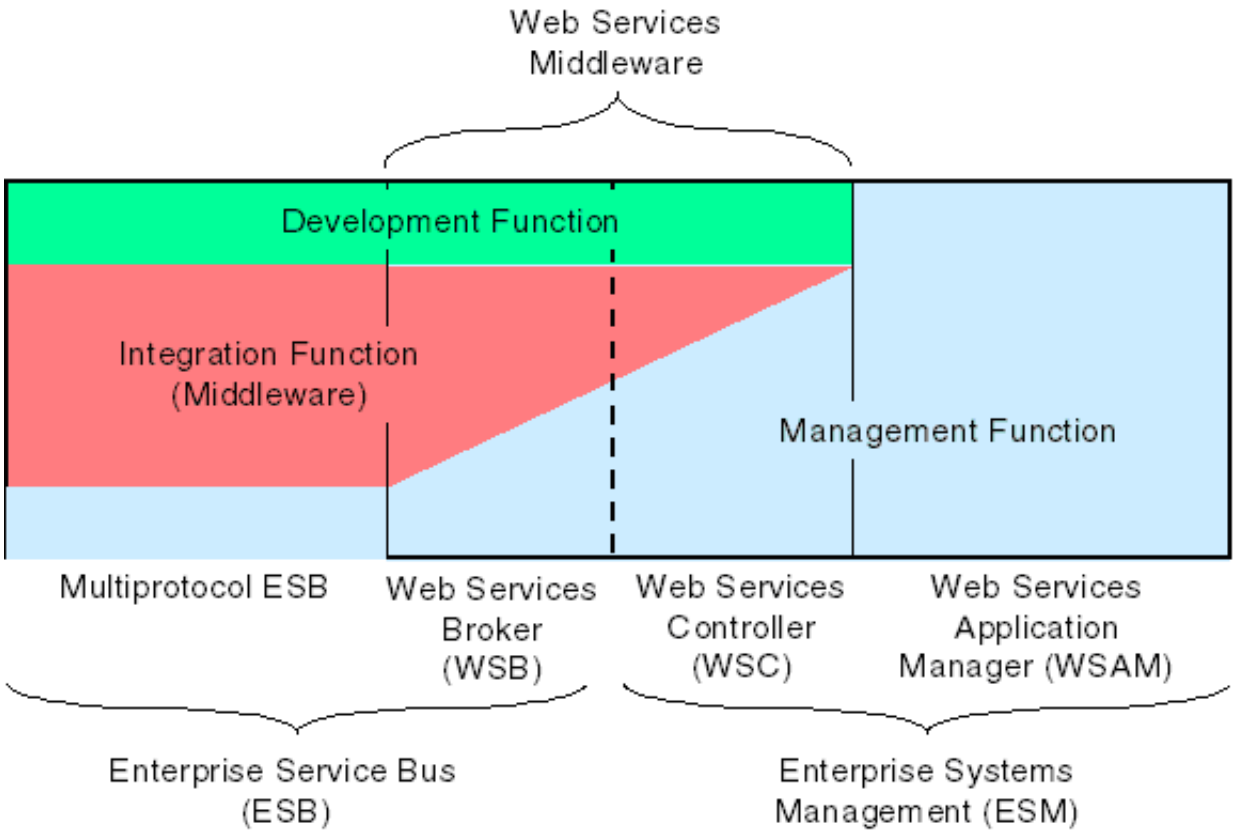
Multiprotocol ESBs: Multiprotocol ESBs support SOAP/HTTP and additional protocols. They implement communication patterns, such as guaranteed delivery and publish-and-subscribe, often following the JMS standard because there are no ratified Web services standards for those patterns yet. These products also provide various value-added services. Examples of such ESBs include:

- Fiorano Software's ESB
- IBM's Services Integration Bus (a future product)
- IONA Technologies' Artix
- Kenamea's Web Messaging Platform
- KnowNow's Event Routing Platform
- Microsoft's Indigo (a future product)
- PolarLake's JIntegrator
- Software AG's EntireX
- Sonic Software's ESB
- SpiritSoft's SpiritWave

- WebV2's Process Coupler

2.4.4 Web Services Middleware

A variety of middleware products that provide integration and management functions specifically for SOAP-based messages emerged during 2002 and 2003. These are sometimes called "Web services middleware" (WSM), "Web services management" (also WSM) or "Web services platform extensions" (so-called because they add functions that go beyond a basic Web services platform, which is just the SOAP protocol stack for sending or listening to SOAP messages). There are two major kinds of WSM products, Web services brokers (WSBs) and Web services controllers (WSCs) – see Figure 6:



Source: Gartner Research (March 2004)

Figure 6: Web Services Middleware Product Positioning

Web services brokers are the first of two types of WSM tools as well as being one of two types of ESB, that is a SOAP-centric ESBs – see the complete description in Section 2.4.3.1 on Web services brokers. Their primary value proposition of WSBs is communication and integration (for example, message validation, guaranteed delivery, publish-and-subscribe, transformation, service registration, service discovery or content-based routing). Multiprotocol ESBs (the other of two types of ESB) are mentioned here for completeness but are not a WSM tool, per se, although they do provide for the management of Web services in addition to other protocols and integrative features – see the complete description in Section 2.4.3.2 on multiprotocol ESBs.

2.4.4.1 Web Services Controllers

Web services controllers are the second of two types of WSM tools as well as being a type of enterprise system management (ESM) tool. Their primary value proposition is management (for example, features directed at one or more of fault management, configuration, accounting, performance or security). Their capabilities may include failover, load balancing, performance monitoring, metering, billing, service-level agreement monitoring or various administrative functions. Some WSCs also have increasing development capabilities that provide management and adaptive functionality for Web services. The following vendors/products offer WSCs:

- Actional
- AmberPoint
- Flamenco Networks
- Hewlett Packard (Talking Blocks)
- Infravio

- Itellix
- Oblix (Confluent)

Because their main purpose is management, WSCs are considered to be enterprise system management (ESM) products. However they are different from other ESM products because they have some communication middleware and/or integration middleware features (often including a limited ESB).

2.4.4.2 Web Services Application Management Tools

ESM products that work only with Web services but that do not include the communication or integration features of WSCs or ESBs are called Web services application management (WSAM) tools. Such products are not middleware and, thus, like most other ESM products, are not really the focus of this middleware research. But for completeness, because they do offer Web services management capabilities, we note that WSAM vendors include:

- Computer Associates (Adjoin)
- Hewlett Packard
- Reactivity
- Service Integrity
- Westbridge

2.4.5 Metadata/Transformation Tools

Some emerging integration middleware vendors focus largely on the problem of transformation. These vendors are offering a new generation of sophisticated vocabulary-based transformation, sometimes described as ontology-based or taxonomy-based transformation. These approaches are aimed at reducing development and maintenance efforts, and clarifying the handling of semantics, especially for the purposes of application integration. These vendors generally have advanced metadata stores and pre-built vocabularies for particular business realms. These products may be used by themselves or in conjunction with integration suites and other products. Examples of vendors with such transformation tools include:

- Contivo
- Flashline
- ItemField
- Metallect
- Unicorn
- Vitria
- ZONAR

2.4.6 EDI Tools

An EDI translator is a software application that an enterprise typically licenses from an EDI software provider or subscribes from a value-added network (VAN). The translator interprets incoming EDI information – typically, in Accredited Standards Committee (ASC) X12 or United Nations Electronic Data Interchange for Administration, Commerce and Transport (UN/EDIFACT) format – and converts it into the format or formats used by the enterprise's in-house systems and applications.

In addition to doing translation, an EDI translation application may also perform one or more of the following secondary functions:

1. Handling the EDI envelope (information about the transaction and the sender)
2. Creating and maintaining document management/audit trails
3. Generation of a functional acknowledgment (equivalent to an e-mail "read receipt")

Most VANs sell or license their own EDI translation software, or offer lists of approved EDI software providers whose applications are interoperable with their networks. Many "trading hubs" (enterprises that act as the primary point of contact among a group of trading partners) negotiate with EDI software providers on behalf of their trading partners. Therefore, their trading partners pay lower prices and receive assistance with network-connection issues.

The following vendors/products offer stand-alone EDI tools:

- Extol International's Extol Integrator
- Global eXchange Services' Application Integrator
- Inovis' TrustedLink
- Sterling Commerce's Gentran Server
- Seeburger's Business Integration Server

2.4.7 Enterprise Information Integration Tools
Enterprise information integration (EII) tools give a virtual view of federated, heterogeneous data to client applications by using sophisticated data navigation and integration techniques. The data view is "virtual" in the sense that it resides only in memory or cache (that is, it rarely persists for long-term storage and is rarely backed up in its intermediate form). EII tools leave the application data "in place," in contrast to ETL tools, which perform "data movement" to create a new copy of data. EII tools can access a range of heterogeneous data sources on different platforms. Data may be cached for performance reasons and thus may not be entirely "virtual." The early usage of EII products tends to be simplistic, generally not using complex transformation, data cleansing, or updates. Although the EII label is new, the basic concept of virtual federated data is not.

Vendors and products that provide data navigation or "virtual data" composition capabilities include:

- Actuate's Nimble Integration Suite
- Avaki's Avaki Data Grid
- BEA Systems' Liquid Data
- Certive's Certive Server
- Composite Software's Composite Information Server
- IBM's DB2 Information Integrator (formerly "Xperanto")
- InterSystems' Cache
- iWay's Generic Gateway (formerly EDA/SQL)
- Journee's Enterprise Data Hub
- Metamatric's Metamatrix Server
- Sybase's Information Liquidity

2.4.8 Content Integration
Content integration (CI) is the integration of unstructured data, such as images, documents, and video, that are dispersed throughout the enterprise in diverse applications and databases. CI tools are a type of data integration middleware that may sit above content repositories from vendors such as Documentum, FileNet and IBM/Lotus. They also may sit above workflow/BPM systems and provide a unified interface into the open work items (a nice capability that fills a need in many situations). Like EII tools, they can create a real-time virtual, federated view of data and they may support Web services interfaces. Day Software and Vignette tools extend the repository into a virtual repository approach.

CI software appears as a superservice or adapter at the OEM layer, but the midtier includes support for federated search and virtual foldering. The move to increase content integration capabilities will be one of the leading drivers behind enterprise acquisition of content management, workflow and application integration technology through 2007 (0.7 probability). There is relatively little competition in this space compared to other kinds of middleware. Examples include:

- Context Media's Interchange Suite
- Day Software's Communique
- IBM's DB2 Information Integrator for Content
- Open Text's Livelink Doorways
- Venetica's VeniceBridge
- Vignette's Business Integration Server

2.4.9 Transaction Delivery Network Software
Transaction delivery network (TDN) software enables enterprises to manage their in-house B2B integration. Independent vendors offer TDN software that typically provides the following functions:

1. Network services allow trading partners to connect to a network, to secure that connection and to manage the transaction from point to point.

2. Trading-partner services allow channel masters, or hubs, to provision new and current trading partners, and also offer some nonrepudiation capabilities.

In addition, integration middleware vendors offer organic, homogeneous TDN software that, when deployed, offers the above services, and leaves integration services (which include services such as transformation, messaging and BPM) and application services (which include document archival and Web forms) to their pre-existing integration middleware solutions. Independent TDN software vendors include:

- bTrade
- Cleo Communications
- Cyclone Commerce
- iSoft
- Inovis' IPNet Solutions
- TrailBlazer Systems

2.4.10 Business Process Managers
The drive to improve process efficiencies will continue the proliferation of process management as a feature of other products. In addition to integration-driven BPM, process management is prevalent in other sectors: Application-specific process management:

- Packaged applications that offer process management (for example, SAP and PeopleSoft)
- Content-management-focused process management (for example, Documentum)

Team process support tools:

- Interpersonal collaboration or knowledge-management-focused process support frameworks
- Team support products
- Groupware systems
- Project and resource collaboration tools

Administrative and task-oriented process tools:

- Administrative process management tools
- Personal task managers
- Simple forms-routing packages, groupware or groupware add-ons

The following list includes a variety of vendors that can support BPM in the general definition being used by vendors and many clients. Not all of the vendors in the following list can support the same degree of complex application integration, and some have no integration strategy to speak of. However, all of these vendors are capable of process management and execution. Enterprises implementing BPM and expecting strong application integration capabilities out of the box will need to be aware of the different classes of process management and acquire accordingly.

The following vendors/products incorporate BPM technology:

- Action Technology/ActionWorks Metro
- Action Technology/ActionWorks Coordinator
- Adobe Systems/Adobe Workflow Server
- Agentis/AdaptivEnterprise Suite
- Akazi/FlowMind
- AMS/Strata
- Apropos/Enterprise Edition
- AptSoft/Director
- Attunity/BPI
- Axentis/Enterprise
- Banctec/Plexus/eFirst
- BEA Systems/WebLogic

- Captaris/Teamplate
- Cardiff/LiquidOffice
- Celcorp/Celware Recorder, Planner, Server
- Ceyoniq/Docutreev
- Chordiant/STSP
- Clear/Tranzax
- CommerceQuest/Traxion
- Concentus Technology/WorkBridge
- Documentum/Workflow Templates
- Drala Software/Dralaware Workflow Solutions
- DST Systems/AWD
- Eistream/ViewStar
- Enterworks/Business Integration Solution
- Exigen/Grade
- FileNet/FileNet P8
- Focus Business Solutions/goal:technology suite
- Fuego/Fuego Suite
- Fujitsu/Iflow
- GeneXus/Workflow
- Global eXchange Services/Business Process Integrator
- Graham Technology/GT-X Suite
- HandySoft/BizFlow
- IBM/WebSphere Business Process Integrator
- Identitech/FYI Product Suite
- Infotone/Integration Hardware
- Insession Technologies/WorkPoint
- Intalio/N3
- IONA Technologies/Orbix E2A Collaborate Enterprise Integrator
- Lexign/Lexign Flow
- Lombardi Software/TeamWorks
- Lotus/Lotus Workflow
- Magic Solutions/Enterprise Application Integration
- Mercator Software/Business Process Integration
- Metaserver/Process Integration Engine
- Metastorm/eWork
- Metis Technologies/Metis Pathways
- Microsoft/Orchestration/Jupiter
- Mobius Management Systems/WorkflowDirect
- Movaris/Process Builder and Server
- Newscale/Request Center
- Nobilis Software/ProcessWriter
- OakGrove/Reactor
- Open Text/Livelink
- Optika Solutions/Acorde Process
- Oracle/10g Workflow
- Orchestria/Active Policy Management
- Pegasystems/PegaRules Process Commander
- ProCarta/Designer and Integration Manager
- QLink Technologies/Q-PAC
- Quantiv/Universal Business Application
- Quovadx/QDX Platform
- Rules Power/Relational Logic Management System
- Savvion/BusinessManager
- SeeBeyond/eInsight

- Serena/TeamTrack
- Singularity/Process Platform
- Staffware/Process Suite
- Sterling Commerce/Sterling Workflow Manager
- SunGard/MINT Knowledge Master
- Sun Microsystems/Sun One Integration Server B2B
- Sybase/Process Server and Biz Tracker
- Synthean/Enterprise Governing System
- Tacit/Active Collaboration Networks
- Teamplate/Teamplate for .NET
- Tenrox/InChange
- TIBCO Software/BusinessWorks and BPM
- Transflow/Workflow
- Ultimus/Workflow Suite
- Versata/Logic Suite
- Visuale/Visual Enterprise
- Vitria Technology/BusinessWare
- W4/W4 Suite
- webMethods/webMethods Integration Platform
- Worktiviti/Flotiva
- WRQ/Verastream
- Zaplet/Zaplet Suite

2.4.11 Business Rule Engines

There are two major drivers for the resurrection of the business rule engine market. The first and foremost is the need for timely response to business change. There is more than a slight pressure to become adaptable and apply the knowledge captured in rule sets to outflank competition and deal with changing business environments. Since business users can change rules without going through a long-running change process that is, at best, measured in days and, at worst, measured in weeks and months, we expect response times will move to hours as we move toward "time to market = 0." This is accomplished by pushing rules outward and allowing business users to have control over critical business rules. Business agility will continue to drive the need for friendly business rule engine changes in a real-time fashion, growing the use of flexible rule technology from 20 percent of organizational penetration to nearly 80 percent by 2007 (0.7 probability).

The second, and not least, of the drivers is the success of rule technologies in vertical and horizontal marketplaces. Rules have the ability to deliver guidance in reference mode and explicit ways of managing business processes in an action mode. In the financial services industry, rules have been quietly successful in delivering underwriting and risk applications, for example. The medical and pharmaceutical industries have also enjoyed the benefits of flexible rule technologies. Almost every significant player in the customer relationship management space has some form of business rule variability. Several successful portal and BPM platforms employ rule technologies. The most recent experiences with rules on the part of the business community has been positive, and many are pushing those successes to new levels of cost containment, time-to-market response and competitive advantage.

Vendors offering some form of business rule engine products include:

- AMS
- Clear
- Computer Associates
- Corticon
- Elity
- Fair, Isaac & Co.
- Formula/ESI
- Haley
- IBM
- ILog
- Magic

- Microsoft
- MindBox
- Novell/SilverStream Software
- Object Star
- Oracle
- Pegasystems
- Qlink Technologies
- RulesPower
- Sapiens International
- SEEC
- SoftLaw
- Sybase
- Synthean
- Usoft
- Versata
- Yasu Technologies

2.4.12 Business Event Managers

Event management products perform several key tasks. They filter events (using rules to select particular information from messages). They correlate and analyze events (matching and reconciling information from multiple sources). They sometimes maintain a database of event information (that is, an operational data store or message warehouse). In addition, they may generate outgoing alerts that will be sent to downstream BAM analytical applications or presented to human BAM information consumers. Examples of event management and presentation vendors (many with BAM capabilities) are:

- Actimize
- Agea
- Apama
- Axeda
- Celequest
- Decision Point
- iSpheres
- Kenamea
- NMI
- Rhysome
- Synthean
- Vayusphere
- Verilytics

2.5 Integrating Application Products

The following product categories are forms of application logic built on middleware and used in ways that reflect application integration (that is, making independently designed applications work together). The test for this distinction is that these categories of product: include application logic that is tailored to a specific application task; and are built using some combination of basic or integration middleware.

2.5.1 Adapter Suites

An adapter suite is a combination of design tools, adapter runtime engine and a collection of adapters that can interface with a variety of different categories of sources or target application systems or protocols. A comprehensive adapter suite should include adapters for databases (for example, DB2, Oracle or Sybase), common technologies (for example, COM, Enterprise JavaBeans or Web services), industry protocols (for example, EDI, S.W.I.F.T., RosettaNet) and applications (for example, SAP or PeopleSoft). Adapter development kits (ADKs) are also needed when no prepackaged adapter is available for a particular (often proprietary) application, and sometimes are provided by themselves as an alternative to a suite of pre-packaged adapters.

Enterprises should insist on detailed information from potential vendors about their adapter suites, including which categories and which specific adapters are supported and how resilient they are to underlying application changes. And if the required adapter is not available or does not meet your custom back-end system requirements, insist on details about the ADK – to build custom adapters for

unsupported sources/targets. Adapter suites are available as part of integration suites or as stand-alone unbundled products. In the latter case, they are typically used for "lightweight" integration projects, generally in composite application scenarios in conjunction with application servers to extend packaged or legacy systems to platform middleware such as Web servers or portals or to implement pairwise integration between two application systems. Adapter suite vendors/products include:

- Attachmate's Smart Connectors
- Attunity's Connect
- DataDirect Technologies
- Insevo's Business Integration Framework and Intelligent Adapters (the latter recently acquired from both Insevo, Inc. and Taviz)
- iWay's Universal Adapter Framework (UAF)
- Jacada Integration Server
- Librados Enterprise Integration Component Server
- NEON Systems' Shadow Connect
- Pervasive (which acquired Data Junction's Integration Architect)
- Sybase
- WRQ

2.5.2 Packaged Integrating Processes
Packaged integrating processes are one form of packaged integration – separately bundled solutions that integrate specific business processes between two or more application systems. Packaged adapters provide native connectivity for each application (for example, SAP) and come pre-configured for specific documents (for example, purchase orders) and process activities (for example, to approve purchase orders).

A packaged process executes in a runtime infrastructure that typically includes some combination of an integration broker hub to handle routing and transformation as well as adapters and communications to link to application systems. Sometimes the runtime infrastructure is a general-purpose integration broker that is also designed for custom integration, and sometimes it is a proprietary runtime engine that is only used to support the packaged process. Metadata is used to define the business document schemas, transformation maps and, in some cases, an ontology that defines common business objects such as purchase orders as well as their subordinate components, such as company names and addresses or product item descriptions.

Representative vendors/products offering some form of packaged integrating process include:

- Ascential (Mercator's) Composite Applications
- IBM's CrossWorlds Collaborations
- iWay's Vertical Bundles
- IMPRESS' Integrating Applications (I.Apps)
- Siebel Systems' Integration Business Processes
- Sierra Atlantic's Application Networks
- Sterling Commerce's UCCnet Bridge
- Taviz Technology's pre-built intelligent adapters
- Vitria's Vitria Collaborative Applications

2.5.3 Packaged Composite Applications
Composite applications are a design pattern that combines existing applications, new application logic and application integration. The result is a new application that integrates existing applications and provides new functionality. A packaged composite application (PCA) is – as the name implies – a pre-built form of a composite application sold as an off-the-shelf licensed product. You license PCAs, just as you would packaged applications, which means that they come bundled with or pre-configured to run with a particular combination of application servers, databases and other platform middleware.

Architecturally, PCAs are quite the same as composite applications, but because they are licensed solutions, they also come bundled with some form of middleware. As implemented, PCAs include all the functionality of a packaged integrating process, but they also include application logic and data. PCAs are, essentially, integrating applications. SAP's xApps are just one example of a packaged composite application that includes adapters, business process templates, object definitions, specific Java

components, the SAP Web Application Server (WAS) and SAP Exchange Infrastructure (XI).

2.5.4 Business Activity Monitoring Tools

Many of the emerging event management, alert management, BAM analysis and BAM dashboard tools are from specialized startups, which are developing relationships with the established integration vendors. We expect to see some consolidation of the BAM specialist vendors with the integration suite vendors because of the natural synergy between these technologies.

All the major integration middleware vendors are developing strategies to pursue some combination of internal development, external partnerships or acquisitions to move into the market for new forms of BAM event management or presentation middleware. Some are already shipping products that support these functions. For example, Vitria announced Business Cockpit in August 2001. The integration, BPM and MOM vendors are naturally well-positioned to provide these new BAM capabilities as extra-cost add-ons to their products. However, vendors from many other realms, including DBMS vendors, traditional BI vendors and system management vendors, are also moving further into the BAM market. Thus, we expect integration vendors will represent only a portion of the BAM-enablement software market during the next five years.

The features of MOM, EBS, BPM and integration suites can significantly reduce the development time and cost of building a BAM solution by making it easier to get input information directly from application systems or indirectly by eavesdropping on application integration communication flows. More than half of the BAM solutions implemented during 2004 through 2008 will use integration middleware and MOM as parts of their technology bases (0.8 probability). In addition, we expect the emerging event management products will become an important market force, as enterprises increase the power and sophistication of their BAM applications. BAM represents a composite market, made up of vendors offering BAM functionality from within many other markets. This list represents vendors that have offerings with BAM functionality, but it is categorized into the major markets where we see BAM emerging. In addition to pure-play BAM vendors, markets with BAM functionality include business intelligence, enterprise software (ERP, SCM and CRM), application integration middleware, IT operations, business process monitoring and system integrators.

BAM pure-play vendors: These vendors generate more than 80 percent of their product revenue selling BAM solutions. They have a complete solution. The products may be focused on a number of specific vertical markets, or offer a generic platform. Some vendors have a specialty, which may be adapters, rule processing, analytics, reporting, or alert processing.

- Actimize – Intelligence Server
- Activience – Mobile Interaction Platform
- Apama – Dynamic Scenario Management
- BIZ360 – Active Market Intelligence
- Black Pearl – Performa
- Boost Information Systems – IntelliSense
- Categoric Software – Xalerts
- CeleQuest – Activity suite
- Cogency Software – Wisdom
- Edge Dynamics – Business compliance firewall
- Elity – Insight
- FirstRain – Discovery, view and event server
- Innovalink – dbNews
- iNova – LightLink
- International Presence – Presence
- iSpheres – Halo
- Iteration – Real-Time Suite
- Metatomix – Real-Time Visibility Suite
- OSISoft – Real-Time Performance Management Platform
- RunServiceNet – DecisionX
- Searchspace – Vertical solutions
- Velara – Vigiert
- Vineyard – Knowledge Sync

Application Integration Middleware (AIM) Vendors: These vendors provide middleware solutions that allow applications to be linked together through messaging or event technologies. Vendors on this list have incorporated real-time monitoring, analysis and alerting offerings into their product lines, which can monitor and report on events of interest.

- IBM WebSphere – Business Integration Monitor (formerly Holosofx)
- KnowNow – Event Routing Platform
- Microsoft – BizTalk (Jupiter project)
- TIBCO Software – Business Factor
- Vitria Technology – BusinessWare Cockpit
- webMethods – Optimize (acquired Dante Group)

Business Intelligence Vendors: BI vendors focus on reporting and analysis of data brought together from multiple sources. Historically, BI vendors extract data from a data warehouse, and provide historical views, but those on this list represent BI vendors that have shifted toward using real-time information, and can alert on data or events of interest as they are available.

- Applix Integra
- AuriQ Systems – RTmetrics
- Business Objects – Dashboard manager
- Cognos – PowerPlay and NoticeCast
- Computer Associates – CleverPath
- Informatica – Business Activity Platform – Partner with webMethods
- Information Builders – WebFOCUS
- Juice Software – Juice
- Microstrategy – Narrowcast Server
- Obvient – FocalPoint
- Sand Technology – Sand Analytic
- SAS Institute – Vertical solutions

Business Process Management (BPM): BPM vendors are focused on modeling, simulating, executing, and monitoring sequences of processes that link together to form business processes. Vendors on this list have monitoring and alerting features that link into multiple applications, and send alerts to end users or other monitoring software.

- AptSoft – Director
- Fuego
- Identitech – FYI
- Mentisys – WorkProcess Engine
- Savvion – BusinessManager
- Sybase – BizTracker
- Synthean – Clearpath
- Teamplate – Template for .NET
- Unitech Systems – Instream

Enterprise Software Vendors: These vendors produce targeted business applications such as enterprise resource planning (ERP), supply chain management (SCM) and customer relationship management (CRM). While many vendors in these markets have real-time monitoring within their products, the vendors on this list represent those that actively support extending the monitoring to external data and event sources. Some pure-play BAM vendors make this list, because they have deployed their BAM technology toward a single market, such as supply chain.

- Cyclone – Business-to-business exchange
- Oracle – Enterprise software
- PeopleSoft – Enterprise software
- SAP – NetWeaver
- Siebel Systems – Analytics
- Sterling Commerce – Connect Control Center

- Teradata – Vertical solutions
- Viewlocity – Supply chain solutions
- Vigilence – Business process execution management

IT Operations: IT operations vendors, also known as networked systems management (NSM) vendors, provide real-time monitoring for IT components and services. The vendors in this list have built products that are targeted to also monitor business attributes and services, and which are of value to business users. Also included in this category are vendors that monitor the syntax and integrity of messages as they flow between applications, sending alerts to IT operations and business users.

- BMC – Service Impact Manager
- Bristol Technology – TransactionVision
- HP – OpenView
- IBM Tivoli – Tivoli Business Systems Manager
- Managed Objects – Formula
- Micromuse – Impact
- MQ Software – Q Pasa!
- Nastel – Autopilot
- Proxima – Centauri
- Swingtide – Monitor/Scorecard
- Systar – BusinessBridge
- Unitech – INstream

The system integration category represents vendors that have established a practice to design and build BAM applications for their customers. Some have developed their own software solution, but do not sell the product without significant services supplied by them.

- NCS Technologies
- Obvient – focalPOINT
- Quantive – Systems Integrator
- SBI – System Integrator

2.6 Integration as a Service
There is a market for B2B integration capabilities that are hosted and delivered as a service rather than delivered as software. Traditionally called value-added networks (VANs), this market segment has evolved remarkably in the past few years and now includes a diverse range of solution providers that include evolving EDI VANs (for example, GXS and Sterling Commerce), emerging Internet VANs (for example, Hubspan and ICC), industry-specific vendors (for example, Descartes and E2open) and specialists (such as Grand Central). Labels for these kinds of solution providers include VANs, Web services networks, transaction delivery networks, business process networks, integration service providers and so on.

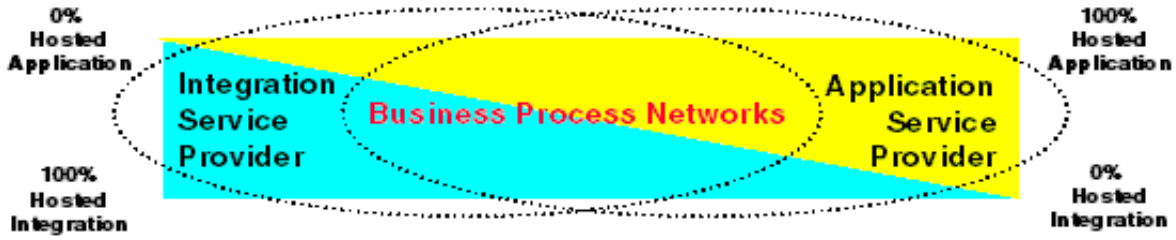
The fact that there are so many labels underscores the confusion with this market segment within the IT industry and the need for clarity regarding the role and evolution of vendors that offer integration as a service. One way to clarify the role of these service providers is to define what they do. We define a provider of "integration as a service" as a provider of hosted B2B integration services that includes some combination of the following major categories:

- Communications services
- Trading-partner management services
- Integration services
- Application services

Communications services provide safe, reliable electronic document and transaction delivery between trading partners and their application systems. Trading-partner services include whatever functionality is necessary to provision and manage the connections for members of a trading community – for example, automated testing tools so that trading partners can test their network connections. Integration services refers to the basic integration broker suite functionality that is deployed at the "endpoints" behind each trading partner's firewall (for example, adapters, communications, transformation, intelligent routing and business process management) to trading-partner back-end system integration (for example, to integrate

CICS or SAP applications with a trading network), but it also refers to integration functionality that is deployed in the "middle," between trading partners (for example, on-network transformation and Web services choreography). Application services include any document- or industry-specific functionality – this ranges from simple archival services (that is, to store transactions in the data center for replay, auditing and nonrepudiation purposes) through full-feature applications, such as supply chain visibility.

Any service provider must, by necessity, offer a minimum level of capabilities for communications services and trading-partner management services. It is not possible, for example, to operate a B2B integration service without being able to efficiently provision new trading-partner connections and then safely and reliably delivering electronic messages and content. There is greater variety, however, between the offerings for integration and application services (see Figure 7).



Source: Gartner Research (March 2004)

Figure 7: Comparing Integration and Application Service Providers

At one extreme, providers (for example, Grand Central) emphasize "integration as a service" – that is, hosting a stack of general-purpose B2B integration functionality that includes trading-partner management, communications, document translation and business process management. Their service allows enterprises to outsource complex B2B application integration projects rather than licensing and managing their own B2B trading hub. At the other extreme, providers (for example, Salesforce.com) emphasize "application as a service" – that is, hosting one or more specific applications (for example, CRM). Their service allows enterprises to fully outsource application management rather than hosting and managing themselves.

It may be tempting to over-simplify what is happening and assume that there are two distinct market segments, categorizing each vendor as either "just" an integration service provider or "just" an application service provider. But the truth is that most vendors do some of both, albeit with a bias based on their core competencies and business value proposition. For example, while Grand Central's primary value-proposition is clearly focused on "integration as a service," its overall value proposition includes the ability to support Web services choreography, business process design and business rules – thus, trading partners can implement "composite applications" in a B2B context in addition to doing basic integration. And while Salesforce.com's primary value proposition is hosting CRM applications, it also supports application integration, allowing its CRM applications to be integrated with those of their users.

The result of this emerging hybrid of integration and application services is a form of business process fusion applied to the B2B context (see "Business Process Fusion: Enabling the Real-Time Enterprise," AV-20-9895). VANs traditionally only delivered messages and data in a fire-and-forget manner and still do a lot of this basic form of integration, but increasingly they are also supporting near-real-time trading-partner interactions and hosting industry-specific applications. For example, Sterling Commerce, GXS and other service providers have introduced UCCnet support as a complement to their integration services in order to serve the item synchronization requirements of the retail industry. To successfully implement UCCnet, many trading communities require a hybrid combination of services and applications that include 1) basic B2B integration, 2) domain-specific documents and process definition (for example, for the transfer of product information) and 3) applications (for example, a catalog to stage UCCnet content). Rather than slowly becoming irrelevant with only basic B2B capabilities, service providers like these are expanding their portfolio of services to include industry-specific processes and applications which increase the value of their services to trading communities. Other service providers, such as E2open in high-tech manufacturing and Descartes in transportation/logistics, have built their business from the start as a hybrid model that combines integration and applications.

Collectively all these vendors are forming a new market segment, "business process networks," that offers domain- or industry-specific B2B process integration services. To gauge the core competency of these service providers look at their service portfolios – many emphasize either integration, applications or both. Potential customers need to clearly establish their own requirements for B2B projects upfront, deciding whether the primary emphasis is basic B2B integration (that is, communications, trading-partner management and back-end system integration) or complex B2B integration (also including business

processes design, business rules and perhaps even applications). In the latter case, consider vendors that host sufficiently complete process design tools and specific applications to serve your industry. But even if the ultimate goal is to implement complex B2B business processes and industry-specific applications, remember that there is a crucial role for basic B2B integration services – flexible, safe and reliable B2B integration is an essential enabling technology for B2B business process fusion.

All of the following vendors offer integration as a hosted service, so they are an integration service provider in one role. Many (but not all) of these also host industry-specific applications in another role, which therefore also makes them a business process network. To be included in this particular list, the vendor must separately offer and generate a significant proportion of its revenue on just integration as a service, although it is possible that its primary focus and source of revenue is from applications or other sources. For example, Descartes, E2open and Railinc all emphasize their industry-specific solutions but nevertheless still separately offer (and generate significant revenue from) a B2B integration services solution. In contrast, we do not include Salesforce.com here because, although it does some integration, it does not offer that as a separate service from its hosted CRM applications.

- Advanced Data Exchange – ADX Network
- AT&T – AT&T WebService Connect
- BT – EDI*Net and Web Services Management Layer
- Burns – Business Exchange Service (beX)
- CommerceQuest – CommerceQuest's Managed Service
- Descartes – Logistics Connectivity
- Dicentral – Total B2B Data Integration
- E2open – E2open Integration Platform
- EasyLink – EDI Solutions
- EDS – EDS*ELIT
- EXTOL – EXTOL Portal
- Grand Central – Business Services Network
- GXS – GXS Interchange Services and GXS EDI*Express and GXS Tradanet
- Hubspan – Hubspan Service
- ICC – ICC.NET
- IBM – EDI Services and Business Exchange Services
- Inovis – Inovis: Access
- Microsoft – Microsoft Business Network
- Mincom – Mincom Axis
- QRS – QRS Exchange
- RailInc Corp – NextPath
- Softshare – The Softshare Network
- SPS Commerce – VAN Services
- Sterling Commerce – Sterling Information Broker
- Viacore – Business Tone

Appendix A: Acronym Key	
4GL	fourth-generation language
A2A	application-to-application
ADK	adapter development kit
API	application programming interface
APS	application platform suite
ASC	Accredited Standards Committee
ASP	application service provider
B2B	business-to-business
BAM	business activity monitoring
BI	business intelligence

BOD	Business Object Document (OAG)
BPM	business process management
BPN	business process network
BRE	business rule engine
DBMS	database management system
CGI	Common Gateway Interface
CI	content integration
CIM	Collaborative Information Model (Vitria)
DBMS	Database management system
DCE	Distributed Computing Environment
DCOM	Distributed Component Object Model
DML	data manipulation language
DOM	Document Object Model
EAD	enterprise application development
EDI	electronic data interchange
EII	enterprise information integration
ENS	enterprise nervous system
ESB	enterprise service bus
ESP	external service provider
ETL	extraction, transformation and load
ETT	extraction, transformation and transport
HIPAA	Health Insurance Portability and Accountability Act
HP	Hewlett-Packard
JDBC	Java Database Connectivity
JMS	Java Message Service
MOM	message-oriented middleware
NFS	Network File System
NSM	network and systems management
OAG	Open Application Group
ODBC	Open Database Connectivity
ONC	Open Network Computing
ORB	object request broker
OTM	Object transaction monitor
OLTP	online transaction processing
PCA	packaged composite application
PIP	packaged integrating process
QOS	quality of service
RPC	remote procedure call
SES	smart enterprise suites
SOA	service-oriented architecture
SOAP	Simple Object Access Protocol
SPI	system programming interface

S.W.I.F.T.	Society for Worldwide Interbank Financial Telecommunication
TDN	transaction delivery network
TI	transport independent
TP	transaction processing
TPM	transaction processing monitor
UDDI	Universal Description, Discovery and Integration
UN/EDIFACT	United Nations Electronic Data Interchange for Administration, Commerce and Transport
URI	uniform resource identifier
VAN	value-added network
WAS	Web Application Server (SAP)
WSAM	Web services application management
WSB	Web services broker
WSC	Web services controllers
WSDL	Web Services Description Language
WSM	Web services middleware
WSN	Web services network
XDBMS	XML database management system
XI	Exchange Infrastructure (SAP)
ZLE	zero-latency enterprise

Gartner RAS Core Strategic Analysis Report R-22-2153, B. Lheureux, R. Schulte, Y. Natis, D. McCoy, B. Gassman, J. Sinur, J. Thompson, M. Pezzini, F. Kenney, T. Friedman, M. Gilbert, G. Phifer, 29 March 2004.

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