



The Power Link
to the Internet

Behind the Scenes of Electronic Business –
Middleware's Leading Role

WHITE PAPER

 SOFTWARE AG

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Setting the Scene for Electronic Business

Electronic business is a must for nearly all types of companies. What previously amounted to a competitive advantage has become a requirement for business success. Why? Because linking applications to the Internet, and to each other, helps companies cut costs, improve customer satisfaction, and speed product delivery. What company wouldn't want to cut costs and make it easier for customers and partners to do business with them?

However, electronic business encompasses a great deal more than just "being on the Web." The scope of change to accommodate electronic business should not be underestimated. To be successful, companies need more than just an isolated Internet strategy, they need an integrated business solution across the organization that encompasses aspects of the electronic business and makes it an integral part of the core functions of the company.

Adopting an electronic business infrastructure is forcing organizations, from dot-com startups to established companies, to rearchitect all or part of their IT infrastructures --and to do it fast. Companies need a simplified, flexible IT foundation in order to do this --one that provides fast solutions to the burgeoning capacity and scalability demands of electronic business.

But how do organizations go about implementing such an infrastructure? In a nutshell: the whole point is to implement a framework which allows a company to integrate, quickly and easily, old and new applications, creating a flow of information through the business. The supporting infrastructure allows the organization to tie existing and future business processes together and link the Internet to the business. Such wide-scale integration, known as Enterprise Application Integration (EAI), depends on one critical component: middleware.

Middleware simplifies the integration task with tools for linking disparate applications while ensuring transaction integrity and security as well as providing performance-tuning features. Such an integration infrastructure makes it easier for IT departments to implement electronic business applications, change

existing applications and add new ones to the processing mix without having to rewrite the software that links them together. This flexibility saves time and money and lets companies deploy new IT solutions to meet the changing needs of the business.

EntireX is exactly this type of middleware: it delivers integration tools, and enables companies to create a communications infrastructure for all their applications, current and future. Providing high-performance and efficiency, in a scalable solution, EntireX is the power link to the Internet --- middleware technology for the Internet Age.

MIDDLEWARE'S CRITICAL ROLE IN ELECTRONIC BUSINESS INFRASTRUCTURES

Middleware lets corporations integrate applications faster and more easily into the electronic business environment, scaling systems up and increasing capacity as needed in order to meet the demands of electronic business. But what exactly is middleware and what role does it play in the electronic business infrastructure?

First of all, middleware is the software that allows enterprise applications to communicate with each other. Although there are many different types of middleware on the market, there are essentially three different classes of middleware functionality:

- data management middleware for distributed databases or files;
- communication middleware for program-to-program communication; and
- platform middleware that provides communication services plus runtime services as an execution environment for application logic.

Most middleware tools and products on the market today provide one or more of these classes of integration. One communication middleware type of product, however, stands out in its ability to support electronic business and EAI requirements:

message-oriented middleware (MOM). MOM technology is the ideal foundation for integration because it allows applications to be loosely coupled, rather than requiring tight integration – an important feature especially when integrating systems across company boundaries.

What is message-oriented middleware (MOM)?

MOM is middleware that operates on the principles of message passing and/or message queuing. In general, MOM is characterized by a peer-to-peer distributed computing model supporting both synchronous(*) and asynchronous interactions between distributed computing processes. MOM generally provides high-level services, multi-protocol support, and other systems management services, thereby creating an infrastructure to support very reliable, scalable and performance-oriented distributed application networks in heterogeneous environments.

(*) Most typical MOM products are designed for asynchronous communication via message queues

Entire X: The Backbone of Electronic Business Integration

EntireX is easy-to-use, flexible and powerful MOM technology, supporting various communication and component models. It provides the high-performance and scalability necessary for mission-critical applications.

EntireX offers message-oriented middleware as well as RPC technology and component-based integration, adapters and interfaces, security, and application management. All these pieces allow an organization to define an integration architecture for enhancing existing applications, linking up legacy applications with new standard software, or adding new custom applications to the mix.

Organizations around the world have given EntireX the starring role in their electronic business infrastructure. EntireX provides:

- Powerful messaging
- Flexible connectivity options
- Internet integration tools
- High reliability
- Efficient resource management
- Enterprise security
- Application management

A REAL LIFE SCENARIO

Electronic business presents companies with an opportunity to create more efficient and cost-effective business processes. In turn, companies use those processes to improve their interactions with customers. It allows companies to provide one, consistent face to the customer. Better yet, service can be improved to both customers and suppliers by expanding the integration of processes to include business partners.

The following is how EntireX provided the foundation for integration of business partner applications in a Web shop solution:

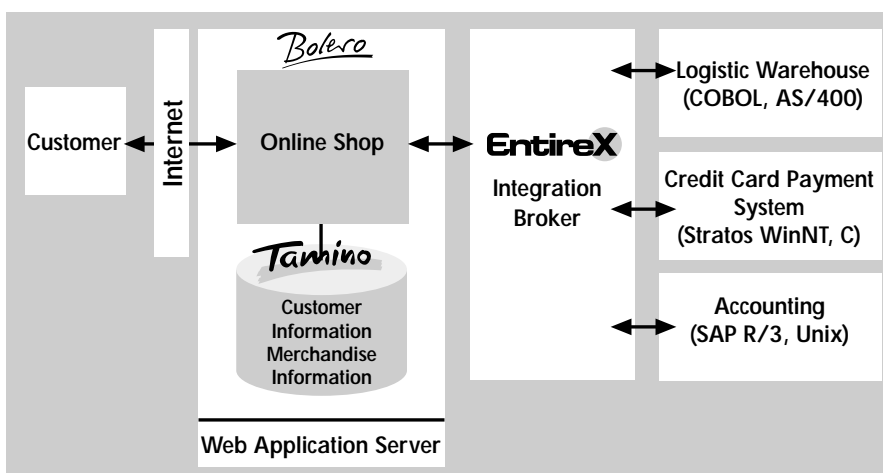
In this scenario, credit card payments, accounting and invoicing are handled by existing internal applications while the logistics for the goods being sold are done by the partner company. XML was chosen as the data format for the transaction data due to its straightforward and versatile access options, with Tamino, the native XML database from Software AG being used for storage. This design allows for quick

and easy expansions, such as the addition of more business partners. The Web application which handles the interaction with customers as well as control of the entire transaction, was developed with Software AG's Bolero, the Java-based development environment for the Internet. To integrate the existing applications, the EntireX Java Adapter was utilized. Linkage to SAP's R/3 is made possible through the use of the EntireX RPC and SAP RFC. The remaining legacy systems in this example communicate via the 3GL Adapter in EntireX.

To avoid customers placing orders which cannot be filled, orders are only accepted once the credit card payment system gives the green light and the logistics application has reserved the item. The communication between the systems involved in this phase of the transaction must be performed synchronously since the customer must wait for the confirmation. In order to guarantee the shortest possible response time, EntireX's Attach Service is used to automatically start, and when required, replicate appli-

cation servers. The load balancing between the replicated servers is handled by the EntireX Broker. This ensures maximum availability and scalability even during peak usage, with no intervention from the server application required.

A completely different request profile, such as issuing of distribution orders to the logistics companies, requires asynchronously initiated processing. In this case, the persistent messaging feature within EntireX ensures that requests are delivered, even in the event of a system failure.



IN THE SPOTLIGHT: THE ENTIREX BROKER

In general, EntireX can be compared to a hardware bus, adding new functions or applications to the system by means of extender cards. Every application that is "plugged into" EntireX represents a functional expansion, with the main purpose of the bus system being to provide a means of communication between the individual components. This bus architecture provides organizations with the foundation for state-of-the-art integrated electronic business applications. The EntireX Broker, a high-performance message server, is the centerpiece of the EntireX Bus System.

Using advanced MOM technology, the EntireX Broker offers support for multiple communication and component models and provides the backbone for integration between an organization's applications and the Internet.

Inside the EntireX Broker

The role of the EntireX Broker is to control communication among distributed application components. It supports many types of communication models (asynchronous and synchronous, conversational, request/reply, and message-oriented) to support a wide variety of application integration requirements.

The Broker shields the communicating programs from platform and language-specific issues by mapping requests and replies to its interface programs (the ACI stubs). At the protocol level, the Broker supports native TCP/IP.

With the EntireX Broker, companies benefit from the flexibility, ease-of-use, and high performance characteristics that make it unique among MOM-based products. Other features include:

- Ensured delivery of messages
- Transparency of physical location of servers to clients
- Attach service for dynamic replication and start of servers
- Workload balancing between replicated servers
- Native TCP/IP support
- A tracing subsystem that supports production tracing

Flexibility: Support for Different Communication Alternatives

In creating an electronic business IT infrastructure, flexibility is a key requirement for the middleware foundation. One area where flexibility is a must is in the way applications communicate with each other. Because different applications may require different methods of communicating, EntireX provides support for a variety of different models:

- **Synchronous** communication means the sender and receiver are active simultaneously. The requesting application sends its message and then stops processing while it waits for a reply (blocking).
- **Asynchronous** is non-blocking communication where applications can be concurrently or non-concurrently executing.
- **Conversational** means participating programs interact with one another in the form of a dialogue, with each program responding in turn to information received from the other program.
- **Request/Reply** is based on a single request and a single return, rather than a conversation. The sender is usually blocked.
- **Messaging-and-Queuing** is based on intermediate message storage. The sending application sends the message to the messaging middleware, which places it in a queue. The sender is generally unblocked.

The EntireX Broker approach is unique among message queuing systems in that applications never see the actual queues themselves, instead they only deal with logical names of senders and receivers. This provides an additional level of transparency for applications being integrated.

In addition, the Broker can reside on the network, on the sender's systems, the server side, or on any other machine in the network. The roles of clients and servers are not fixed and can change dynamically within a conversation.

High Reliability

The EntireX Broker provides optional message persistence by storing message queues to a non-volatile medium. Persistence ensures that messages reach their destination even in the event of a system failure. EntireX can also group logically-related messages into Units of Work that are committed to the EntireX Broker for further transmission when complete. In case of failure on the server side, the receiving program can back out the whole Unit of Work, making it available for processing later or by another server.

High Performance and Resource Management

Server replication, automatic load balancing between replicated servers, and automatic, dynamic adjustment of the system environment ensures client requests are answered quickly and resources are put to efficient use.

The EntireX Attach Service dynamically replicates and starts servers, based on Broker requests for services. In a CICS environment, this includes transactions that are offered to the network as a Broker service. Additionally, the Attach Service can start clients, based on a send operation by a server.

The way the Attach Service manages the replication and starting of servers also leads to an efficient balancing of the workload within an EntireX environment: the Attach Service registers as the Attach Server with the Broker and can receive attach requests to start additional servers to avoid bottleneck situations.

Workload balancing is achieved using high and low water marks specified in the server definitions. The Attach Service keeps the number of server replicas registered with the Broker between these levels, starting replicas when their number falls below the set minimum.

The Basics: Communicating with the Broker

Before discussing the types of applications which can be plugged into the EntireX bus, it's best to start with a short description of the basic communication mechanisms used by EntireX.

ACI (Advanced Communication Interface)

Communication with the Broker is handled through Advanced Communication Interface (ACI) programs. The ACI has SEND and RECEIVE functions that provide the Broker-based communication basis for the EntireX bus. On the ACI level, any communication model is supported.

EntireX RPC

EntireX's Remote Procedure Call represents a higher level of ACI abstraction. It shields the application developer from the technical details of the ACI such as addressing the (remote) server, establishing communication, converting data formats, etc. The communication model used with RPC technology is synchronous request/reply. The developer can use familiar call syntax (C, Visual Basic, etc.) to generate the appropriate RPC stub automatically. The EntireX RPC is the underlying communication method used by Software AG's wrapper technology, described in further detail below.

EXTENDING THE REACH OF THE WINDOWS COMPONENT

MODEL: ENTIREX DCOM

While Java and CORBA are available on a wide range of platforms, DCOM was originally available on Microsoft platforms only. EntireX delivers fully interoperable DCOM implementations for many Unix systems and the OS/390 mainframe, allowing companies to use a single, consistent, component model for the whole enterprise, from the desktop to the mainframe.

EntireX DCOM delivers all interfaces and services to build and run DCOM server components. Special support for Cobol on the mainframe and NaturalX, the DCOM extension to Software AG's high-level business language Natural, open up DCOM to business programmers. A porting guide assists users with porting DCOM components from Windows systems.

INTEGRATION SIMPLIFIED: ENTIREX ADAPTERS

Like the EntireX Broker, flexibility is also a key feature of the surrounding technology used to "plug" applications into the EntireX bus. Delivered as the EntireX Software Developers Kit (SDK) and the Broker Services suite, a rich set of interfaces and tools allow applications written in a wide variety of languages to connect to the EntireX bus. The tools and interfaces can be mixed and matched as required, depending on the particular data processing landscape to be supported and the programming task at hand. Companies are not tied to a particular architecture, communications method, or programming language.

Another key characteristic of the application adapters is simplicity. EntireX has an easy-to-use interface that requires practically no programming skills. For example, intelligent wizards turn a procedural function

into a DCOM component, CORBA object, Java class or XML (Extended Markup Language) document with the push of a button.

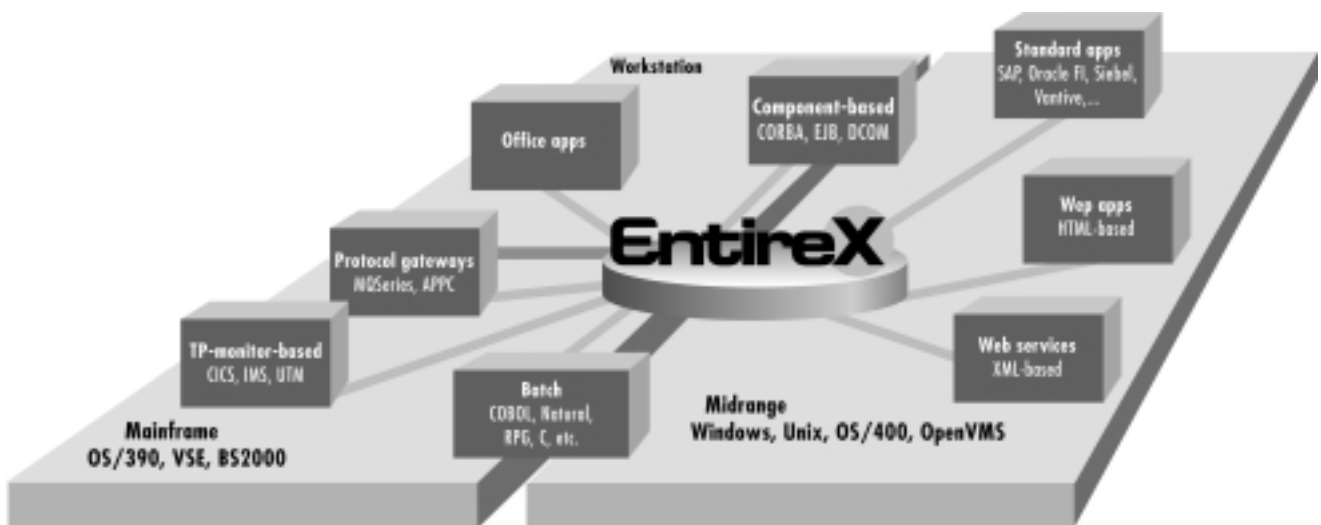
The following section details the breadth of the EntireX adapter and services technologies with examples of supporting features for an entire spectrum of application types.

Internet

EntireX allows you to wrap existing enterprise application functions with standard interfaces so they appear just like DCOM or Java objects or XML documents. This easily enables them for the Internet: DCOM components can be used by any Web browser or server scripting tool that supports ActiveX, while Java clients or scripting can invoke these functions as Java methods.

Wireless Mobile Devices (WAP)

EntireX provides seamless integration between wireless WAP-enabled



mobile devices and back-end enterprise applications. Special Java classes are provided to support generation of WML (Wireless Markup Language) pages for access from WAP devices.

Applications Supporting DCOM

DCOM / ActiveX is supported by most development tools on Windows and is what application developers in the Windows world are familiar with. EntireX provides the following DCOM adapters:

ActiveX Control

The ActiveX Control addresses developers who use DCOM-enabled application development tools on the PC as ActiveX containers (for example, Visual Basic, PowerBuilder, or scripting tools on the Web server.) EntireX ActiveX Control enables integration of the desktop and the Web with mainframe or Unix-based server applications ("backends").

DCOM ACI

While ActiveX Control is available on Windows platforms only, the DCOM ACI provides access to the Broker ACI via DCOM on non-Windows platforms where EntireX DCOM is available. With the DCOM ACI, it is possible to access EntireX messaging services on Unix or mainframes via DCOM with no footprint on the Windows clients.

DCOM Wrapper

The EntireX DCOM Wrapper is a PC-based service program (a wizard) which uses the EntireX ACI and RPC technology to generate DCOM-enabled components automatically. The wrapping makes it possible to treat existing applications as ActiveX components. The DCOM Wrapper provides access to server applications on server platforms such as MVS, Unix, or Windows NT and many others. The DCOM Wrapper uses an IDL file (Interface Definition Language) which describes the RPC interface and generates a Wrapper object on the basis of the interface description.

Java Applications

EntireX provides special Java class libraries to link applications written in Java or Bolero, Software AG's Java-based development environment for electronic business, to the EntireX bus.

Java Wrapper

The Java Wrapper provides access to RPC-based components from Java applications. EntireX Java RPC enables users to develop both client and server applications written in Java. In addition, Java applets can also be used as an RPC client.

Java ACI

EntireX Java ACI is a Java class library that provides access to the Broker ACI for Java programmers. It enables the creation of both client and server applications in Java. Any of these can then interact with each other and with other applications written in other languages on the same network using EntireX Broker. The Java ACI also contains the framework necessary for Java RPC calls.

CORBA Applications

CORBA Wrapper

The EntireX CORBA Wrapper enables CORBA 2 compliant applications to access an EntireX RPC server. The CORBA Wrapper generates EntireX RPC stubs, a CORBA IDL file and an agent. The agent behaves like a CORBA server and like an EntireX RPC Client.

CORBA ACI

The EntireX CORBA ACI provides the messaging functionality of EntireX Broker to CORBA applications. For example, a CORBA object can send a message asynchronously to a non-CORBA application, thus avoiding the tight coupling that CORBA-based communication would require.

XML Applications

An extension to the Java Wrapper provides XML communication to existing non-XML servers. With no additional programming effort, data from existing applications (like CICS transactions) can be provided in XML format to electronic business applications. The EntireX XML Wrapper receives an XML document from a Web server or Java application, translates it into a remote procedure call (RPC) on an existing application, creates an XML document from the result of this call, and sends it back.

EntireX can be extended with Tamino X-Bridge, a component of Software AG's Tamino XML Platform, to provide a central message hub for all XML-based communication. Tamino X-Bridge receives XML documents directly from the Internet via HTTP and routes them to the

appropriate receiver(s) based on the content of those documents. This relieves the sender from having to know the physical address of the receiver. Tamino X-Bridge also provides message transformation to ensure that the data is delivered in a format that the receiving application understands. The rules for message routing and transformation are defined in XML allowing any appropriate XML tool to be used for their definition. Tamino X-Bridge has been specifically built for the Internet and XML and supports emerging standards like SOAP (Simple Object Access Protocol) and BizTalk.

Natural Applications

The Advanced Communication Interface (ACI) for Natural allows the Natural developer to interface directly with the EntireX Broker and Broker Services using an API suited to their needs.

In addition, the EntireX RPC provides developers with a connectivity and wrapping capability which allows them to "object wrap" legacy code in order to make it available as components in a wider enterprise object environment. EntireX RPC enables client programs to access

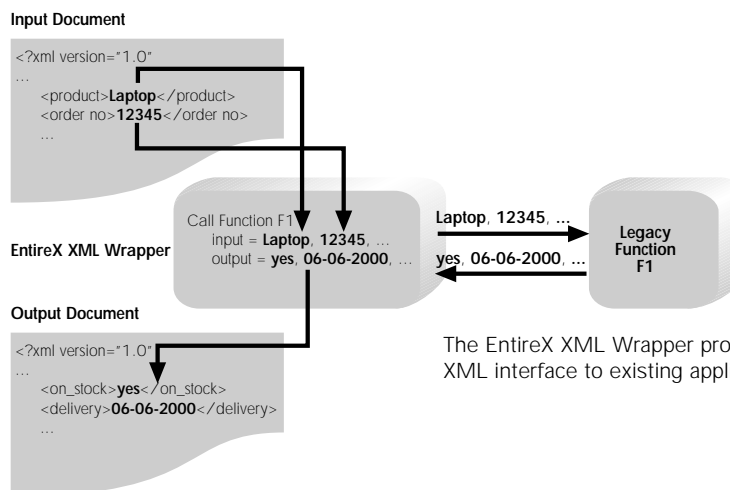
Natural RPC server subprograms and 3GL RPC server applications on mainframe, Unix, Windows 95 and Windows NT platforms. EntireX RPC is fully compatible with the Natural Remote Procedure Call facility.

CICS Applications

Again, the Advanced Communication Interface (ACI) for 3GLs provides the 3GL developer with an interface to the EntireX Broker and Broker Services. Easing the integration pains of legacy applications, the EntireX CICS RPC Server provides calling of existing CICS transactions from client programs on other platforms using EntireX RPCs.

The EntireX CICS 3270 Bridge allows the user to construct distributed applications that interact at the programmatic level with existing CICS applications without modifications to these legacy systems. The CICS 3270 Bridge is used when either RPC or the Broker Native API cannot be implemented due to:

- non-ownership of the application,
- the high risk of modifying the application, or
- loss of the source code for the application.



The EntireX XML Wrapper provides an XML interface to existing applications

Clients can be any application for which an ACI adapter is available. A native DCOM interface to the EntireX 3270 Bridge is provided to simplify integration with Windows applications.

For more detailed information please refer to the EntireX 3270 Bridge White Paper.

Applications Supporting APPC

The APPC Adapter is EntireX's interface to LU6.2-based applications (such as SAP's R/2) and serves as the gateway to a wide range of mainframe environments (CICS, IMS). The APPC Adapter uses the ACI interface programs to map client requests to LU6.2 verbs and server responses back to the client.

MQSeries Applications

The MQSeries Adapter is EntireX's interface to IBM's message-oriented middleware MQSeries. This interface allows an application developer to write client or server applications, using the ACI as the communication API while the partner uses native MQI calls.

ENTERPRISE SECURITY

EntireX Security

EntireX Security allows seamless joining of authentication on the desktop with existing authorization rules on the server (for example, RACF, ACF2 on the mainframe) without introducing any new APIs.

EntireX Security provides protection for applications utilizing the Broker and Broker Services with functionality that includes authentication for distributed application components, authorization to start and execute as well as encryption of messages. All user and resource definitions are managed through RACF, TOP SECRET and ACF2. In addition, customer-unique solutions are supported through exits for customized solutions.

The goal of EntireX Security is to allow an organization to control the use of all applications, including distributed components, from a central point. The result is that an organization can implement full, flexible control with a "one user = one definition" approach, enhancing previous investments in host-based security systems and infrastructures.

For non-mainframe environments, authentication of EntireX users is performed against the native Unix or NT security system.

For more detailed information please refer to the EntireX New Security Concept White Paper.

APPLICATION MANAGEMENT

EntireX provides a powerful management component within EntireX that solves the difficult problems of developing, distributing, managing and monitoring applications in a distributed and heterogeneous enterprise environment. It consists of an extensible framework that supports and coordinates a collection of development, administration and reporting utilities for EntireX distributed applications.

The EntireX management component provides a built-in script editor and interpreter. Developers can create their own Web site to control and monitor a distributed application.

OUTLOOK

The Internet is characterized by rapid change with new standards and methods becoming established within a very short timeframe. Take XML, for example: by integrating data and meta data in standardized documents, XML has become a kind of universal language for data transmission and storage. Application integration for electronic business will increasingly be based on exchanging XML documents – especially when crossing company boundaries.

Future versions of EntireX will continue to enable companies to exploit emerging new Internet technologies without sacrificing existing investments. Take the concept of Web services, for example. Web services are self-describing, self-contained, Web-accessible building blocks that enable developers to architect and aggregate applications and services from local and remote resources - implementing the vision of the "programmable Web." EntireX will support the standards, like WSDL (Web Services Description Language), UDDI (Universal Description, Discovery and Integration) and SOAP (Simple Object Access Protocol), that are required to make this happen. For example, support for SOAP will be further enhanced to allow existing applications to act as Web services as well as request information from other Web services via SOAP. Thus, existing systems will be able to transparently participate in the "pro-

grammable Web" without having to deal with XML or SOAP themselves. Powerful tools will automate the mapping process as far as possible while still allowing for flexible customization.

Other planned enhancements include support for JMS (Java Message Service) and the Open Applications Group's AMI (Application Messaging Interface). Publish and subscribe will be provided as an additional communication model. In the application management area, support for standards like SNMP and market leading management tools will be added.

New Internet application areas are discovered almost daily. Internet and World Wide Web standards are fields of constant flux and new development. As a member of the W3C (World Wide Web Consortium) as well as the WAP Forum, Software AG is closely monitoring the standardization efforts for the World Wide Web and is dedicated to incorporating relevant new developments into its products. The openness and flexibility of EntireX make it best suited for adopting new technology quickly and, typically for EntireX, in a way that is easy to use. In combination with the Tamino XML Platform, comprising components for storage, development and integration of XML data and applications, Software AG provides a comprehensive product suite for electronic business.

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