Integration Technologies of PeopleSoft Enterprise

Making the Real-Time Enterprise a Reality
Overview

This white paper provides an overview of PeopleSoft Enterprise Integration and its supporting technologies. It is intended for both technical and non-technical readers. Most of the technologies covered in this paper were first available with PeopleTools 8.1; the topics in this white paper are as of PeopleTools 8.45.

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PeopleSoft Integration Philosophy

Clearly, business today involves working much closer with customers, partners, and suppliers; interactions that are enhanced through the timely delivery of mission critical information. The challenge is in implementing this new real-time enterprise in today’s complex IT environments. Historically there has been a tendency to implement new solutions in a haphazard way – solving urgent business problems with little or no concern for the wider enterprise requirements. Unfortunately, this has left enterprises with a myriad of necessary and disparate systems, all operating in different environments, using differing protocols and running without regard to their effects on the rest of the enterprise.

We have two options when confronting this problem: we can assume that a standard will be in place soon to bring together all systems and data, or we can operate as if a single standard will never become a reality. Given the history of information technology, and the fact that much of the value in an organization’s systems resides in legacy environments which will never be rewritten or wholly replaced, it seems as if we are left with the reality that change is the only certain path. No single panacea, no magical standard, will address the heterogeneity and competing standards that always accompany change.

This is not to say that some standards have not taken hold and prove extremely valuable in your move to the real-time enterprise; primarily, internet standards such as HTTP, HTML, and Web services standards such as Extensible Markup Language (XML), Simple Object Access Protocol (SOAP), and Web Services Description Language (WSDL). One can quickly grasp the power of standards when you remember the tremendous growth in the internet which occurred over such a short period of time due to a consistent client interface (HTML and a browser) and a standardized communication vehicle (HTTP).

Seeing the potential in the internet, PeopleSoft was the first ERP vendor to adopt a Pure Internet Architecture™. This allowed users, both internal and external, to interact with the software through a standard web browser, without any custom software needed on the users computer.

PeopleSoft has been leading in the field of Web services, even before the standard existed. XML messaging forms the bases of our application messaging strategy. PeopleSoft does not just talk about Web services, we utilize them as the backbone of how all our enterprise applications communicate. As the first major ERP vendor to offer all business functions as standard Web services, PeopleSoft continues to work to evolve and define the Web service standards of the future. Although Web services will not be a panacea for the woes of integration, they will play an ever-increasing role in the successful integration of data, process, and people.
At PeopleSoft, we also recognize that an organization’s integration requirements can span from the simple to the complex, and so we offer a full range of solutions, right-sized to your needs. These include everything from batch, through basic application messaging, to an extended integration platform. We also recognize that many organizations already have made a choice on one or sometimes more than one Enterprise Application Integration (EAI) vendor that we need to provide connectivity into. PeopleSoft began formalizing many of our EAI partnerships in early 1999, with virtually every leading EAI vendor being certified to work with PeopleSoft technologies.

While many of our customers use EAI vendors as their central integration infrastructure, PeopleSoft heard loud and clear from our customer base that they wanted us to deliver robust integration technologies in order to lower implementation and maintenance costs. Customers don’t want to be forced to purchase a third-party EAI solution just to integrate PeopleSoft application into their existing environments - this is especially true for less complex integration scenarios. PeopleSoft has listened to our customers and has delivered a robust set of integration technologies embedded within our core applications.

PeopleSoft is committed to all application modules shipping with the ability to produce and consume standard Web services. This Web service gateway functionality enables customers to use other EAI, Business Process Management software or any other application that produces and consumes Web services. This supports customer choices for these extended integration services.

While any PeopleSoft Enterprise application can expose a field or logic as a Web service, PeopleSoft has used this capability to build pre-defined interface points to major business functions. These are currently known as Enterprise Integration Points (EIPs) and represent interface contracts that will not change from release to release of the software. Using these integration points provides an enterprise a better total ownership experience and reduces the cost of integration.

PeopleSoft recognizes that good integration starts with the applications and their interface points, not just tool sets. That is why we spend as much effort on the Integration Content (Metadata, process models, design patterns, interface contracts) as we do on the toolsets themselves.
**PeopleSoft Integration Offerings**

PeopleSoft’s integration technologies are a part of the AppConnect business integration platform. AppConnect comprises the Portal, Integration/Process, and Analytics components of PeopleSoft that allow the orchestration of multiple roles, applications, and data into successful business processes.

The Integration/Process services of AppConnect include:

- Basic integration services
- Pre-Packaged integrations
- Extended integration services
- Process Analysis

*Basic Integration* is comprised of the components included in PeopleSoft PeopleTools. This includes everything needed to get information into and out of PeopleSoft applications. The focus for basic integration is simplicity of setup, with the least number of moving parts. It provides:

- Point-to-Point
- Batch File Transfer
- Application Messaging
• Component Interfaces
• Transactional Application Program Interfaces (APIs)
• Web services

Realizing that not all vendors have implemented standard Web services, we have extended our support in PeopleTools 8.45 release to include ERP connectors for SAP, Oracle and Siebel. This enables the proprietary business functions from these application vendors to be surfaced as standard Web services, where our customers can interact with them via the Web services capability built into our basic integration services.

_Pre-Packaged Integrations_ extend the basic capability. PeopleSoft Process Integration Packs (PIPs) deliver end-to-end business process integration between PeopleSoft Enterprise applications and SAP and Oracle applications. PIPs provide integration, data transformation, routing, cross-reference maps, and the connectors and adapters needed for the targeted business process. These include pre-built and tested reference implementations.

_Extended Integration Services_ are for more complex or advanced functionality. These include partner products that fill a specific need. For advance hub-and-spoke scenarios we offer the Integration Server from webMethods. We also offer extract transform and load (ETL) tools from Ascential.

_Process Analysis_ is provided by the PeopleSoft Process Modeler. Process Modeler is an interactive, role-based, graphical modeling tool that allows you to easily define and validate your business processes. It includes a comprehensive library of over 1,800 models that represent PeopleSoft’s recommended business process flows.

This paper will focus on the basic integration capabilities included in PeopleTools 8.45.
The PeopleSoft Integration Broker

The Integration Broker provides the Web service gateway functions for PeopleSoft Enterprise applications. This includes the ability to produce and consume industry standard Web services and is comprised of four key elements: Packaged Connectors, Intelligent Routing, Transformation, and a Development and Monitoring Environment.

The Integration Broker itself consists of several PeopleTools technologies:

- **Application Messaging** — Messaging architecture for both synchronous and guaranteed delivery asynchronous integration into and out of the Integration Broker. Application Messaging is really the heart of the PeopleSoft Integration Broker.

- **Component Interfaces** — Object-oriented, request/reply, component architecture that encapsulates PeopleSoft data, business logic and security.

- **File Interfaces** — Robust file processing capabilities for file-based integration—still a common method for addressing integration requirements.
These core technologies of the Integration Broker stack are discussed in more detail later in this document.

**Integration Broker and Web Services**

Pure internet integration capabilities have been core to the PeopleSoft Pure Internet Architecture™ (PIA) since the first release of PeopleSoft 8. Our goal is that any system should be able to access PeopleSoft components and integrate seamlessly with PeopleSoft systems using standard internet protocols. XML over HTTP has been key to this. Both pure internet access and integration have taken off since the design and development of PIA. Pure internet access received much of the initial attention in the market place. Now with the growth of Web services, pure internet integration is becoming more prevalent.

The PeopleSoft Integration Broker facilitates the use of Web services for interacting with other systems, as well as exposing the business logic in any PeopleSoft application. Any discrete component of application functionality can be exposed as a Web service. Examples include product inventory, employee address, and customer profile. Any of these application components can be published and accessed behind the firewall or over the internet as Web services.

One of the reasons Web services have become so popular is because they are loosely coupled. They have well defined interfaces and can be easily accessed from remote systems using internet technologies. They require a much simpler level of coordination between systems, for instance, the underlying technology behind the Web service can be changed and replaced without impacting the
systems that invoke it. This loosely coupled nature of Web services simplifies the integration process, lowering the cost of integration and maintenance while making it easier to integrate applications than techniques used in the past.

Web services offer extensibility over previous technologies. Once you implement a Web service interaction between two systems, you can extend that interface to plug in additional systems. Each new system that will invoke that service just has to know what data to put in the request XML and where to send it. Web services align with the no code on the client aspect of the PeopleSoft Pure Internet Architecture, so there is no API-specific code to maintain at each system that participates in the business process.

Implementing integrations with Web services is one way to solve cross-platform integration issues. A PeopleSoft Web service can be invoked from applications developed in Visual Basic, Java, C/C++, Perl, etc. Most development languages and enterprise level packaged software products have support for Web services, therefore reducing the amount of time required to interface with PeopleSoft.

**Integration Broker and PeopleSoft’s EAI Partners**

PeopleSoft’s partnerships with leading EAI (Enterprise Application Integration) vendors have not changed with the introduction of the Integration Broker. Since every PeopleSoft Enterprise application that runs on PeopleTools 8.44 has the Integration Broker, both customers and EAI vendors can leverage its technologies for connecting PeopleSoft Enterprise applications to a third-party EAI infrastructure. EAI vendors now have more choice as to how they can integrate to PeopleSoft. Some vendors prefer Web services technologies, while others may prefer a Java Messaging Service (JMS) interface. Vendors can even create and maintain their own custom adapters to PeopleSoft.
Application Messaging

PeopleSoft Application Messaging is a message-based interface architecture that facilitates interaction between systems and processes through the use of Web services. It is the foundation of the PeopleSoft Integration Broker. Application Messaging features a completely server-based architecture that allows PeopleSoft applications to interact with Web services in response to the invocation of business events within the Component Processor. These messages are published in XML format and delivered to subscribing systems over a secure HTTPS connection. PeopleSoft Web services support also includes the use of SOAP and UDDI for discovery and invocation of services.

Application Messaging supports both bi-directional synchronous and asynchronous messaging. Synchronous messaging can be used for invoking Web services in other systems and returning the results into a PeopleSoft Component before continuing with a process, or for exposing PeopleSoft business logic as a Web service to calling systems. Asynchronous messaging is used to guarantee delivery of data between PeopleSoft and other applications without having to halt a business process because a subscribing system is unavailable.

A key benefit of Application Messaging is that third-party systems can initiate services in PeopleSoft and subscribe to messages using standard internet technologies. To publish a message for a guaranteed delivery service, the third party simply performs an HTTP Post to the PeopleSoft Application Messaging Gateway, passing the XML document. To subscribe to a message, the third party only needs to be able to receive a XML message over HTTP from the Gateway.

Here is an example of how Application Messaging can be used:

Application Messaging Example

Application Messaging Example Flow:
1. When creating a sales order, you need to make sure that sufficient product is on hand to fulfill the order. After entering the quantity and product information, a synchronous process is initiated to invoke a Web service in your inventory system for a real-time confirmation of sufficient quantity.

2. The Integration Broker sends an XML message to the inventory Web service, and an XML message is sent back to the Integration Broker to acknowledge that the order can be fulfilled.

3. The results of this process are displayed in the order entry page.

4. The sales order is completed and saved. An XML Application Message is then delivered asynchronously to the two subscribing systems.

5. The Application Messaging framework guarantees delivery of the order data to the two subscribing systems.

**Application Messaging in PeopleSoft Enterprise**

Application Messaging is used throughout PeopleSoft Enterprise to address integration between PeopleSoft applications and between PeopleSoft and third-party applications. Here is a small subset of Enterprise Integration Points where Application Messaging is being used:

- **Setup Table Replication.** There are a number of setup tables within PeopleSoft applications (e.g., Department, Account, Vendor, and Customer). Application Messaging is used to replicate the contents of these tables between PeopleSoft systems and third-party systems.

- **Advanced Shipping Notice.** Inventory sends a customer an Advance Ship Notice for an order entered in Order Management by creating an outbound Electronic Data Interchange (EDI) transaction through Application Messaging.

- **Advanced Shipping Receipt.** Purchasing creates receipt data based on a vendor's Advance Shipment Notice received as an inbound EDI transaction through Application Messaging.

- **Bill of Material.** Used by Product Data Management (PDM) integration, this allows Engineering and Manufacturing Bills of Material to be updated by an external system.

- **Customer/Address/Contact Data.** Used in Customer Relationship Management (CRM) to synchronize customers and contacts with Human Resources (HRMS) and Financials (FDM), and to synchronize products and items with FDM.
- **Warehouse Management Integration.** PeopleSoft Enterprise is integrated with several leading warehouse management solutions. Application Messaging shares data between PeopleSoft Inventory and these systems for transactions such as Order Release, Physical Inventory, Inventory Adjustment, Inventory Transfer, and Inventory Balance.

- **Personal Data.** PeopleSoft HRMS maintains employee information that many third-party systems need. Application Messaging synchronizes this data with the third-party systems.

**PeopleSoft Message Designer**

Message definitions are created in the Application Designer by dragging and dropping record definitions into the Message Designer. The message definition also contains the business logic subscription events for processing both inbound asynchronous and synchronous request messages.

![PeopleSoft Message Designer](image)

**Integration Broker Monitor**

The Integration Broker Monitor is a pure internet dashboard for Application Messaging. The Monitor gives you a view of all messages flowing into and out of the Integration Broker.
PeopleSoft Integration Broker Monitor

You can drill in to the details of a particular message to check delivery status, view the XML of the message before and after transformation, and cancel or resubmit delivery to a subscriber.

Transformation

Integrating with different systems means accommodating multiple data models. For instance, if a PeopleSoft CRM application publishes out customer data to two subscribing systems, the structure of the customer data being sent may have to be altered so that it can be consumed by the other systems. For this reason, transformation capabilities are a requirement of an integration broker in order to manage this data exchange.

Transformation logic can be defined using either PeopleCode or XSLT, which is an open standard for data mapping; some of your in-house development staff may already have experience with it. By using the Integration Broker, you can store your mapping definitions in one place so that if the data model of one of your applications changes, you can reflect that change outside of your
PeopleSoft applications. Having fewer points to change means lower cost in maintaining integrated systems.

The XML message definitions and processing logic become building blocks for connecting one or more systems into that business process. Since transformations and end-point destinations are administered independently of messages, you can reuse the XML message interface to accommodate multiple requestors or providers of a business process.

Message Interface Example

Routing

Central to any messaging architecture is a routing function. Routing ensures that the incoming message is delivered to the right receiving system(s), and outgoing messages are delivered to the appropriate recipients.

Content-Based Intelligent Routing

Content-based routing is the process of making routing decisions based on data in the message. For instance, examine the value of the business unit field in an outbound message. If the business unit is “USA”, then route to one system, otherwise route the message to another system. The “intelligent” aspect of routing is the ability to evaluate variables outside of the message to make routing decisions. After examining the business unit in the current example, other elements of the business environment such as supplier availability, currency exchange rates or time of day can be evaluated to help make the final routing decision.
**Definitional Routing**

Not all systems are capable of using web services at the same level of granularity. A third party system may be designed to have one web service for customer data, whereas a PeopleSoft CRM implementation may have two interfaces that are more specific in scope. The goal in integrating the two systems is to reuse the existing interfaces; so definitional routing is used to specify that the single message will be split into two messages (with the use of transformation) that comply with the more granular Web services.

**Connectors**

Connectors are a means to interface PeopleSoft Application Messaging with other technologies. While web service interfaces are growing in popularity, not all applications support them, and web services aren’t always the answer to building a multi-application integration. Connectors bridge the technology gap to support systems that do not natively support Web services.

Unified queuing between the PeopleSoft Application Server and the Gateway means there is only one “pipe” that messages flow through. The Gateway determines which Connector will handle the message based on metadata included in the message envelope. The targeted Connector then serves as a bridge between PeopleSoft and the protocol of the recipient of the message. The flexibility of the Gateway allows you to develop additional Connectors and plug them in to existing transactions.

**PeopleSoft Connector Gateway**

PeopleSoft delivered Connectors are not hard wired; application data, transformation and routing rules are defined as metadata and executed in the applications server. You can create a new business process and share its functionality with other systems without having to rewrite or recompile a given Connector. Delivered Connectors include HTTP, Email, FTP, SAP, Siebel,
Oracle and JMS. Custom Connectors can be developed using Java or C/C++ in order to utilize other interface technologies and protocols.

**PeopleSoft ERP Connectors**

PeopleSoft also delivers connectors for some of our competitor products. These include SAP, Oracle and Siebel. These when used with the included iWay SoapSwitch you can deliver the business functions of third party applications as standard Web services.

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**Component Interfaces**

All PeopleSoft applications are built upon Components, which are the necessary database tables, business logic, security and graphical presentation elements required for a particular business process. Component Interfaces make the business logic and data available as an object that is accessible externally from the application or within a PeopleCode environment.

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**PeopleSoft Component Interface Architecture**

An external system can invoke PeopleSoft Components over HTTP(S)/XML or it can invoke the Component Client using Java, COM or C/C++ bindings. The Component Client is a multi-threaded client that interacts with the application server to execute PeopleSoft business logic. This may invoke Application Messaging services if needed as part of the business logic. The Component Client also interacts with the Security Manager for Lightweight Directory Access Protocol (LDAP) authentication services.
Component Interfaces in PeopleSoft Enterprise

Component Interface technology is used in PeopleSoft Enterprise to address API-based synchronous integration from third party applications to PeopleSoft applications, as well as a means to apply business logic to an application message. This is a sample of Enterprise Integration Points with Component Interfaces in PeopleSoft Enterprise:

- **Setup Table Interface.** Quite often, external systems do not want to replicate table data from PeopleSoft to their systems. They simply want a synchronous API into the PeopleSoft system so they can retrieve the data on demand. PeopleSoft exposes a large number of setup tables through Component Interfaces. These interfaces can also be used to import setup data into the PeopleSoft system if the master copy of that data is maintained in a different system.

- **Sales Order Status.** Interactive inquiry displays Sales Order Header, Line Item, and Scheduled Shipment Status.

- **Customer and Contact Creation.** When a lead is created, a Component Interface in the Sales application of PeopleSoft Enterprise CRM is used to create a customer or contact corresponding to the lead. Similarly, another Component Interface is used when a lead is converted into an opportunity.

- **Process Scheduler API.** Allows a third party to manipulate the process scheduler tables and control batch job submission.

- **Expense Sheet.** Allows third party systems to access expense sheet data within PeopleSoft Expenses.

Component Interface Example

The Expense Report Approval example demonstrates how a Component Interface can be used.
Expense Report Component

In order to expose the application logic behind this component to a third-party system, a Component Interface definition is created. The Component Interface exposes a set of properties and methods for a component so that the third party doesn't need to understand the complex underlying data structure and business logic of the component.

Expense Report Component Interface

The Component Interface Designer is split between two frames. The left frame is the Component data structure. This is usually a fairly complex structure that...
is not exposed to the third party. The frame on the right is the Component Interface definition. Through this definition, the keys to the component, the properties, and a set of methods are exposed to third parties in a much friendlier manner.

In the example, a third party could do a search on the Expense Report components using the FindKeys EmployeeID, Name, ExpenseReportDate, and/or ApprovalStatus, and the Find method. Once a component is instantiated using the Get method, the third party application has full access to the component properties (e.g., ExpenseReportDetail rows). The third-party system could view the expense report details and then either deny or approve the Expense Report by setting the ApprovalStatus property and invoking the Save method.

Here is a simple example of Visual Basic code that invokes the EXPENSE_REPORT Component Interface.

```vbnet
Private Sub SaveData_Click()
    Dim objSession As New PeopleSoft_PeopleSoft.Session
    Dim oCOMP_INTFC As EXPENSE_REPORT

    If objSession.Connect(1, "PIASERVER:7000", "PTDMO", "PTDMO", 0) = False Then
        MsgBox ("Can't connect")
    End If

    Set oCOMP_INTFC = objSession.GetComponent("EXPENSE_REPORT")
    oCOMP_INTFC.EmployeeID = "8001"
    oCOMP_INTFC.ExpenseReportDate = "06/27/2000"
    oCOMP_INTFC.Get
    oCOMP_INTFC.ApprovalStatus = "A"
    oCOMP_INTFC.Save
End Sub
```

**Component Interfaces—Visual Basic Code Example**

This Visual Basic application performs the following operations:
1. Connects to the PeopleSoft Application Server (PIASERVER:7000).

2. Gets an instance of the EXPENSE_REPORT component interface.


4. Invokes the Get method to fetch the component for those GetKeys.

5. Sets the ApprovalStatus property.

6. Invokes the Save method to save the change made to the ApprovalStatus property and invoke the Expense Report save processing.

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**File Interfaces**

File-based integration was once the dominant method to address integration requirements. While there are now more extensible technologies available, using flat files may still be the best option for certain integration needs. Robust file processing capability is a requirement of any integration platform in order to support existing and new integrated processes. PeopleSoft delivers the File Layout designer for graphically defining where data should be located in the file. The File Layout definition becomes a metadata object that is accessible from Application Engine for batch processing of file data and invoking PeopleSoft business logic.

**File Interfaces in PeopleSoft Enterprise**

The following are some examples of how customers can use file processing:

- Read file data and map it to a Component Interface.
- Read file data and publish an Application Message.
- Read file data and insert it directly into PeopleSoft tables.
- Query PeopleSoft tables and write the results to a file.
- Subscribe to an Application Message and write the data from that message to a file.
- Storing a file attachment.

**File Layout Designer**

By dragging and dropping record definitions into the File Layout designer, you can specify the mapping of the data elements in the file. File Layouts become PeopleCode objects that are accessible from Application Engine. To make
importing file data easier, an Application Engine program can be automatically generated, thus facilitating importing file data without writing any code.

**PeopleSoft File Layout Designer**

**Application Engine**

Application Engine is the PeopleSoft high-volume application processor for large-scale batch processes. It leverages the file I/O processing available in the Component Processor to read and write files in fixed-length, delimited, and XML formats. Application Engine programs are developed with the Application Designer and can leverage common PeopleTools objects such as Records, PeopleCode, and SQL Objects and get the same metadata driven development benefits (such as Upgrade support) that developers get when developing online, transaction oriented applications. It should also be noted that Application Engine programs can also leverage the other integration technologies such as Application Messaging, Component Interfaces, and Java integration, so that developers can create batch processes to address complex, high volume integration scenarios.
Java Integration

Although not part of the Integration Broker technology stack, Java is a common approach customers are using with PeopleTools 8 to address integration.

A large number of software developers today know Java and sometimes would prefer to write business logic in Java instead of PeopleCode. Starting with PeopleTools 8.1, application developers can invoke Java objects from PeopleCode which execute on the PeopleSoft Internet Application Server. Our PeopleCode/Java interface is bi-directional, meaning that PeopleCode programs can invoke Java objects and that the Java objects can invoke PeopleCode objects. Since Java programs can invoke PeopleCode objects, developers can leverage powerful PeopleCode functionality such as SQL access and Application Messaging within their Java programs.

The following is a very simple example of a PeopleCode program invoking a Java object:

```/* Invoke Java class CalcSalesTax to calculate the state sales tax. */
Local JavaObject &oSalesTax;
```
Local number &AMOUNT;
Local char &STATE;

/* Create an instance of the object. */
&oSalesTax = CreateJavaObject("com.peopleSoft.ar.CalcSalesTax");

&STATE = &PO.STATE.Value;
&AMOUNT = &PO.AMOUNT.Value;

/* Invoke the CalculateTax method to calculate the tax for the state and amount. */
&oSalesTax.CalculateTax(&STATE, &AMOUNT);

At runtime, the Component Processor within the PeopleSoft Internet Application Server invokes the Java object when the PeopleCode executes.
Summary and Benefits

Achieving the “Real-time enterprise” requires that every system that touches a targeted business process be integrated. For you to realize the full benefit from your PeopleSoft software investment you need effective, standards based integration. Employees need it, suppliers require it, and most importantly, customers demand it!

Using PeopleSoft’s AppConnect Integration technologies embedded in PeopleSoft Enterprise, you can meet the integration challenge. Whether simple file transfer or complex connections between legacy systems, packaged applications, and trading partners; these can all be created and managed securely over the internet. Whether basic Web services, or a more extended integration platform, PeopleSoft can drive time and cost out of the integration issues that stand between your application islands and the Real-time enterprise.

Whether you are already a PeopleSoft customer, or are considering one of our applications or a 3rd party integration tool, you can be confident that your integration requirements can be handled by the same PeopleSoft infrastructure that thousands trust today to run their real-time enterprise. This is integration technology is built-in, and built-to last – delivering on the promise of the real time enterprise with a superior total ownership experience.

For more information on PeopleSoft technologies and our integration products, please visit us at