Geac® Expense Management: An Architectural Overview

Now more than at any other time in recent history, companies are faced with the need to deploy solutions that enable them to impact the bottom line by lowering expenses and improving employee productivity. Geac® delivers by automating employee-facing financial processes, resulting in cost savings, productivity gains, and increased corporate control. Our unique architecture enables us to provide the most flexible, scalable, and powerful solution on the market.

Geac

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Geac Expense Management

Geac Expense Management automates employee-based financial processes. A significant portion of corporate spending is placed in the hands of employees every time they travel, purchase an item, or make many other daily decisions. By automating these complex business processes through the use of Geac Expense Management, companies benefit from the centralized control of employee-initiated corporate spending. Comprised of a set of modules that automate key business practices and ensure employee conformity to business policies, Geac Expense Management also includes tools for administering the system, displaying status information, and exporting data to other enterprise systems, as well as tools for analyzing valuable employee spend data.

Geac Expense Management consists of four applications: Geac Expense Reports, Geac Payment Requests, Geac Timesheets, and Geac Travel Plans – built using Java™ 2.

This technology choice enables scalability and ease of deployment on multiple platforms and devices. The applications share a common user interface and can be accessed through a common HTML-based dashboard called Geac Connect.

Applications that will be deployed to every employee in an organization are fundamentally different than ERP, CRM, or other enterprise applications, and require an architecture that can be rolled out to large numbers of users with little or no training required. Geac strongly believes that our combination of Java and HTML is the best technology choice for expense management applications because it provides end users with exceptionally rich functionality and ease of use, while enabling the solution to be easily rolled out to thousands of users just by accessing a browser. Applications that use an HTML-only architecture may sacrifice end-user satisfaction and performance for ease of deployment, whereas Geac can provide the best of both worlds.

Geac automates employee-based expense management processes in a single, integrated platform.

Geac Expense Management Architecture Features

Architecture advantages of this Geac application suite include:

- A fully integrated suite for employee-related expense management
- Real-time business policy validation
- Automated workflow
- Off-line accessibility
- Robust analytic capabilities
- No end-user training requirements
- Support for centralized or decentralized administration
- Multiple platform and device support
- Integration with Web services, such as travel booking, credit card feeds, and content services
- Rapid and cost-effective deployment
- Scalability for large, multinational organizations
- Global support and features for complex organizations in a single installation

The following pages provide additional detail regarding the Geac Expense Management architecture and technology choices and the benefits they provide.

Standards-Based Architecture

Geac Expense Management was built for the Internet from the ground up, using proven Internet technologies and standards. As an early adopter of Java technology, Geac has always built applications using Java, and continues to use Java technology products on the clients and the servers.

By providing support for both Java and HTML, Geac provides users with the best of both worlds – the rich functionality of Java and the ubiquity and simplicity of HTML. This standards-based approach enables Geac to fit into any corporate IT environment and integrate with a myriad of leading enterprise solutions.

On the server side, Geac uses the suite of technologies available in Java 2 Enterprise Edition (J2EE). Technologies used by Geac from this suite include Enterprise Java Beans (EJB), JavaServer Faces (JSF), JavaServer Pages (JSP), Java Standard Tag Libraries (JSTL), Java Servlets, Java Mail, Java Naming and Directory Interface (JNDI), and Java Database Connectivity (JDBC).

On the client side, Geac provides multiple client deployment options based upon the needs of the customer. This includes HTML-only solutions for zero installation and a Java client. The Java client uses the suite of technologies available in Java 2 Standard Edition (J2SE). Technologies used by Geac from this suite include the Java Foundation Classes (JFC/Swing), the Java Cryptography Extensions (JCE), and the Java Network Launching Protocol (JNLP).

For HTML rendering, Geac uses standards-based HTML 4.0 and CSS1 (Cascading Style Sheets), with minimal use of JavaScript, to ensure support for all of the popular browsers. A standards-based architecture allows Geac to easily exchange information with external sources. For configuration information and communication with external Web services, Geac uses XML. In order to communicate across an enterprise, Geac Expense Management uses standard protocols such as TCP/IP (with and without SSL), HTTP (and HTTPS), LDAP, and SMTP.

Architecture that Leverages Leading Technology Vendors

Because Geac's strength is in providing employee-facing expense management applications, we partner with technology vendors who enable us to provide the infrastructure needed for a complete solution. This includes using open source technology when it meets our requirements. Technology from the following vendors is seamlessly embedded in our suite and is included as part of the Geac solution:

BEA/WebLogic®. The WebLogic Server provides the base for our back-end server components. The WebLogic Server provides our J2EE components and we use the clustering, monitoring, and management tools supplied with the server.

Sun. Sun supplies the J2SE components that we use on UNIX® and Microsoft® Windows® platforms. This includes the Java 2 Runtime and Java Web Start. This also includes the Java 2 Runtime used for our servers.

Apple. Apple supplies the J2SE components that we use on Mac OS X platforms.

Business Objects. Business analytics vendor Business Objects enables Geac to provide a tool that transforms data into valuable information for vendor negotiation, policy compliance and enforcement, and proactive business management.

Open Source Tools. The open source movement has produced a number of industrial-strength tools that are used throughout the corporate world. Geac uses MyFaces, an open source implementation of the JavaServer Faces standard. We use a number of tools from the Apache Foundation, including the Apache Web server, the Jetspeed portal framework, and various XML tools. Additionally, we use the Rhino JavaScript interpreter from the Mozilla organization.

Architecture for Performance

The Geac Expense Management architecture was built to scale up and perform well in very large enterprises. Published benchmarks prove that we can support user populations over 100,000 employees, handling thousands of concurrent users submitting thousands of documents per hour on departmental class machines.

Geac performs well not only with large numbers of users, but also in networks where latency is a problem and/or bandwidth is limited. To counter the effects of high latency, the Geac client makes very few roundtrips to the server and in each roundtrip sends very little data. Additionally, all traffic can be compressed if bandwidth is limited. This ability to function well in a limited-bandwidth environment (including fully disconnected from the network) is another key feature made possible by our Java client architecture.

Geac Expense Management applications use multiple tiers (defined by J2EE) to allow scaling based upon the user load and high availability requirements, which makes it easy to add Geac services on existing or new hardware. This scalability can include utilizing cycles on the desktop to minimize load on the network and the servers.

Client Tier. Users normally access Geac Expense Management applications through the Geac Connect portal or via the embedding of Geac Connect components within their corporate portal. Geac Connect is a series of components (called "Portlets," rendered in HTML) that provides access to Geac functionality, such as status, launching the Geac application, and user-level reporting.

Geac Expense Management has three different clients: a zero-deployment version utilizing HTML, a highly interactive Java client with a rich user interface for both online and off-line use, and an e-mail client for simple review
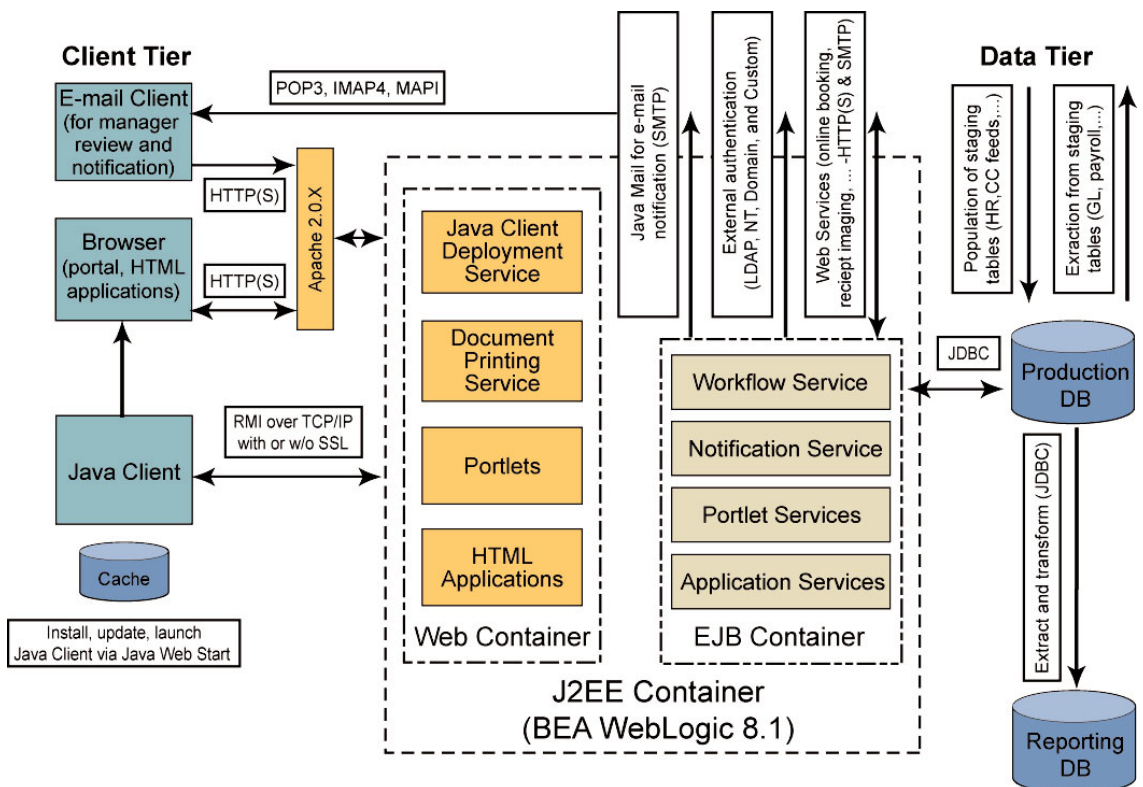
Geac Expense Management performance architecture.

tasks. The choice of which client to use depends upon the needs of the customer. Both the HTML and Java clients can be launched from a Connect Portlet, from a corporate Web page or portal, from the desktop, or from an e-mail message (for those e-mail clients that support URLs and/or HTML rendering). When using the Java application, we are able to use the resources on the client machine, provide a very interactive user experience, and run in a disconnected mode when users do not have access to the servers

Web Tier. This tier is responsible for the rendering and support of the Connect Portlets, presentation and much of the business logic for the HTML client, document printing, support for the e-mail client, and the deployment and updating of the Java client (via JNLP).

EJB Tier. This tier is responsible for common services needed to support Geac Connect and the Geac Java client. This includes services such as data access and persistence, workflow, notification, and authentication. Geac uses standard J2EE connection pools for connecting to the data tier in order to scale as resources are needed and shrink during periods of low activity. In most installations, the Web and EJB tiers will run on the same machine and in the same process.

Data Tier. This is where the databases reside, the primary one being the transaction, or production, database. A reporting database is also created, which is optimized for performing data analysis. Maintaining a separate reporting database eliminates any impact on the production database, ensuring optimal performance.

Architecture for Multiple Deployment Options
The architecture of Geac Expense Management supports different deployment options based upon the needs of the customer. While most customers will create expense

reports using our Java or HTML clients, busy managers will find it more convenient to use their e-mail tool for the review and approval of documents. Additionally, there are users who often find themselves disconnected from the corporate network, but still need to create and submit expense reports, review and approve timesheets, or perform other expense-management-related operations. Geac fully supports this functionality by allowing the Java client to run in a disconnected mode, either explicitly or upon failure to connect to the server.

When the user's computer is connected to the network, data needed for proper operation can be synchronized to the client. Documents that have been modified can be uploaded, and documents that the user wants to take on the road can be downloaded. Data on the client is maintained in an encrypted form to add security in case of loss of the machine. All this is accomplished without any conscious effort by end users; they simply interact with the off-line client the same way they would interact with the online client.

Geac's Java architecture makes this possible by allowing the off-line client to perform virtually the same as our online client, with the same user interface and real-time business rules. This is important because it enables employees to use the product off-line without the additional training costs and end-user confusion that results from using an off-line client that has a different architecture than the online client, such as ones that use Microsoft Excel or Visual Basic.

Additionally, for those customers who do not want to deploy the Geac expense management solution within their IT infrastructure or use their own scarce IT resources to set up and manage the application, Geac has a state-of-the-art hosting facility and can host the application for the customer.

**Geac Expense Management
supports a variety of deployment options**

HTML client.

E-mail client.

Java client.

Architecture for Corporate Control

A key advantage of implementing Geac's expense management solution is the tremendous cost savings that result from an increase in corporate control over employee expenditures. Geac's architecture offers the highest level of corporate spending control available from any vendor, due to the combination of three special features:

1. Real-time enforcement of business policies. End users receive instant notification that they have violated a policy or made a data-entry error.

2. Automated, business-rule-based workflow. Documents can be routed differently in different situations.

3. Support for group-based data. Different policies and workflow routing can be applied to different groups of employees.

Real-time enforcement of business policies contributes to ROI by improving employee knowledge of business policies or reducing the number of errors that occur during data entry. Business policies may include checking for a receipt, checking for a preferred vendor, or checking

spending limits such as the maximum allowable daily hotel rate. These aid the user in determining if their expense or purchase is within policy. In the case of the Geac Travel Plans and Geac Payment Requests modules, the user is notified in real time that a purchase is outside of policy, before the purchase is made, resulting in direct cost savings. Likewise, users can benefit from business rules that check for data entry errors, such as entering more than 24 hours in one day in a time sheet, or entering a project code that the user is not authorized to charge against.

The Geac Expense Management application also can direct the flow of the documents through the workflow. For example, the system can route information to or around specific steps based upon the contents of the document, such as "route to your VP if the total expenses are over £1000," or "skip auditing if there are no policy violations." The application also can send notifications to people based upon document states and contents, such as "notify the manager or auditor when a document needs to be reviewed," and "notify the creator of an expense report when it is approved and paid." Additionally, based upon previous history, certain users

can be marked as "must always audit" to deal with those that continually violate policy. Workflow capabilities can include automated steps such as exporting documents to general ledger, payroll, or project accounting systems, or performing statistical analysis of documents and collections of documents to uncover potential fraud or track spending against contracts with travel vendors.

Group-based data is the most advanced of these policy controls, allowing rules and workflow to apply to specific individuals or groups of individuals, resulting in virtually unlimited configurability. For example, an employee based in Germany could be subject to a business rule that reminds the user of a different set of preferred vendors than an employee based in the U.S. Likewise, spending limits could be set differently depending on professional title. For example, while a four-star hotel room might be a policy violation for a sales account executive, it would not be a violation for a senior vice president. No other vendor has more experience administrating these types of rules and controls than Geac, and our system administration tool enables their smooth and seamless setup and maintenance.

Architecture for Maintainability
An often-overlooked feature of enterprise applications is their ability to be maintained easily by the customer. The majority of the functionality in the Geac Expense Management applications can be configured using a suite of Geac setup and administration tools. These tools are optimized for different types of users, from the system implementer who creates the initial setup, to the business manager who needs to manage business policy. Additionally, permissions can be assigned to sub-functions within the tools to allow access to specific business policy management functions. Types of changes include:

- Modifying business policy settings, such as changing an approved vendor, changing overtime calculation rules, and changing per diem rules and rates.

- Creating new business policy rules.

- Defining new information to be captured upon document creation.

- Changing existing document printing styles and adding new ones (document printing is performed via JavaServer Pages templates and an easy-to-use tag library).

The goal of these setup and administrative tools is to give customers the ability to configure and maintain the solution themselves, without the need to hire expensive consultants or overburden the IT staff. Geac's architecture lightens the load on IT in several ways. This includes enabling business-user administration of the application, a zero install client using HTML where appropriate, and the use of Java Web Start, Sun's implementation of the Java Network Launching Protocol (JNLP), to minimize the costs of installation and upgrades for the Java client.

In the Geac expense management system, business professionals can use our system administration tool to make changes to – or write – business rules, manage user hierarchies, and more. This eliminates the need for IT or expensive consultants to perform this work, allowing them to focus instead on more critical issues. In addition, no IT involvement is needed to push updates out to Geac user desktops. Java Web Start enables these updates to be automatically pushed to the user.

In order to meet additional policy requirements that are not covered by one of our 150 business rule templates, JavaScript can be used to evaluate any custom policy compliance.

Architecture for Integration
It is expected that customers will choose to integrate their expense management solution with other enterprise systems, both to feed corporate information into Geac, as well as to populate other applications with relevant Geac data. Geac makes it easy to integrate external systems, whether transactional or non-transactional in nature. Non-transactional data feeds are independent of specific documents, imports from HR systems, or exchange rate data. Transactional systems are normally specific to an event, such as importing credit card transactions, exporting a document to a general ledger or purchasing system, or importing an itinerary from an online booking agent. To ensure that these types of situations can be addressed by our integration strategy, Geac Expense Management provides multiple mechanisms for importing data from and exporting data to other systems:

1. Staging tables for internal systems such as HR import, and GL/payroll export and status check.

2. Web Services for those external services that provide this type of interface. This currently includes Geac's integrations with receipt imaging companies.

3. XML over HTTP (or HTTPS or even SMTP) for systems that provide "Web Service"-like interfaces. This currently includes Geac's integrations with online travel booking agents.

The reality of most organizations is that they have a multitude of systems from various acquisitions or mergers. Geac's open approach ensures that we can support whatever systems the customer may have in place. Extensity will never limit the customer to only working with one specific ERP provider, one specific corporate card provider, or any other required solution.

Architecture for Business Analytics

Geac provides the ability to analyze employee spend data, which can provide valuable insight that can be used for vendor negotiation, policy compliance and enforcement, and proactive business management. In order to accomplish this, Geac's business intelligence strategy is twofold: real-time reporting accessible to all users and world-class business intelligence tools for business analysts.

For analysis capabilities, Geac has partnered with Business Objects. Reports showing expenditures per cost center or business policy violations per department can help an organization track down rogue spending or employees that need to be made aware of business policy. Additionally, the data can be used to drive down costs in the organization by providing information for vendor negotiation.

To provide the best quality data for use with the Business Objects analytics, Geac has created a specialized reporting database from the transactional database. This database is a streamlined version of the transactional database (with no loss of information), and is optimized and tuned for reporting. This approach also eliminates any load associated with reporting on the transactional database, which can directly affect client response time.

A separate reporting database requires a tool to populate it from the transactional database. The final component of the Geac reporting solution is an ETL (extract, transform, and load) tool. This tool extracts data from the transactional database, transforms (simplifies) the data, and then loads it into the reporting database. This tool can be run in both full and incremental modes. In normal operation, a customer would only use the incremental mode and run the tool daily or weekly. The full mode is only needed if the customer decides to re-create the reporting database. The tool is parameterized for time (e.g., only populate the reporting database using last year's data), type of document (e.g., only populate the reporting database with Geac Timesheets data), and state of the document (e.g., only populate the reporting database with documents that have gone all the way

through the approval process). In addition, customers can have as many different reporting databases as required by their reporting and analysis needs.

Additionally, the reporting database has a well-documented data dictionary to allow customers to write their own reports, either using the Business Objects tools embedded in our solution, or the customer's own reporting tools. We also provide a fully configured Business Objects Universe for the report database if the customer chooses the Business Objects reporting option. Additionally, Geac enables the customer to create new reports to meet their unique reporting needs.

While traditional business analytics cover a large portion of a corporation's reporting needs, there is still a need for real-time information about critical functions of the system. To fulfill this need, Geac Expense Management provides a dashboard via a set of Connect Portlets that operate off of the transactional database. The Portlets range from status about an individual's documents and outstanding credit card transactions, to a manager's display of which employees within a group have not yet filed their timecards for the last time period. These Portlets are also easy to configure and build so that they can be added as new types of status reports as needed.

Architecture that Fits Within the Corporate IT Environment

Geac's expense management solution is designed to fit within the customer's existing IT infrastructure. For example, hardware platforms, operating systems, network hardware and protocols, and relational database management systems (RDBMS) are normally already in place when Geac's application is installed. Geac has been designed to easily fit into many environments. Using 100 percent Java for our servers has allowed us to fit into UNIX (Solaris on Sparc hardware), Linux (RedHat Enterprise on Intel hardware), and Microsoft Windows (Windows NT®/2000 on Intel hardware) environments with exactly the same code. By using JDBC to abstract our interface to databases and standard SQL, we are able to support the popular and robust RDBMS's (Oracle®, IBM® DB2® UDB, and Microsoft SQL Server™). Perhaps most important, our Java client allows users of almost any operating platform to access the Geac solution, with support for Microsoft Windows, Unix, and Mac OS X.

For those IT organizations that have centralized repositories for user authentication, Geac again supports the popular systems. We offer NT domain authentication and Active Directory for Windows platforms, and LDAP for Windows and UNIX platforms.

The easiest way to fit into existing IT infrastructures is to use standard interfaces where possible and commonly used proprietary interfaces where standards do not yet exist or are not appropriate. For example, Geac integrates to proprietary interfaces such as the Microsoft Windows NT Service Manager for launching and controlling our servers and the Windows NT Domain controller for authentication. We fit within the existing networking infrastructure by using standard networking protocols, working with popular load balancing solutions such as Cisco LocalDirector, BigIP, and WebLogic Clustering, as well as with popular proxy servers and firewalls.

Geac supplies its own authentication system but can also take advantage of an existing common repository for users and passwords. Geac Expense Management supports LDAP (and thus, Microsoft Active Directory) and NT Authentication. In addition, Geac supports single sign-on (or login bypass), in which case all authentications are done by an external authentication system. This provides Geac with validation tokens, with no user passwords passing through Geac. Single sign-on is most commonly used when Geac is accessed from behind an existing corporate portal or corporate authentication/access control system (such as SiteMinder®).

Because the Geac solution is built on top of the BEA WebLogic Server, we can take advantage of the monitoring and management tools supplied by BEA. This includes using the WebLogic console and administration servers for monitoring and managing the WebLogic servers, and support for monitoring via two standards-based interfaces, the Java Management Extension (JMX) and the Simple Network Management Protocol (SNMP). Additionally, since our servers can be installed into the Windows Service Control Manager, the servers can be managed via Windows management tools.

Architecture for Security

Geac takes great care to ensure that every aspect of our solution meets strict security standards. Thus, we provide a number of features that allow the customer to secure their data, including encrypting the data going between the client and server, integrating with a customer's internal authentication systems, encrypting sensitive data in the database, and encrypting any data stored on the client. This encryption between our clients (both HTML and Java) and the Geac servers is accomplished using SSL (Secure Sockets Layer), a standard mechanism used by Internet applications to encrypt sensitive data. For example, SSL is used when users submit their credit card numbers at e-commerce Websites, using either 40-bit (for certain international locations) or 128-bit encryption (for domestic and many international locations). Even if SSL is not enabled, data of a sensitive nature – such as user passwords and tax identification numbers – are, as a rule, not sent across the network. Those sensitive items that need to be sent across the network are always encrypted before being sent.

To maximize the security of the data in the database, Geac only requires a single login for access to the Geac schema. That login only needs minimal permissions (only the ability to execute SELECT, INSERT, UPDATE, and DELETE SQL statements). As a further protection, sensitive data is encrypted in the database to ensure that it is not accidentally viewed by users with direct access to the database. Geac also recommends that customers put the database host and the server hosts on a private VLAN in order to limit access to the database and improve performance.

Conclusion

Geac Expense Management, part of the Geac Performance Management solution, uses its leading architecture to provide one of the most complete, secure, and robust expense management solutions on the market. This architecture enables Geac to provide the highest level of return on investment to hundreds of companies who have licensed Geac solutions. With hundreds of thousands of deployed users worldwide, Geac has proven that our solutions can meet the needs of large and complex organizations.

List of Acronyms and Abbreviations

API	Application Programming Interface
CRM	Customer Relationship Management
CSS	Cascading Style Sheets
EJB	Enterprise Java Beans
ERM	Employee Relationship Management
ERP	Enterprise Resource Planning
ETL	Extract, Transform, and Load
GL	General Ledger
HR	Human Resources
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
HTTPS	Secure HyperText Transfer Protocol
IT	Information Technology
J2EE	Java 2 Enterprise Edition
J2SE	Java 2 Standard Edition
JDBC	Java Database Connectivity
JFC	Java Foundation Classes
JMX	Java Management Extension
JNDI	Java Naming and Directory Interface
JNLP	Java Network Launching Protocol
JSF	JavaServer Faces
JSP	JavaServer Pages
LDAP	Lightweight Directory Access Protocol
RDBMS	Relational Database Management System
ROI	Return On Investment
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SQL	Structured Query Language (the language for relational database management systems)
SSL	Secure Sockets Layer
TCP/IP	Transmission Control Protocol/Internet Protocol
URL	Uniform Resource Locator (the 'address' for pages and services on the Web)
VLAN	Virtual Local Area Network
XML	Extensible Markup Language

About Geac

Geac is a global enterprise software company for Business Performance Management, providing customers worldwide with the core financial and operational solutions and service to improve their business performance in real time.

Geac software and solutions are deployed at more than 18,000 organizations around the world. About half of the Fortune 100 use and rely on Geac systems every day. Geac collaborates with existing and prospective customers through a network of approximately 2,300 professionals in 53 locations worldwide.

To Take Action

To find out more about Geac products or services, visit www.performance.geac.com, call +1.800.922.7979, or send an e-mail to chris.kelly@geac.com.