

ENSEMBLE WHITE PAPER

ENABLING THE REAL-TIME ENTERPRISE BUSINESS ACTIVITY MONITORING WITH ENSEMBLE

Executive Summary

Business Activity Monitoring (BAM) enhances business intelligence by detecting events within enterprise systems, filtering them for items of interest, and presenting that information to an executive in the form of a visual “dashboard” on a computer screen.

Ensemble provides advanced Business Activity Monitoring solutions, built atop a comprehensive and extremely fast platform for application integration, composite application development, data coordination, and business process/workflow management.

Ensemble is designed around the precept that successful business integration solutions are driven by metadata. Metadata definitions represent, and bring order to, all integration touchpoints, including data, services, and business processes – as well as the messages and data flows that are the nerve impulses of a system. Thus Ensemble takes a data management-centric approach to integration.

That approach is realized with the single, shared metadata repository and ultra-scalable message warehouse that are at the core of Ensemble’s architecture. Its data management capabilities and data-centric approach, combined with a strong Service Oriented Architecture, make data easily available to any application that needs it.

Ensemble’s Business Activity Monitoring capabilities exploit all these characteristics to enable rapid construction of advanced and comprehensive set of BAM solutions. Thanks to its unique fusion of technologies, Ensemble taps a broad source of enterprise business data, provides the tools that turn business data into business intelligence, supports sophisticated analytics to spot trends and exceptions, and enables automated responses to specified conditions. And InterSystems’ proven technology innovations enable these capabilities to operate in real time, with the highest levels of reliability and scalability.

1. INTRODUCTION

The goal of Business Activity Monitoring is to provide management with immediate awareness of business events across the enterprise as well as changing business conditions, so that appropriate and timely decisions can be made. By providing executives with this kind of real-time information, BAM solutions reduce costs and speed the execution of business strategies.

Ensemble’s Business Activity Monitoring capabilities rely on its foundation of enabling technology. The Ensemble technical enablers exploited by BAM include:

- **Full-Spectrum Integration and Development** – an environment that supports rapid development and integration of: composite applications, custom adapters, and business process orchestrations – in support of BAM solutions
- **Universal Service Architecture** – an advanced and unique abstraction technology that enables consistent and efficient object representation of different programming models and data formats for rapid access to application functions and data
- **Persistent Object Engine** – a high-performance, high-availability distributed object database, message warehouse, and metadata repository that provides ultra-fast retrieval and manipulation of messages and events
- **Customizable Management Environment** – a comprehensive set of tailorable and extensible monitoring and management facilities that are tightly integrated with the messaging engine and message warehouse, as well as with business process management and development tools

Ensemble’s technology provides three major advantages for BAM solutions. First, it provides a broad information base. Ensemble’s Universal Service Architecture and Persistent Object Engine allow the system to persistently store all messages and events that pass through the system, and to make them all accessible in the same format and by way of the same mechanisms.

Second, Ensemble provides the ultra-high performance necessary for the true “Real-Time Enterprise” (RTE). Ensemble’s high-performance Persistent Object Engine allows a great deal of complex processing to be performed on business data, events, and messages in real time, in order to transform raw data into business intel-

ligence. So Ensemble not only encompasses a broad set of information from underlying applications and business processes – it also analyzes and correlates this information on-the-fly.

Third, Ensemble enables real-time reaction to business intelligence and events. In addition to raising dashboard alerts so that users can take action, Ensemble’s BAM solutions can automatically trigger sophisticated, programmatic actions in response to the business intelligence it develops. In this way, Ensemble’s BAM implementation enables an adaptive closed-loop system for business process management, making it possible for business processes to react dynamically to changes in the business environment.

Ensemble’s Business Activity Monitoring builds upon, integrates with, and exploits all of Ensemble’s advanced development, management, and integration capabilities, by fusing together previously autonomous technologies in support of rapid and comprehensive integration.

Thus Ensemble fuses business intelligence technology with data transformation and routing technology. It fuses event-driven architectures with service-oriented architectures. It fuses business application development with business process modeling and orchestration. It fuses all these things to provide and support Business Activity Monitoring solutions. And it achieves this with a single development environment, a single management environment, and a single architecture.

This unique fusion and comprehensive approach results in extremely fast integration and composite application development, as well as support for the broadest set of application integration approaches and solutions, including data coordination, business process and workflow management, composite application development, and, finally, Business Activity Monitoring.

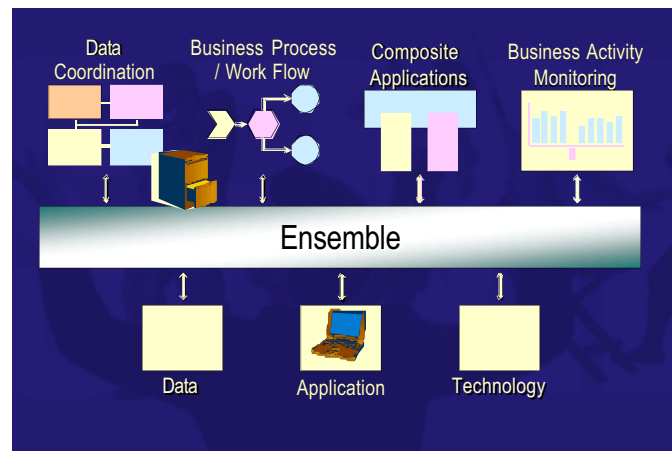


Figure 1: Ensemble, The Next Generation Integration Platform

Speed is a common theme across all aspects of Ensemble: speed of development, of integration, of system performance, and of time-to-solution. Faster reaction times result in lower costs, better service, and higher customer satisfaction for any business. But for some industries – for example, those that deal in perishable information or goods – it is an enormous competitive advantage.

2. ENSEMBLE’S BAM ARCHITECTURE OVERVIEW

Ensemble’s BAM architecture is implemented in three logical layers:

- Event delivery and display layer
- Event processing and filtering layer
- Event absorption layer

Event Delivery and Display

The delivery and display layer is responsible for notifying recipients about an event once the nature of that event (e.g., impact and severity) has been analyzed and evaluated. Notification can mean both the presentation of information to an executive by way of a dashboard, or the triggering of an automated process.

A dashboard is a specialized web page that uses meters to provide a real-time, graphical display of measured values, as shown in Figure 2. The measured value is associated with a specific property within a Business Metric Service class.

Ensemble includes a complete set of meter styles, including speedometers, odometers, fuel gauges, light bars, traffic lights, indicator lights, line charts, and bar charts – and it supports the development of customized meters. Note that Ensemble dashboards are implemented using standard HTML and SVG (Structured Vector Graphics), so there are no proprietary ActiveX or Java components to deal with.

Thus Ensemble’s delivery and display capabilities provide business agility and flexibility. While many BAM approaches give managers insight into transactions and operations, they lack the ability to close the process feedback loop, and to effect dynamic changes to the processes that carry out business strategy. In this way, Ensemble can notify recipients of an exception, and continuously feed information back into the relevant business processes, causing them to react dynamically to changing events. It is this adaptive closed-loop system that turns your organization into a real-time enterprise.

Now let us briefly examine how Ensemble’s development environment aids the creation of BAM solutions. Full Spectrum Integration and Development simply means that you use the same “diagrammatic” or GUI-based environment – The Studio – whether

you are building a dashboard widget, a complex adapter, a business process definition, or a complete business activity monitoring application.

As we have seen, BAM solutions exploit all aspects of Ensemble’s underlying capabilities. Therefore, a BAM development environment must be able to deal with difficult problems at many different levels, including the creation of complex adapters, the modeling/definition of both simple and complex business processes, and the development of full-blown composite applications.

This unified environment has many associated advantages, including greatly reduced complexity and training costs and greatly increased speed of development. Full spectrum integration and development even provides insurance against vendor lock-in, because everything in Ensemble is exposed equally well to both Ensemble’s tools and to third-party tools of every kind.

Because Ensemble abstracts system components and represents them in a consistent form, and because these representations can be projected into code or other standards-based formats that developers can take forward and embellish, Ensemble gives you bi-directional interoperability between multiple different development and business process definition tools.

Ensemble provides great flexibility in choosing a path to arrive at a BAM solution, which can then be deployed in Ensemble's high-performance execution environment.

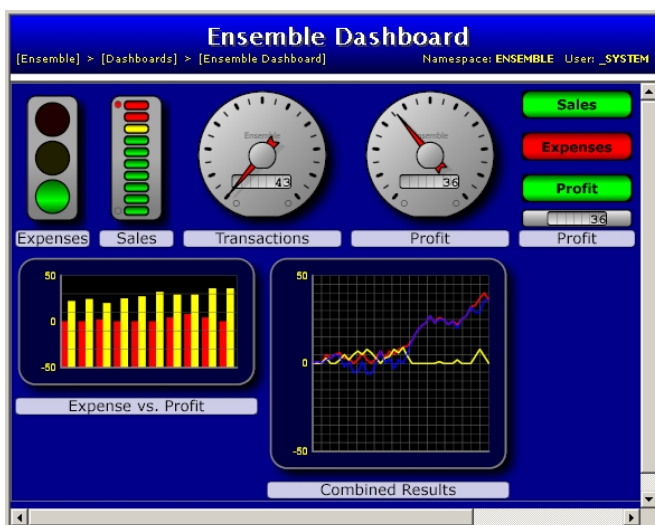


Figure 2: Ensemble Dashboard and Meters

The delivery and display layer exploits all of Ensemble’s notification and alert mechanisms to notify recipients about an event. For example, you can specify that when a Key Performance Indicator (KPI) measurement goes out of range, Ensemble will automatically display that information in the form of a traffic light, send appropriate messages via email and pager, and trigger a program or business process to deal with the event.

Event Processing and Filtering

The event processing and filtering layer consists of a set of Business Metric Services, which filter and/or analyze message warehouse data in real time.

A business metric service gathers relevant information in order to calculate a Key Performance Indicator (KPI). A KPI calculation can analyze and correlate events/messages by employing pre-built analytical models as well as templates that can incorporate real-time access to any number of back-end operational systems.

For example, a business metric service class can calculate values by invoking applications, by gathering data from external database systems, by accessing (via objects or SQL) data stored within Ensemble (such as messages or Business Process information), or by executing code.

A key advantage that Ensemble delivers for Business Activity Monitoring is the power and speed it brings to the development of sophisticated KPIs through the abstraction and projection capabilities of its Universal Service Architecture. Abstraction provides a consistent object view of underlying systems and applications—no matter what platforms, languages, data models, storage architectures, network protocols, or other technologies those underlying systems use. In creating a performance indicator, Ensemble abstraction enables a developer to rapidly access the widest range of data, without becoming entangled in the technical details of the underlying applications.

Ensemble projection makes that abstracted data available to the widest range of development tools and technologies, from Java, C++ and .Net, to SQL, XML and Web services. That frees developers to use the most effective approach for building each KPI, and eliminates retraining by virtue of using tools and technologies that each developer already knows.

Once a KPI has been calculated, it is stored in the BAM cache and becomes available to the event delivery and display layer. This high-performance, persistent cache provides efficient and common retrieval, such that multiple cache readers can use a given KPI value without incurring the expense of recalculation (recalculation occurs only at the intervals specified by the business metric service that defines it).

Business Metric Services

A business metric service is a specialized business service that gathers, or otherwise calculates, one or more numeric values. It is automatically triggered at specified intervals to perform the calculation. This calculation can incorporate:

- A call to an external application
- A query to an external database
- An SQL query against Ensemble data, such as stored messages and business process information
- Execution of metric class code

Ensemble places calculated values in a high-performance, persistent cache so that multiple users can retrieve these values without incurring the expense of recalculation.

Business metric values can be displayed on dashboards via one or more meters, and/or can be used to trigger business operations and business processes.

Ensemble provides a New Business Metric Wizard, which makes it ease to create new business metric classes.

Event Absorption

The event absorption layer is responsible for the collection of events. This layer leverages Ensemble's transactional message warehouse, which persists and manages all the messages/events that pass through the system and make them available, as objects, for continuous real-time analysis. The message warehouse is implemented via the proven technology of InterSystems' Persistent Object Engine.

The ability to persistently store all of the messages that pass through the system increases system reliability, provides great flexibility in reporting and analysis, and enables transaction compensation functions to be pre-built and executed in real-time. And of course a message warehouse is required in order to provide end-to-end management of messages and the business processes they drive.

Transactional Bitmap Indexing

Database query performance is critically dependent on having indexes on the properties used for searches. Most databases use indexes that, for each possible value of the column or property, maintain a list of identifiers for the rows/objects that have that value. A bitmap index contains a separate bitmap for each possible value of a column/property, with one bit for each row/object that is stored. A bit set to 1 means that the row/object has that value for the column/property.

The advantage of bitmap indexes is that complex queries can be processed by performing Boolean operations (AND, OR) on the indexes, thus determining exactly which instances fit the query conditions without having to search through the entire database. Bitmap indexes can often boost response times for queries that search large volumes of data by a factor of 100 or more.

But bitmap indexes suffer from two problems: 1) they can be painfully slow to update in a relational database, and 2) they can take up far too much storage. Thus with relational databases, bitmap indexes are rarely used for transaction processing applications.

InterSystems' transactional bitmap indexes use unique technology to eliminate these two problems. Updating this new type of bitmap is often faster than traditional indexes, and sophisticated compression techniques radically reduce storage requirements. The result is ultra-fast bitmaps that can often be used to search millions of records in a fraction of a second in on-line transaction-processing database.

It is transactional bitmap indexing that allows Ensemble's BAM capability to perform real-time analysis of live data, without impacting the performance needed to store the data persistently.

The Persistent Object Engine has two components: a virtual machine, and an object store. They are tightly coupled and operate in the same memory space and environment. The virtual machine is where the message broker and orchestration engine execute. It is optimized for event-driven logic so that processes can react rapidly to incoming events.

Persisting huge amounts of message traffic – without impacting overall system performance – clearly requires extremely high performance. The underlying technology of the Persistent Object Engine is shared with our Caché database product, which has a proven capacity for terabytes of data, tens of thousands of concurrent users, and hundreds of thousands of database operations per second.

Ensemble also employs transactional bitmap indexing, which can radically increase the performance of complex queries, and allows very fast access to live data in the message warehouse.

Thus, in the context of BAM, the Persistent Object Engine provides more than “mere” transactional speed. While the ability to handle huge transaction volumes is impressive, it becomes even more useful due to Ensemble's ability to rapidly access and analyze this information, both for process management and BAM.

Managing BAM Solutions

We have briefly described what BAM can accomplish, and how Ensemble's underlying technology supports BAM. Another of Ensemble's technology enablers is its customizable management environment, which makes it easy to debug BAM solutions while they are being developed, and to diagnose and fix any problems that may surface in an operational setting.

Integrated systems tend to be difficult to manage because they are often loosely coupled. The nature of asynchronous business processes and message-oriented applications makes it difficult to trace their threads of execution, and therefore to debug them. To address this difficulty, an integration platform must provide good end-to-end management capabilities, at development time as well as after deployment. Ideally, the integration platform should record every single message that passes through the system and provide

the ability to analyze this stored information and trace message paths – as is the case with Ensemble’s message warehouse.

Ensemble’s management features also include message warehouse maintenance, configuration control, queue and process monitoring, detailed event logs, and usage histograms. Thus Ensemble provides a wealth of diagnostic data, as well as the tools to analyze it in real time. In addition, Ensemble management tools are extensible, and support standards-based (e.g., SNMP) third-party management tools. Ensemble gives you BAM solutions that are capable and usable in every aspect, from development to integration to operational deployment.

3. BAM SCENARIO

Consider a healthcare provider or institution that uses multiple laboratories to perform tests for its patients and clinicians. Each of its departmental systems might interact with a single laboratory, or use multiple laboratories, to obtain test results. But whatever the mode of interaction between provider and laboratory, it is a business process.

It is easy to imagine a straightforward Business Process Management (BPM) approach to increasing efficiency; for example, the business process might route tests among these multiple laboratories based on the availability of specific instrumentation or equipment, or on geographic location, or on any number of other possible criteria.

But the biggest process problem faced by this healthcare provider is that laboratories can experience bottlenecks, and tests can become backed up. For example, a lab might be overloaded on a given day due to random fluctuations, or as a result of a local outbreak of disease, or because of a blizzard that shuts down the region. There is no BPM mechanism that allows the provider to do any kind of dynamic "load balancing" for laboratories – and this is where Ensemble’s BAM can provide a solution.

For example, BAM can enter the picture when the provider and the labs agree on a Service Level Agreement (SLA) that specifies how long it should

take for a particular type of test result to be returned. This becomes a Key Performance Indicator (KPI). BAM allows you to define a business metric service that calculates this KPI – it might measure when the test was sent, when the results were returned, and use whatever other information might be relevant (e.g., time-of-day constraints in the SLA). The important point is that there is now a real-time measurement that reflects some aspect of that business process. Because of this, the system can monitor this business process. It can capture when every single test is sent, when every set of results is returned, and so on. The data points from this measurement can be processed and the results monitored using a visual dashboard. The dashboard might display a speedometer or traffic light or whatever type of gauge is desired; but there is now a visual representation of this KPI, which is recalculated continuously.

Now imagine that Laboratory “C” begins to fall behind in the execution of their SLA. The Laboratory “C” traffic light “goes red” and we know we have a problem. This is the essence of BAM.

However, the fusion of BAM and BPM provided by Ensemble means that the continuously-calculated KPI can provide feedback to the business process. As long as the Laboratory “C” KPI is within its specified range, the process operates in its normal mode. But as soon as the KPI goes out of range, the business process can stop dispatching tests to Lab “C” and refrain until the KPI is back in range. Suddenly, this business process is reacting intelligently to events, in real time.

But even this is only a first step. Suppose that we define business process metrics that compare the results of the lab tests with known medical norms, rather than simply measuring conformance to the SLA. For example, we might know the incidence level for a particular disease in a particular location; that the average number of flu cases in the month of January for a given hospital over the last 50 years is X.

Armed with this knowledge, and with the ability of Ensemble to manage messages based on their content, we can define KPIs to monitor what is actually happening in that hospital. For example, we might have a KPI that measures the incidence of flu cases and defines an acceptable range up to 50% more than the historical average. When that KPI “goes red,” it is a

good indication that certain medical steps should be taken, and that information could be sent to the hospital emergency room or to public health authorities.

We have only begun to explore what BAM solutions can be used to accomplish. Every enterprise wants better business intelligence and greater agility in responding to it. So the only difficult thing to imagine is what kind company would not benefit from real-time Business Activity Monitoring.

4. SUMMARY AND CONCLUSIONS

Ensemble's BAM capabilities embody the convergence of operational business intelligence (BI) and real-time application integration. Its real-time data analytics and notification mechanisms – coupled with its connectivity, reliable messaging, ultra-fast/ultra-scalable message warehouse, and integrated powerful BPM tools – make Ensemble the perfect platform for building Business Activity Monitoring solutions.

Ensemble's sophisticated message warehouse has built-in business processes and primitives, bit-mapped indexing, and the ability to have processes running in the background in order to continually monitor the live message stream as well as stored messages. These capabilities let you spot trends and exceptions in time to do something about them.

Ensemble's unmatched performance and abstraction capabilities enable BAM to operate in real time, and to utilize business information from every corner of the enterprise. This gives organizations the timely business intelligence they need, and the ability to respond to that intelligence quickly enough to make a difference.

Next Steps

To find out more about Ensemble or other InterSystems products and/or to be contacted by an InterSystems representative, please visit our website at: www.InterSystems.com/Ensemble

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