AVAYA

WHITE PAPER

Event Driven Architectures in the Responsive Enterprise

January 2007

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Section 1: Introduction

To be competitive in today's real-time world requires greater business agility than ever before. Organizations and their people are working faster, and have to respond ever more quickly and effectively to real-time business events. The rigid silos that exist today between business applications and communication capabilities limit information exchange and impede enterprise agility. The good news is that new solutions are emerging that can flexibly link applications, business intelligence, and communications together to create a new class of synergistic business processes that increase the enterprise's ability to respond to threats and opportunities.

Communications Enabled Business Processes (CEBP) help enterprises enhance operational efficiency, worker productivity and customer satisfaction by streamlining human engagement in critical business processes. These solutions integrate with business process applications to predict and sense events, then respond by managing real-time multi-channel communication with process users and decision-makers. This speeds response times, reduces human delays, and frees workers from managing communications details so they can focus on making decisions and resolving issues before they impact customers.

This white paper introduces the concept of **Event Driven Architecture (EDA)** and describes the key role it plays in enabling new business strategies for Communications Enabled Business Processes. Specifically, this paper:

- describes a new stage of information infrastructure that enables enterprises to become more responsive;
- gives examples of the business benefits of implementing more responsive communications-enabled processes;
- provides a method of analyzing the costs and benefits of new responsive solutions;
- outlines the sequence of steps required to evaluate, design, implement and tune responsive applications;
- helps enterprise's get started in their planning for event-driven, highly responsive communications-enabled processes.

Section 2: Computing and Communication in the Responsive Enterprise

A challenge of the 21st century is that people in an enterprise must be increasingly aware of activity outside the enterprise — in regulatory agencies, electronic markets, among customers and within the extended supply chain. Enterprises correlate data from within and outside the enterprise to draw inferences: Is a storm or port congestion likely to impact delivery of goods to a customer and trigger penalties? Successful enterprises respond in a timely, appropriate manner by getting the best group of people and tools together to evaluate the situation, initiate a response, and — if necessary — escalate the response up the management hierarchy.

Avaya solutions for Communications Enabled Business Processes (CEBP) are a holistic combination of software, consulting, and services that integrate Avaya Intelligent Communication within core business processes. CEBP enable enterprises to be aware of activity within and outside the enterprise by monitoring communications, databases and IT applications as well as being able to bring people together to quickly react to events. The Avaya CEBP solution includes the Avaya Event Processor which provides real-time data analysis and event detection, the Communications Process Manager, which executes and orchestrates all of the communication activities required when an event in a business process requires contact with one or many key individuals, and the professional services support to design and implement the solution.

This solution helps enterprises make inferences from multiple heterogeneous sources of information to detect critical conditions. It helps initiate and track responses to opportunities by selecting people and tools based on expertise and availability. People distributed across multiple locations are brought together by a robust communications infrastructure including telephony, video conferencing, voice and text messaging and

collaborative software. Avaya CEBP help monitor progress of the response — alerting people with specialized expertise, escalating alerts to managers with greater responsibility if necessary or terminating the situation and logging information for later analysis.

Avaya CEBP add great value in solving business problems with the following attributes.

1. A high emphasis on risk management. For business processes with both significant volume and high transaction value, the impact of slow detection and response to critical events can be financially devastating. Timely response is therefore considered critical.

2. Complexity in determining what constitutes a situation that requires attention. In some cases, the problem of detecting important situations is exacerbated by the large number of conditions that must be monitored — each condition may be relatively simple, but tracking all of them continuously is difficult. In some cases critical situations are inferred by identifying patterns over time and across customers, suppliers, markets and other constituents of the company.

3. Communications within the business process that span across both geographies and organizations. Teams may be distributed across different locations and may interact through different types of communication media. As an added complexity, different situations may require the selection of specific team members based on expertise, location, availability, workload distribution and other factors.

4. Responses often take multiple steps including initial evaluation by a first-response team, identification of additional members of the team, acquisition of more data, escalation up the management hierarchy if necessary, final disposition and later analysis of lessons learned. The orchestration of responses often requires a state-of-the-art communications infrastructure for distributed collaboration.

Examples

A mutual fund company needs to identify and qualify potential sales leads and maintain ongoing customer relationships. The primary challenge is to efficiently determine which events are actionable. Sales representatives, wholesalers, and marketing representatives do not have a way to detect key lead, prospect, and customer activity occurring in a wide variety of potential customer touch points. What they need is a system that will automate the detection and correlation of activities taking place within and across corporate websites, Customer Relationship Management (CRM) systems, campaign management applications, and transactional systems. Avaya CEBP can integrate with website information, CRM interaction data, sales transactions, and marketing segmentations and classifications. Alerts can be configured to detect significant sales events and notify the relevant personnel for appropriate action.

A major manufacturing organization monitors its factories, suppliers and logistics. The company is executing a plan to become more agile and responsive to problems in the manufacturing process and to needs of its customers. Avaya CEBP enable the company to infer opportunities or threats in its manufacturing process and supply chain. Avaya's communication infrastructure helps identify appropriate people to deal with each situation based on presence, availability and expertise; appropriate conference calls are instituted, and the response to each situation is tracked from initiation, possibly through escalation, to final solution.

A credit card company monitors its network that enables credit card charge requests to be routed to appropriate banks and with approvals or denials returned to vendors. When Quality of Service (QoS) criteria between the credit card company and its banks are likely to be violated because of congestion in the network or problems with routers, appropriate engineers and risk managers are alerted with information about the specific problem and they are provided with the software tools to respond. The team of people who should be alerted depends on several factors including the location and severity of the problem, availability of personnel with different expertise and workloads.

The trading arm of an energy company trades futures of different energy products based on a multiplicity of factors and complex models including the overall load on the power grid, planned and actual temperatures in different parts of the country served by the grid, the states and capacities of the parent company's power plants, and the overall risk exposure. The trading operation has multiple locations, each with several traders. A critical factor in the success of the company is extremely rapid reaction to risks and opportunities which are created by factors outside and within the trading company and the parent organization. Appropriate teams are alerted and given specific data relevant to the situation to help them make quick and effective decisions. For both the credit card company and the energy company, Avaya CEBP can enable alerts that mobilize resources for timely problem management and issue resolution.

Section 3: Event Driven Architecture

Avaya CEBP integrate both Event Driven (EDA) and Service Oriented (SOA) Architectures. The Avaya Event Processor, which represents the EDA component, also falls under the category *Complex Events Processing* (CEP) or *Event Stream Processing* (ESP) in the literature. As companies embrace Service Oriented Architectures (SOA) to gain the benefits of re-use and encapsulation of software services, they are beginning to recognize the need to apply the same concepts of modularity to software that deals with business events as well. Many problems in the business can be solved by SOA; however, as illustrated in the above examples, responsiveness can be best achieved by also embracing event-driven architectures.

In a nutshell, here is how EDA works: Any notable change of state in an enterprise, or outside the enterprise (but in a way that affects the enterprise), is called an Event. For example, a customer purchasing a product at the company web site may be an Event. A succession of these Events is termed as an Event Stream (e.g., a stream of purchase orders). Simple Event Processing would be to take each purchase event and fulfill the order. Complex Event Processing recognizes that there may be patterns within a Stream, or more interestingly, correlated across various Streams, that may be vital to glean in real-time. For example, a purchase stream that contains multiple orders on the same item with increasing rapidity signifies that the product is gaining in popularity, and the company must react by mobilizing its production to meet the increasing demand. This may be further correlated with external data streams that contain news information about the product, and RSS feeds from product review sites that indicate that the product is being talked about extensively, which would further accentuate the need to be responsive to this changing market condition.

Thus, by utilizing Avaya's EDA-based solutions, an enterprise can achieve its goals of being more responsive.

Section 4: Cost/Benefit Analysis

Estimating Benefits

The primary benefit of the Event Driven Architecture within Avaya CEBP is that it enables enterprises to be proactive in exploiting opportunities and managing problems. An evaluation of benefits includes a quantification of the value of rapid proactive response to situations that arise in (a) normal operations and (b) truly critical situations — opportunities and crises — that happen rarely but have huge impact.

The estimation of the benefits of proactive response in dealing with rare contingencies is subjective; it requires quantification of the probability of rare events and estimation of the benefits of rapid proactive response in dealing with such events. Nevertheless, the benefits of proactive response in dealing with rare but critical situations are significant. Benefits of rapid response in day-to-day operations can be estimated more objectively and can be based on recent historical data.

The benefits of a responsive, event-driven infrastructure in normal operations falls in two categories: (a) improved profits from more effective operations with the existing workforce and (b) reduction in employee costs. In many cases, the benefits of more responsive operations are far greater than that of reducing payrolls.

The benefits of more responsive operations can be estimated from recent historical data by quantifying the costs of opportunities that were missed altogether and tardy responses to opportunities and problems. In the case of the energy trading division, an analysis of a month's trading data showed several opportunities and problems that were missed because traders couldn't keep track of all the attributes of energy and transshipment markets, the status of the parent company and overall risk. A responsive infrastructure enabled the trading division to capitalize on more opportunities and the costs of implementing the responsive infrastructure were recovered in weeks. In this instance the payroll did not decrease but profits increased substantially.

In the case of the mutual fund company, the primary benefit of the Avaya Event Processor is timely conversion of sales leads to customers. Sales and marketing personnel had no way to keep track of significant events occurring at the customer touch points. To estimate the benefit of the infrastructure, the company evaluates the improvement in productivity obtained by identifying and dealing with opportunities and problems early.

Manufacturing divisions use the responsive infrastructure to monitor performance measures throughout the factory and its supply chain, identify potential problems, and proactively handle problems before they become crises. For example, delays in supply of an electronic component by the company's normal supplier would have caused delays in supplying large quantities of a finished product to an important customer with consequent penalties; increasing delays of the component raised a red flag, and a response team reduced the potentially huge costs of a serious problem by identifying alternate suppliers and making relatively small modifications to schedules. The benefits of a responsive infrastructure can be estimated by analyzing likely contingencies and the differential in costs of responding in the usual way or responding proactively using a responsive infrastructure.

A cost-benefit analyses of responsive infrastructures must include an estimate of the benefits of proactive response in dealing with rare make-or-break events should they occur. Estimating the probability of such events is more difficult than estimating the benefits of proactive response. A crisis for a trading company occurs if the combined trading position for all traders results in massive risk exposures to rare events. In some cases, merely alerting clients to potential problems early enough allows clients to avoid or ameliorate crises.

Estimating Costs

Making an enterprise responsive requires an analysis of the business: to what conditions will more rapid proactive response improve profits; what are attributes of team members who should be first responders to different situations; what tools and data do they need; and when should responses be escalated? The benefits of responsive applications are business benefits; therefore, the value of these applications depends in large part on the roles that business users play in specifying these applications. The effort of end users in specifying and evaluating responsive systems must be factored into the costs of the application.

In the case of the energy trading division, different people in different roles benefited from improved responses to different conditions. Energy traders wanted to be alerted to the best trading opportunities whereas risk managers wanted rapid responses when risk exposure benchmarks were likely to be violated. Different traders had different specifications of trading opportunities. Understanding how to make the company more profitable by being more responsive took time and effort on the part of traders, risk managers and plant managers. IT work was required to tailor products to the specific needs of the organization, but the costs of IT development were less than the costs of business process design.

After a responsive system is in place it must be tuned to meet the true needs of the organization; often the initial design isn't perfect, and hence the costs of systems tuning must be factored into the cost/benefit analysis. One problem that crops up is that of false positives and negatives: false positives are alerts for unimportant situations that do not require special responses, and false negatives are conditions for which alerts are not issued or are issued too late to be useful. Systems in which there are too many false positives are turned off because useless alerts hurt productivity and are ignored when they get annoying. The rationale for the system is to help the enterprise respond to important conditions and systems in which many conditions are not detected (false negatives) add no value

An integrated intelligent communications infrastructure is crucial in reducing costs of false positives and negatives. One core aspect of Avaya CEBP is the service-oriented Communications Process Manager, which works with the Event Processor to mobilize the business process response to events by identifying people with the appropriate expertise who are available for real-time interaction, and then enabling members of a team to collaborate using appropriate communication media. Experts can identify and discard false positives rapidly. Another aspect of the Communications Process Manager is support for escalating responses rapidly; managers higher up in the reporting hierarchy are only asked to respond to situations that have been analyzed and filtered by others. As a consequence, people who manage large organizations are not constantly bombarded with alerts. In the case of the mutual fund company, a CFO is alerted only after a condition is evaluated by people in the CFO's reporting chain. The infrastructure for problem evaluation and escalation is rapid and thus enables conditions that require the CFO's attention to get to the CFO in time.

The final part of the cost is that of software, data acquisition, and IT development work required to integrate and tailor products to meet the specific needs of the enterprise. Most enterprises already have many of the software components required to support responsive infrastructure. These components include an integrated intelligent communications infrastructure, databases, push data sources such as stock tickers, access to pulled data from Web services and in some cases, rules engines and business intelligence systems. Adding the Avaya CEBP solution to this environment can therefore have a solid ROI because it leverages these considerable existing investments, allowing them to deliver new business value.

Section 5: Steps in Implementing a Responsive, Event Driven Infrastructure

The implementation of an Event Driven Infrastructure typically involves the following steps:

- Identify events that require response, and estimate costs and benefits
- Identify information sources
- Determine how the critical conditions may be detected
- Implement the algorithms to detect specific threats and opportunities

As we just discussed, the first step is to estimate benefits and costs for implementing systems that make the enterprise responsive to different types of conditions. Benefits may far exceed costs in making the enterprise deal with a variety of situations - from relatively small changes to make call centers more responsive to architecting processes for entire divisions. In this case, a decision must be made on what changes to implement first.

In the case of the energy trading division, a cost-benefit analysis showed that making the division more responsive to the global energy picture had a near-term payoff so the division chose to make substantial changes. In the case of the mutual fund company, employees were already monitoring multiple reports, detecting potential problems, analyzing data cubes, and getting teams to respond to critical conditions; however, they were doing so without an infrastructure designed for the purpose. The mutual fund company proceeded more incrementally, making employees more productive in dealing with a small number of critical situations, evaluating costs and benefits, and then making additional changes.

The first step identifies those business processes for which the company must be more responsive, determines how quickly a response should be initiated, the process by which membership in the first responder team is determined, and how the response is coordinated over time. In most cases, a business process already exists, and the task is to specify improvements.

There are a few applications in which responses must be executed in milliseconds — some military systems and IT intrusion detection systems must respond to attacks immediately and automatically. Most responsive applications, however, are people-centric: they require appropriate people to be alerted early enough that the enterprise can respond effectively. Many applications require teams to be constituted and alerted in a few seconds, whereas responses in minutes are adequate for other applications. An early step in designing a responsive system is determining adequate response times and the membership of first responder teams.

The specification of the system also identifies how the response must be tracked and how it should evolve: in what cases should additional people be alerted; how is communication established with them; what additional data is required and how is it obtained; when should the problem be escalated and how? These aspects of specifying responsive systems are primarily business-oriented and secondarily IT-oriented because the major benefit is in greater responsiveness of business processes.

The next step is to identify data sources necessary to detect critical situations. In many cases, relevant data sources already exist within the enterprise since the enterprise monitors key business processes and has sensors on factory floors and in the supply chain. In some cases, additional data sources are identified to help detect situations that merit rapid response - some of these data sources may be outside the enterprise and its partners. Electronic markets and Web sites of regulatory agencies and even competitors may provide information that allows the enterprise to become more responsive.

The design of the responsive system must ensure that it can handle the volumes of pushed data at peak loads because critical conditions often occur at peaks. In many cases, a large fraction of the pushed data can be filtered and discarded immediately, leaving more manageable data rates for further analysis. When data is pulled by the enterprise it must ensure that requests are not made so frequently as to degrade performance of the data supplier's sites but data must also be pulled often enough to ensure responsiveness.

Data used in detecting critical conditions may be structured, unstructured, or partially structured. Data with defined schemas and semantics are structured; data in news stories and email is unstructured, and data obtained from tables in Web sites is partially structured (e.g., information in an online catalog may include structured fields such as the item price, and unstructured fields such as the detailed description, user reviews, etc.). Unstructured data needs human analysis (which may be aided by machine-based natural language processing) whereas structured data can often be handled automatically. Filtering unstructured data — text, images or video — to determine what should be analyzed by humans, is a challenge particularly since people tend to pay less attention to systems that send too many false positives or "spam" messages. Business experts and IT developers work closely to determine what data sources are appropriate and the systems and protocols required for data acquisition.

The third step is to identify the mechanisms by which the critical conditions specified earlier can be detected from the data sources. Software helps experts become more productive in detecting important situations; therefore the process of detection must be people-centric. Very rarely are detection and response processes entirely automated without interaction from people. Therefore a key aspect of design is the support of individuals and teams in identifying critical situations.

After identifying the conditions to which more rapid response is required, the hierarchy of response teams, the orchestration of the response, and the data sources analyzed to detect critical conditions, the fourth step is to implement the algorithms by which critical situations are detected. The conditions to be detected fall into two broad categories: (1) specific threats and opportunities that are known in advance and (2) abnormal situations that have not been characterized earlier as critical situations.

Examples of opportunities and threats characterized in advance are lucrative trading opportunities and fraudulent insurance activity. In such cases the enterprise knows the patterns in the data that identify the critical condition, and the challenge is to specify the patterns and detect them rapidly. Algorithms continuously correlate and sift through multiple data streams searching for these patterns. In other cases, abnormal situations are identified and flagged for analysis by appropriate experts who deal with the specific type of abnormality. In such cases, normal conditions are specified in advance and states that deviate significantly from normality are identified as requiring further analysis.

Specifying patterns across multiple data streams can be non-trivial. The costs of training lawyers, doctors and traders to learn pattern-specification notations, even if they are based on widely used computer languages such as SQL, are prohibitive. The costs of IT personnel learning each end user's conditions and then specifying patterns for them is, likewise, prohibitive. A solution is for IT to work with a small number of end-users to identify templates of patterns, leaving individuals to specify the parameters that fill in each template.

Patterns that identify critical conditions are either specified parametrically by end users working with IT staff, or are learned from examples. Both parametric specification and machine learning from examples requires the business users' expertise and time. In the case of machine learning, the business user trains the software by providing examples of conditions that are critical and conditions that are not.

Section 6: Getting Started

As previously discussed, it is critical to identify applications that benefit substantially by becoming more responsive. Are there lines of business identified processes that do not respond at all to important situations or respond tardily? Once identified, estimating the benefits of detecting critical conditions and responding in a timely proactive manner is necessary. A trial or pilot project on a limited aspect of the overall problem can demonstrate real value with end users. The pilot project helps validate the estimated costs of restructuring business processes, the costs of integrating and tailoring software products to fit the specific needs of the business, as well as the benefits of improving the process. Sufficient time must be allocated to pilot projects to get business users' specifications at the outset, and to get their feedback after the project is completed. All these applications are ultimately people-centric, and end users are the final determiners of value.

Avaya provides a comprehensive solution for Communications Enabled Business Processes (CEBP) that includes consulting services to help organizations discover new opportunities for ROI and business value. Avaya has worked directly with many customers to apply the principles discussed in this paper. Contact Avaya at www.avaya.com to get further assistance and learn more about the services, software, partners and support available to help you create a responsive enterprise.

Section 7: Conclusion

Responsiveness is a key attribute of successful enterprises in the 21st century. Change occurs at a faster pace each day. Enterprises have to deal with many different constituents including regulatory agents, multiple markets, competitors, suppliers and customers. Increasingly these constituents have individual needs; for example customers have more choices and want more specialized services and products. Data in the form of different media — voice and text messages, call centers, sensors, business process monitors — arrive at ever increasing volumes. People in the enterprise are overwhelmed with data and the need to service so many different types of constituents that they miss or respond tardily to critical situations. A truism, but well worth repeating, is that the key to making the enterprise more responsive is to make its people more responsive.

This white paper identifies people-centric technologies that help make employees at all levels of the enterprise more responsive. The technologies help employees pay attention to what matters at each point in time, identify and constitute teams to deal with important situations, provide the intelligent and integrated communications infrastructure that enables distributed teams to collaborate to solve time-critical problems, and help monitor the response until the situation is dealt with. Several organizations have implemented responsive, event driven applications with significant returns on their investments.

Demonstrated keys to success for these organizations are:

- Identify key areas for improving the responsiveness of the organization;
- Estimate the return on investment;
- Create a pilot project to illustrate the use of the technology, providing sufficient time for business end users to specify the application requirements and for implementation of the system;
- And finally, have business users evaluate the increased business value of the responsive application before taking further steps.

Avaya's solution for responsive, event driven applications is designed around the premise that an enterprise is as responsive as its people. Avaya has a long history of products and services that enable greater business agility through Intelligent Communications. Avaya's event and communication-enabled business process solution helps with the most valuable resource of the 21st century: **people's time and attention**.

About Avaya

Avaya enables businesses to achieve superior results by designing, building and managing their communications infrastructure and solutions. For over one million businesses worldwide, including more than 90 percent of the FORTUNE 500®, Avaya embedded solutions help businesses enhance value, improve productivity and create competitive advantage by allowing people to be more productive and create more intelligent processes that satisfy customers.

For businesses large and small, Avaya is a world leader in secure, reliable IP telephony systems, communications applications and full life-cycle services. Driving the convergence of embedded voice and data communications with business applications, Avaya is distinguished by its combination of comprehensive, world-class products and services. Avaya helps customers across the globe leverage existing and new networks to achieve superior business results.

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