Predicts 2012: Cloud Computing and Event Processing Will Be the Key Advances in Application Architecture

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Compositions, including composite applications, mashups and business process management (BPM) solutions, are becoming the primary vehicles used by IT to support innovative business initiatives. Service-oriented architecture (SOA), event processing and in-memory computing (IMC) are contributing critical capabilities to these compositions, and the cloud is hosting the compositions, as well as the services knitted together by the compositions. This research brings IT executives up-to-date on the ways these technologies and architectures will evolve during the next one to three years.

Key Findings

- During the next one to three years, most innovative business initiatives will demand that developers leverage the flow of event data generated by the interplay of applications, devices, users and their environments. The architectures and technologies that most effectively process these events will become standard in a majority of new applications during that time.

- SOA implementations will increasingly favor the use of physical or logical intermediaries that isolate service providers and service consumers from changes required by service reuse, as well as changes required by SOA federation.

- IMC will be an accepted and expected part of the architecture used by many applications developed for cloud deployment. IMC will be an implicit part of applications developed to run on platform as a service (PaaS) offerings, and designed to deliver high developer productivity.

- Cloud-native applications have distinct advantages in performance, maintainability and operational characteristics, but their architectures are quite different from traditional enterprise systems. However, the significant investment required to implement a new architecture will only be made in situations in which the application’s economic value is also significant — for example, software as a service (SaaS)-delivered applications.
Recommendations

- Business analysts familiar with event processing and the concept of real-time analytics should be involved in new, large business process improvement projects, so that they can identify opportunities to make operations more intelligent.

- SOA service architects and developers should use an intermediary to abstract the implementation of each service's nonfunctional capabilities away from the implementation of the business functionality provided by the service.

- Developers, developer technology providers and cloud platform service providers should embrace advanced IMC technologies as critical enablers for global-reach, cloud-native applications. They should also consider them for incrementally improving the scalability, performance and availability of established applications.

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Strategic Planning Assumptions

In 2015, more than half of new business applications will leverage event streams to improve situation awareness and decision effectiveness.

By 2015, more than 60% of services will be implemented using on-premises gateways or cloud-based services to provide nonfunctional capabilities.

By 2014, more than 65% of user-developed cloud applications will employ advanced IMC technology to meet quality of service (QoS) requirements.

Through 2015, only 1% of applications will have significant architectural modifications to support cloud, mobility or IMC.

Analysis

What You Need to Know

Two incontrovertible sea changes are affecting enterprise applications: cloud computing and event processing. Most clients are familiar with cloud computing, but they frequently misread the use of
the cloud for enterprise applications, often mistakenly believing the same architecture and development process that work for on-premises applications will work for the cloud. Gartner predicts that there will be an ongoing struggle between the need to optimize applications for cloud deployment and the desire to stay with familiar development and architectural approaches.

Events and event processing, which are used in most cloud-native applications, present a different type of challenge. Event processing is still new to many enterprise developers and architects. Once the basics of business events are understood, the need to leverage events in mobile and customer-focused Web applications becomes clearer. Given the newness of event-driven architecture (EDA) and complex event processing (CEP), IT executives will struggle with development and deployment; however, they don’t have much choice in the matter. Enterprises that do the best job of harnessing location, presence and other events local to a user will be far ahead of trailing-edge adopters.

Unlike the cloud and event processing, SOA is not leading-edge at this point — it’s far along in its journey on the Gartner Hype Cycle to the Plateau of Productivity. However, since SOA is foundational for applications that run in the cloud, leverage services that live in the cloud and leverage events, any significant changes in SOA adoption or best practices is noteworthy. As a result, we call attention to the dawning realization among architects that using an intermediary in a service deployment architecture is a best practice for delivering the loose coupling and separation of concerns that are hallmarks of SOA.

Strategic Planning Assumptions

**Strategic Planning Assumption:** In 2015, more than half of new business applications will leverage event streams to improve situation awareness and decision effectiveness.

**Analysis By:** Roy Schulte

**Key Findings:**

Real-time event data is increasingly emitted by new sources, including mobile computing devices, native cloud applications, news feeds, radio frequency identification (RFID) tags, GPS sensors and social computing sites (e.g., Twitter). These streams of event data complement the traditional, structured transactional IT data that supports operational business applications, as well as the unstructured data, such as email and documents, that supports human communication. The primary reasons event data is proliferating is the lower cost of sensors, networks and computing power; the universal adoption of Internet-based standards, such as Internet Protocol (IP), uniform resource identifiers (URIs) and DNS; the spread of social computing; and the proliferation of smartphones, tablets and other portable devices with onboard GPS, compasses, accelerometers and ambient light sensors. As more event streams become available over high-speed networks to virtually any person, application or device in any location, it becomes increasingly practical to augment the intelligence of many kinds of business activities.

Event data provides up-to-the-second situation awareness, including context awareness, on issues such as where people and things are, what condition they are in, what they are doing, and what has just happened anywhere inside or outside a company’s environment. This enables systems that
provide early warning of impending equipment failure, alerts of possible fraud, background information for real-time cross-selling and precision customer service, reports on SLA compliance and many other kinds of notifications.

**Market Implications:**

Most of the people who directly benefit from real-time event data in a business context are individuals or first-level line supervisors making immediate operational decisions regarding individual transactions or customers, or minute-to-minute adjustments in the way operations are running. Real-time event data is also the essential input to smart devices and fully automated sense-and-respond systems, such as smart electrical grids and smart buildings. Every large company has some aspects of its operations that can be made more intelligent and responsive by leveraging event data. Companies that sell packaged applications or many kinds of physical devices are also enhancing their products to take advantage of event stream data. Analytic applications performed on real-time event data, particularly CEP applications, are an important aspect of the mushrooming "big data" movement.

**Recommendations:**

- Use real-time event stream data for near-term decisions, where action must be taken within minutes, seconds or milliseconds after receiving new information.
- Business analysts, architects and developers familiar with event processing and the concept of real-time analytics should be involved in new, large business process improvement projects so they can identify opportunities to make operations more intelligent.
- CIOs and other IT leaders should invest in educating their architects, database administrators and a core group of developers and business analysts in EDA and CEP, so they know where and how to apply those concepts.

**Related Research:**

"Smart Devices and Sense-and-Respond Systems Are Event-Driven"

"The Trend Toward Intelligent Business Operations"

"How to Justify the Cost of Real-Time Operational Intelligence"

**Strategic Planning Assumption:** By 2015, more than 60% of services will be implemented using on-premises gateways or cloud-based services to provide nonfunctional capabilities.

**Analysis By:** Ross Altman

**Key Findings:**

- Securely connecting service requesters and providers is particularly challenging when these endpoints exist within different security domains.
Although the code required to provide secure SOA communications can be embedded in the client program and service implementation, systematic applications benefit from the functional decomposition of service-based communications, with nonfunctional capabilities (such as authentication, authorization, encryption, signing and logging) segregated into a separate architectural element — a gateway.

Several product and service categories can be used to provide the segregated functionality required to control access to a service, including SOA and XML gateways, SOA runtime governance software and cloud services brokerages.

A robust implementation of secure SOA communications requires identity management and federation capabilities, which can be provided by a set of mature identity and access management products, as well as the well-defined processes needed to effectively manage those products.

Market Implications:

Developers use SOA in systematic development projects because SOA enables them to functionally deconstruct a large complex problem into smaller and more easily addressed problems. In most conversations regarding functional decomposition, this concept is applied to the implementation of the functional capabilities of the application. However, it also applies to the implementation of the application’s nonfunctional capabilities, like communications security. The implementation and deployment of secure SOA communications in a separate entity provides several of the benefits more generally associated with decomposition of an application’s functional aspects, including requirement variability, reuse, separation of duties and agility.

Requirements for SOA security will increase for requests from other enterprises, requests that flow across the Internet and requests that involve data that must be kept private — e.g., financial and healthcare data, as well as data that, if revealed, can subject someone to identity theft. Although it’s possible to develop the code required to ensure the secure and private exchange of data under these circumstances, the benefits of functional decomposition will accrue to enterprises that segregate this functionality into an intermediary — an SOA gateway.

This should not be construed as an unequivocal endorsement of the SOA gateway concept or any group of SOA gateway vendors. Such technology, and the investment required to implement it, may seem like overkill for opportunistic applications. However, for the development, deployment and life cycle management of systematic composite applications and other compositions, implementations of the various SOA security capabilities within an intermediary is a best practice.

Recommendations:

Architects and developers of systematic applications should use an SOA gateway product or service to abstract security issues away from the implementation of the business functionality provided by the service.

Developers of a situational, opportunistic service can use an established intermediary or a cloud intermediation service, or can implement secure SOA communications within their service code.
For the systematic development of SOA services, implementations of the nonfunctional capabilities within this SOA intermediary should be separated into multiple extensible and reusable policies or technical services.

**Related Research:**

"Using SOA Gateways for Secure SOA Communications"

"Application Integration and SOA Gateway Appliances Losing Market Share to Cloud Alternatives"

**Strategic Planning Assumption:** By 2014, more than 65% of user-developed cloud applications will employ advanced IMC technology to meet QoS requirements.

**Analysis By:** Massimo Pezzini

**Key Findings:**

Cloud computing potentially supplies user organizations with the technologies and the approaches that enable the implementation of global-reach, cloud-native applications capable of supporting tens or hundreds of thousands (or even millions) of users generating huge and unpredictably fluctuating workloads. By natively leveraging the intrinsic characteristics of cloud computing (that is, parallelism, elasticity and redundancy), these applications enable high-risk/high-reward business models (for example, Web commerce, online gaming, SaaS and social networks), such as those implemented by Amazon, eBay, Google, Twitter, Facebook, salesforce.com and Workday.

To meet the high performance, scale and availability demanded by cloud-native applications, architects usually apply key design tenets, such as data partitioning, data replication, in-memory data, parallelization and asynchronous communication between application components. IMC technologies, such as in-memory data grids (IMDGs), in-memory database management systems (IMDBMSs) and in-memory low-latency messaging (LLM), will be critical to enable high performance and scalability by holding business data in memory (thus avoiding the bottleneck associated with accessing on-disk data) and by enabling fast, asynchronous interprocess communication.

In-memory data can be supported through basic, in-memory caching technologies, such as the open-source memcached or Ehcache. However, these products lack the advanced capabilities — for example replication to support high availability; persistency, overflow and warming up management (to persist in memory data on disk for recovery and restart purposes); and transaction management, monitoring and management — needed to support business-critical, QoS requirements. Those capabilities are instead supported by closed- and open-source IMDG products, such as GigaSpaces XAP, Hazel Bilisim’s Hazelcast, IBM WebSphere Extreme Scale, JBoss Infinispan, Microsoft Windows AppFabric Caching Services, Oracle Coherence, ScaleOut Software StateServer, Software AG’s Terracotta, Tibco Software’s ActiveSpaces DataGrid and VMware GemFire. IMDGs are reasonably mature, supported and actively promoted by powerful and influential vendors. They also provide such critical features as support for parallelism, elasticity and eventing mechanisms.
IMC technology, including IMDGs, is also increasingly integrated, often as an optional add-on, in products frequently used in global-reach, cloud-native projects — enterprise application servers, portal products and enterprise service buses (ESBs) — to boost these products' performance and scalability. Some vendors (e.g., IBM and Oracle) extensively utilize these technologies as underlying foundations of their PaaS offerings, although in a way that is not directly visible to users. Some providers (e.g., GigaSpaces, Microsoft) provide IMC capabilities as part of their suite of PaaS functionality, and other vendors will adopt the same approach in the future. A large and growing number of user organizations will explicitly, but more often implicitly, take advantage of IMC technologies in the context of cloud-native application projects.

**Market Implications:**

Support for IMC will continue to be delivered in the form of capabilities offered by discrete, independent products or PaaS offerings, but will increasingly become an attribute of broader software suites that vendors will try to maintain as compatible as possible with the current generation of products to favor adoption from the installed base and partners. This approach allows users to introduce IMC technologies in an incremental, minimally disruptive way, even if some of its anticipated benefits may not be fully delivered, due to the technical compromises that vendors will have to accept to avoid backward compatibility disruption. Therefore, in the context of their global-reach, cloud-native application projects, a large number of mainstream organizations will implicitly take advantage of IMC technologies, primarily as embedded components of other application infrastructure products.

Instead, technically savvy user organizations will explicitly leverage IMC programming models for maximum benefit. However, because of the scarcity of IMC-specific skills, the lack of standards coupled, and a fragmented vendor and technology landscape, during the next five years, the explicit use of IMC technology will remain an expensive value proposition that can only be justified in the context of high-reward (and often high-risk) initiatives.

Users will have to go through technology learning curves, devise new application design techniques, and tackle new data administration, security, management and disaster recovery challenges. Service providers capable of delivering methodologies and best practices to address these issues and technology providers offering relevant tools and cloud services will be able to exploit a significant and fast-growing business opportunity.

**Recommendations:**

- End-user organizations should embrace advanced IMC technologies as critical enablers of global-reach, cloud-native applications, but should also consider their use to incrementally improve the scalability, performance and availability of established applications.

- For less demanding projects, end-user organizations should adopt traditional application infrastructure products and cloud services that can be incrementally extended with IMC technologies to secure additional performance and scalability potential should their applications run out of steam.
End-user organizations should monitor product vendors' and PaaS providers' progress in incorporating IMC-enabling technologies in their offerings.

Technology providers should articulate a strategy for leveraging IMC technology — through internal development, acquisitions or partnerships — to build differentiation in the application infrastructure market for high-end, demanding projects.

Technology providers should plan for the pervasive use of IMC technology also in mainstream application infrastructure products — application servers, portal products, BPM suites, ESBs, etc. — in the form of add-on products that boost performance, scalability and availability.

Technology providers should encourage initiatives meant to define IMC industry standards to broaden the addressable market, reduce mainstream users’ skepticism and attract third-party investments.

Cloud service providers (PaaS and SaaS) should adopt advanced IMC technologies to support the implementation of high QoS cloud services.

Related Research:

"From OLTP to Cloud TP: The Third Era of Transaction Processing Aims to the Cloud"

"Innovation Insight: Invest in IMC for Breakthrough Business Innovations"

"Taxonomy, Definitions and Vendor Landscape for Application Platform Products"

Strategic Planning Assumption: Through 2015, only 1% of applications will have significant architectural modifications to support cloud, mobility or IMC.

Analysis By: Dan Sholler

Key Findings:

- Cloud-native applications have some distinct advantages in terms of performance, maintainability and operational characteristics, but their architectures are quite different from traditional enterprise systems.

- Tools will enable developers to port on-premises applications to the cloud. Although it does not optimize these applications for this architecture, this approach will allow enterprises to realize many of the benefits of cloud deployment, such as usage-based pricing, nearly instant provisioning and rapid scalability.

- Only situations in which the application’s economic value is large (for example, SaaS-delivered applications) will support the necessary investment in new architectures.

Market Implications:

Although the shift toward cloud, mobile and IMC have significant effects on the architecture of systems, fully exploiting the opportunities in these areas will require new architectural models.
However, these models will largely be ignored during the next three years, as a lack of knowledge, standardization and tooling support will make them difficult to implement. A few highly valuable and highly specific systems will be upgraded or built to use these models, but most software will be derived from established systems, and use existing architectural patterns. Only in circumstances where the software is being sold as a SaaS solution, and the application is critical to an organization, will enterprises risk newer approaches using new architectural models.

**Recommendations:**

- For critical cloud applications that will drive revenue and differentiation, look to new cloud-native architectural models.
- Use elements of the cloud-native architecture to improve traditional applications (for example, in-memory data caching).

**Related Research:**

"Workday Is Driving New Application Architectures and Designs"

"Mobility, Cloud and Multicore Systems Are Changing Application Architectures"

**A Look Back**

In response to your requests, we are taking a look back at some key predictions from previous years. We have intentionally selected predictions from opposite ends of the scale — two where we were wholly or largely on target, as well as one we missed.

**On Target: 2008 Prediction —** Through 2011, fewer than 15% of large organizations will be able to implement a single, federated, enterprisewide SOA backplane.

Most enterprises with multiple SOA initiatives are working with islands of enablement within different organizational domains — i.e., they have multiple instances of their SOA infrastructure, and they manage these separate SOA backplane implementations with separate development, operations and governance personnel. For this reason, relatively few enterprises have successfully implemented a single, federated, enterprisewide SOA backplane (actually, a grid composed of several backplanes). Also, only around 50% of large enterprises have established a unified enterprisewide SOA center of excellence (COE), although they may have SOA COEs in individual domains.

**On Target: 2008 Prediction —** By 2012, half of all SOA services in production will employ the WOA substyle of SOA.

The vast majority of new SOA services built today for consumption over the Web as cloud-based APIs are using the Web-oriented architecture (WOA)-style. However, most SOA services that have been built (and are still being built) for consumption by internal applications use the WS-* standards. Consequently, the WOA style of Web service will probably be hovering around the 50% mark at the end of 2011.
Missed: 2008 Prediction — Through 2010, the lack of working SOA governance arrangements will be the most common reason for SOA failures.

Although most SOA implementations through 2010 lacked smoothly working and well-enforced SOA governance arrangements, the most common reasons for failure in SOA projects were more mundane. The most common reasons for SOA failures through 2010 were misplaced priorities and unreasonable expectations. Also, enterprises have struggled with erroneous service granularity (usually their services were too fine-grained) and a failure to negotiate sufficiently explicit and comprehensive service contracts.

SOA has now moved through the Hype Cycle to the Plateau of Productivity, so enterprise IT does a better job of setting expectations and managing the basics of API development. However, IT still underinvests in SOA governance, both on the design and development side and on the runtime operations and management side.
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