THE DECENTRALIZED DATA CENTER
In the Age of Service Oriented Architecture

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Abstract: The adoption of SOA in business computing environments is growing due to the promise of significant cost reduction in the planning, deployment and operation of IT projects. However, the organic transformation from legacy enterprise applications to SOA applications only has been seen mostly in large enterprises data center where services are centralized. Patterns of adoption of SOA, in combination with emerging technologies lead us to believe that the traditional data center owned by a large organization, i.e., the traditional monolithic data center, will evolve into a more federated form. This new dynamic will affect large and small business alike.

1 INTRODUCTION

Service-orientation and adoption of SOA (service-oriented architecture) in business applications have been discussed in depth in the literature as well as documenting the SOA transition from conceptual vision to engineering reality.

However, our research indicates that most IT managers and end users view SOA as a way for large enterprises to improve IT efficiency and reduce costs. A prior paper postulated the evolution of service orientation around an industry-wide portfolio of standardized services available to organizations and businesses large and small. In fact, this anticipated evolution would ensure that the benefits of service orientation would be available to a broad range of organizations, large, small, private and governmental, and regardless of location or the maturity of the economy in which they are offered.

The concept of outside-in SOA previously discussed in a previous paper by the authors followed by an analysis of patterns of evolution in the physical infrastructure where these services reside, namely in data centers. We believe that patterns in the adoption of SOA will also affect the way data centers are deployed and sourced.

The decentralization brought by compound service oriented applications will logically lead to a similar pattern of decentralization in data centers. This evolution mirrors the trend toward outsourcing for development and operations that has occurred in the past 10 years.

2 INSIDE-OUT: SOA IN LARGE ENTERPRISES

The increasing adoption of SOA in the industry brings the promise of significant cost reduction in the planning, deployment and operation of Information Technology (IT) projects. Added regulatory compliance characteristic of this period has brought additional incentives to explore means to bring in regulatory relief.

Traditionally, corporate applications have been deployed in stovepipes, as illustrated in Figure 1, one application per server or server tier hosting a complete solution stack. Ironically, this trend was facilitated by the availability of low-cost commodity servers fifteen years ago. Under this system physical servers are procured, a process that takes anywhere from two weeks to six months. When the servers become available, they are provisioned with

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an operating system, database software, middleware and the application. Multiple pipes are actually needed to support a running business.

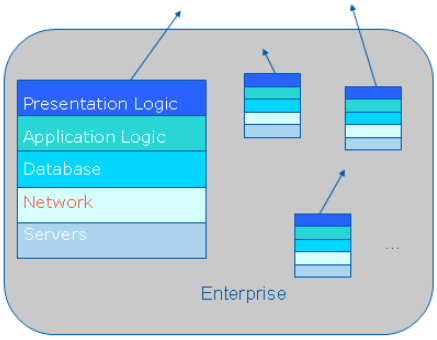

Figure 1: Traditional application stovepipes vs. SOA.

With SOA, monolithic applications are broken into standards-based services.

To cope with the long development and transition cycle of "internal-only" SOA approach described above, many enterprise IT departments pursue a path outlined in Figure 2. While the overall SOA solution architecture is defined and controlled by the IT department, some of these services may be outsourced to external service providers to build and support (host). This progression starts with small with non-mission critical services while the IT internal development teams focus on core, complicated, mission critical services.

Some companies may be under no such restrictions, and the core may become so small that it becomes indistinguishable from the outsourced services as shown in Figure 3. This evolution for SOA adoption can be construed as inside-out where an SOA environment is built out from reusable in house services out of which a few eventually become outsourced.

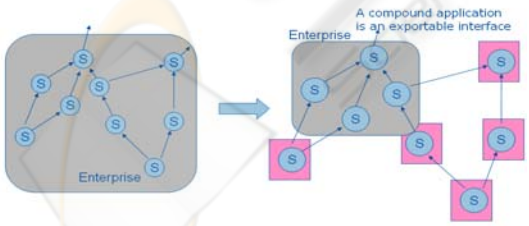

Figure 2: Transition from inside-out to outside-in SOA.

3 DECENTRALIZED SOA

Small business can actually completely sidestep the inside-out process described above and build their solutions entirely out of outsourced services. We call these services servicelets or microservices they are self-contained hardware and software components that can be "snapped" together using Web services technology into full fledged business applications.

Figure 3 illustrates these ideas. A well defined business process (e.g. purchase order creation and processing, bank transactions, etc.) could be represented by a set of SOA services integrated by different users depending on their specific business needs, the process of picking and choosing the right pieces for their businesses. Mash-ups in the Web 2.0 world today constitute an example.

The model is highly compatible with services provided by a few large internet portal datacenters (such as Google, Yahoo, Baidu, Salesforce.com, etc.) therefore reduce the needs to have large, company owned, complex centralized data centers

This adoption of SOA will take place under a different dynamic: instead of reuse from within, or across organizations in a large enterprise, considered a necessary condition for critical mass, we will see the same critical mass, but with reuse now be happening across whole economic ecosystems. We call this dynamic an outside-in dynamic for SOA adoption.

In other words, the outside-in model for SOA depends on decentralized ecosystem players providing composite applications that are used to build more complex SOA-style composite applications.

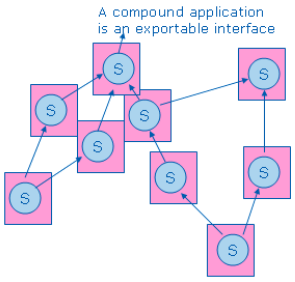

Figure 3: For decentralized business computing environment the core becomes arbitrarily small to the extent that it's no longer distinguishable.

With such an inside-out SOA model, specialized SOA services that could be shared by many businesses could emerge.

The dynamic of this process is that as service technology matures, services will become and will be traded as commodities. This will lead to varying degrees of specialized providers. It simply will be cheaper to build specific functionality by contracting out constituent components in the marketplace rather than build the same functionality wholly in house.

The fungible, interoperable services mentioned thus far will have an effect in the way data centers are deployed and operated. The services mentioned in the SOA "application" layer are eventually hosted in a data center. Running these services in a rigid, monolithic physical infrastructure would to some extent, negate the benefits of agility.

4 THE PHYSICAL DATA CENTER INFRASTRUCTURE

What is the physical data center infrastructure necessary to support such outside-in environment? The adoption of commodity servers for hosting enterprise applications started in the early 90s, away from mainframe and RISC based hosts. At that time the cost of the hardware was much higher than it is today.

Commodity servers brought in an attractive value proposition with the option of additional capacity in increments of tens of thousands of dollars, often less than that. Fledgling companies and rising upstarts found these servers could be deployed very quickly without long procurement cycles.

For commodity servers, conventional wisdom indicates that the norm was a one-application-per-server provisioning approach. Actually it was worse than that. Deployments with many servers per application were not uncommon at all, starting with the classic 3-tier distributed architecture that splits storage, application logic and presentation logic (Web server) in different machines.

Furthermore, an often used mechanism for improving Web server performance was to split the front end into several servers, with each server taking on requests on a round-robin basis.

This approach made sound economic sense at the time because they brought business agility that was unattainable with more traditional technologies. It also provided logical isolation.

Unfortunately, these trends led to companies deploying thousands of servers. This condition is affectionately called "server sprawl". This development became unsustainable due to space and energy consumption.

5 THE UTILITY COMPUTING INFRASTRUCTURE

The new vision for the enterprise architecture is a multi-layered architecture in which applications draw on shared services and computing resources. The utility computing infrastructure is the foundation for that architecture.

The business engine that is driving the new vision for the data center is strategic cost reduction and agility, the same goal as SOA in application space.

In particular, for SOA to become reality, the data center infrastructure needs to reflect this new approach to the point that the infrastructure itself will become service oriented.

Furthermore, if we take as a given that in the advanced maturity stages data centers become policy-oriented and business drives IT, it will be hard to ignore business considerations both at the strategic and tactical level.

Under SOA, cross-company barriers may not be barriers at all. In other words, the trend toward outsourcing can be expected to accelerate. Outsourcing will not only encompass applications under the concept of software-as-a-service (SaaS), but will also likely include physical plant.

Data centers may become very large, with one provider taking on one function for several enterprises, or very small in the case of a specialty service provider.

A prerequisite under this new environment is that the architecture, processes and analysis methods applied will need to be scalable over a much broader range than what is common today.

6 SOA DEVELOPMENT

In this example we describe an enterprise IT environment with several key enterprise applications such as customer relationship management (CRM), business-to-business (B2B) portals, enterprise resource planning (ERP), and others. In a typical IT environment, these applications are hosted internally at a centralized data center. However, in the "outside-in" model, this IT department is horizontally specialized and does not directly own any large data centers, just a few servers to integrate services provided from other service providers. In fact some of the applications may be renting in a pay-as-you go SaaS (Software as a Service) model. This IT department operates by integrating applications services needed to meet its customers' needs. Due to the nature of SOA, it is not locked to a particular services provider. It can easily switch to a better cost-effective service provider or when the business needs change.

The trend toward distributed, multi-tier data center designs has been taking place for the past

fifteen years. A parallel trend in software has been the gradual separation of computing engines from the applications and from the data being operated upon. Until very recently, an enterprise application was tightly bound to a physical server and used direct-attach storage, i.e., data was kept in hard drives inside the same server boxes. This arrangement was reasonable from the standpoint that the data in a hard drive was tightly bound to the application that created it.

The first boundary to be breached was the one between compute engines and applications: advances in software engineering made it possible to run an application in a multiplicity of platforms. The emergence of storage area networks (SANs) and network attached storage (NAS) took the data out of the boxes. In the past five years the adoption of XML web services interfaces accelerated this trend through increasing interoperability and by making data usable by most any application.

What has not changed in this process is the prevalence of vertically integrated solution stacks. Compute engines, applications and data can be mixed and matched. However, except for very specific exceptions involving outsourcing, the common notion is that these three elements do not cross corporate boundaries. These boundaries will be breached as well under an outside-in SOA environment and as part of the technology maturation process. The reasons will be simple economics: outsourcing services will lower cost and yield higher operational efficiencies than an equivalent in-house solution.

Enterprise application services will be procured through a hierarchical, multi-layered ecosystem. Technology maturation makes specialization possible with opportunities to add value at each layer.

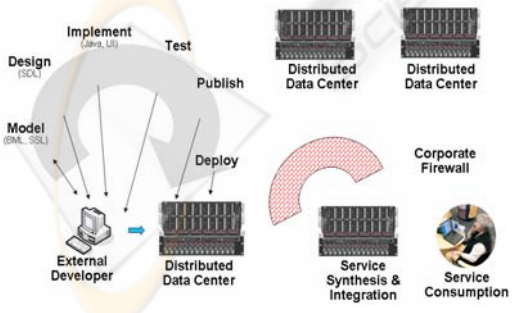

Figure 4: Creating and sharing typical outside-in services using a decentralized model.

As illustrated in Figure 4, an independent service provider goes through the typical service development process from "model", "design", to "implement". Once a service is developed, it will drive rigorous test process to ensure service integrity and quality. The service then will be transferred to a data center to publish and deploy. Since services are independently developed, they could be deployed at a smaller data center at decentralized locations. During the service development process, a service could also invoke services from other service providers. These offerings can run the whole gamut of outsourced applications available today, from e-mail sold by the mailbox (in quantities from one to several hundred thousand), to services like payroll, healthcare settlement services, CRM and ERP.

7 CONCLUSIONS

"Outside-in" SOA is still at its early stage of definition. However, it promises to extend the benefits of SOA to small and large enterprises alike through ecosystem supported interoperable services. SOA in turn will impose requirements of agility on the physical data center infrastructure with will change radically the way data centers are deployed and operated today.

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