

Editorial: Big Services Era: Global Trends of Cloud Computing and Big Data

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NOWADAYS, the hot topics on novel information technology include cloud computing, social networking, mobile Internet, and big data. The major goal of cloud computing is to share resources, which consist of infrastructure, platform, software, and business process. When those resources are provisioned as services, the value of cloud computing is realized. From a cloud offering perspective, Infrastructure As A Service (IaaS), Platform As A Service (PaaS), Software As A Service (SaaS), and Business Process As A Service (BPaaS) are typical service delivery types in cloud computing. "Servicelization" is the way of defining interfaces for resource sharing. Servicelization is also the way of offering social networking services, big data analytics, and mobile Internet services. In short, "everything as a service" is creating a Big Services era due to the foundational architecture (i.e., Service-Oriented Architecture) of services computing.

Those new technologies are creating differentiating business models, application innovations, and computing patterns. In order to illustrate the global trends of cloud computing and associated technologies, I would like to use enterprise architecture as a base to articulate the innovations created and consumed by enterprises. The most popular enterprise architecture standard is The Open Group Architectural Framework (TOGAF), which covers business architecture, application architecture, data architecture, and technology architecture.

From a business architecture perspective, cloud computing is creating brand new business models. For example, Instagram leverages cloud computing as a platform to offer photo sharing services integrated with popular social networking sites. After 19 months in operation, it only had 12 employees when it was acquired by Facebook at \$1.1 billion. EdX online education service is also built on Amazon's cloud computing platform to offer courses for students worldwide. A course has been offered to more than 120,000 students in a virtual classroom over the Internet. As for innovations in application architectures, cloud computing speeds up the servicelization of application software. Software has been componentized for reuse and recomposition for creating value-added services. Building APIs-based platforms has become a mainstream approach to focus on extensibility and scalability. Domain-specific applications such as human resource management and customer relationship management have dominated the SaaS market. Social networking aspects have been integrated as core enablers of enterprise applications to facilitate effective communications. Large application software vendors are transforming their packaged applications to cloud-based, social-network-enabled, analytics-intensive, and mobile-reachable SaaS offerings.

In terms of innovations in data architecture, cloud computing is driven by killer applications. The more applications there are, the more data there is. Moreover, big data needs more computing power and storage provided by cloud computing platforms. Data architecture needs to be redesigned to elaborate on massive domain and industry-specific data. Hadoop type of infrastructure has been offered as a service for researchers, data analysts, and developers to process big data in a cost-effective manner. In addition, cloud database is another direction to leverage data and files as a base and offer identity management and fine-grained APIs. New applications can be built on those APIs and run on mobile devices, web browsers, and other programming tools and environments.

The next innovations are around technology architecture. There are three major trends. The first innovation trend is to integrate hardware, software, and service into one box. This type of innovation can hide the complexity of the enterprises' IT systems and make them cloud ready. Most importantly, the services aspect of the box can capture best practices of operations in various scenarios. Meanwhile, the box provides a development toolkit to enable developers to import knowledge and experiences into the integrated black box. The second innovation trend is to provide open cloud platforms by leading Internet service providers. Application engines, big data analyzing algorithms, cloud storage APIs, and prediction and translation APIs are gradually becoming important tools and assets for open innovations. The third technology architecture innovation comes from mobile Internet and social networking services. Technology architecture is used to realize application architecture and data architecture, which further supports business architecture.

The last innovation is around architecture governance for cloud computing. It includes the standardization of individual architectural building blocks within business architecture, application architecture, data architecture, and technology architecture. For each of the four architectures, we need to create unified interfaces and protocols to exchange information. The semantics of the exchanged information and data structure also needs to be standardized to build an interoperable ecosystem for cloud computing. For example, the Distributed Management Task Force (DMTF)

is currently working on standards in such areas as cloud management, cloud auditing data federation, software license management, system virtualization, and partitioning and clustering. The Open Group has published its SOA Reference Architecture Standard and is currently working on a Cloud Computing Reference Architecture Standard. It is noted that open source stacks of cloud computing could potentially become default standards once they are widely used in various solutions.

I hope you have enjoyed this exciting year of innovations in cloud computing. As a natural next step, big data analytics will be widely leveraged in more and more cloud applications for exploring deep business insights. Of course, mobile Internet and social networking services will generate much bigger data in real-time and virtual communities. As we know, the field of services computing covers all science and technologies of creating and leveraging the latest computing to design, create, deploy, and deliver services. Let's work together to grow our services computing community and welcome the Big Services era!

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