

# An E-Retailing System Architecture Based on Cloud Computing

Chanchai Supaartagorn

**Abstract**—E-retailing is the sale of goods online that takes place over the Internet. The Internet has shrunk the entire World. World e-retailing is growing at an exponential rate in the Americas, Europe and Asia. However, e-retailing costs require expensive investment, such as hardware, software, and security systems. Cloud computing technology is internet-based computing for the management and delivery of applications and services. Cloud-based e-retailing application models allow enterprises to lower their costs with their effective implementation of e-retailing activities. In this paper, we describe the concept of cloud computing and present the architecture of cloud computing, combining the features of e-retailing. In addition, we propose a strategy for implementing cloud computing with e-retailing. Finally, we explain the benefits from the architecture.

**Keywords**—Architecture, cloud computing, e-retailing, internet-based.

## I. INTRODUCTION

ELECTRONIC retailing or E-retailing (also called “Online retailing”, “Online shopping”) is the sale of goods and services through electronic media such as the Internet. In this business model, retailers sell goods and services directly to the customers bypassing any intermediaries in a supply chain. E-retailing is not limited to retail store hours and place for selling. The customers can buy goods or services at anytime and anywhere over the Internet. E-retailing has witnessed strong growth in the last decade. In 2014, online retail sales in Europe are projected to reach £131.18 billion, accounting for 18.1% of total European retail sales [1]. In addition, online retail sales in the US are expected to increase by 11% to \$291 billion this year [2].

E-retailing costs require expensive investment. Enterprises developing the system need to invest resources in hardware, software, and security systems established by the service providers with a certain expertise in running and maintenance [3]-[5]. As a business expands its scale, the required resources will increase beyond the capacity of the enterprise. Cloud computing is becoming a new service model and an attractive technology due to its dynamics scalability and effective its usage of resources. Cloud computing technology allows enterprises to operate with less investment. The technology focuses on delivering services with a given pricing model. The model is a strategy called “pay-per-use”. It makes it possible to access online storage, to rent virtual hardware, or

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to use development platforms and pay only for their effective usage, with no, or minimal, upfront costs. In addition, the service also includes expert staff to run and maintain it continuously.

In this research, we propose an e-retailing system architecture that utilizes cloud computing in the online retailing process and copes with the problems of e-retailing. Moreover, the paper describes the concept and characteristics of cloud computing, and special analysis of the main aspects in improving e-retailing by cloud computing.

The rest of this paper is organized as follows: Section II describes an overview of cloud computing. Section III presents an e-retailing system architecture based on cloud computing. Section IV proposes a strategy for E-retailing system development based on cloud computing. Section V explains the potential benefits of the architecture. Section VI draws the conclusion and proposal for future research.

## II. BASIC CONCEPT OF CLOUD COMPUTING

### A. Definition of Cloud Computing

Cloud computing is a new technology for managing information technology resources. There are various definitions of cloud computing. Here, we try to clarify what cloud computing is. The first definition was given by UC Berkeley Reliable Adaptive Distributed Systems Laboratory as “Cloud computing refers to both the application delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services” [6]. Reference [7] Forrester Research defined cloud computing as “A pool of abstracted, highly scalable, and managed infrastructure capable of hosting end-customer applications and billed by consumption.” The definition that received industry-wide acceptance was composed by the National Institute of Standards and Technology (NIST) as “Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., network, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” [8].

From the above definitions, we can define cloud computing as “Cloud computing is a shared pool of computing, storage, application and services. Users access cloud computing through the Internet using networked client devices, such as desktop computers, laptops, tablets and smartphones. The service cost is based solely on the demand and users pay money according its usage.” Fig. 1 shows the overview of cloud computing.

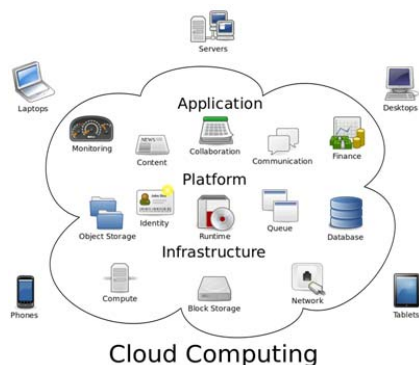


Fig. 1 The overview of cloud computing [9]

### B. Service Models of Cloud Computing

Cloud services can be divided into three service models, which are: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). The details are explained below.

- Infrastructure as a Service provides a set of computing resources, including virtualized servers, network connectivity, operating systems and storage. Infrastructure providers are owners that manage and maintain the services. They deliver customizable infrastructure on demand. In addition, users will pay only for the used resources, eliminating capital expense; thus, the budget will be better controlled, which is the most difficult task for small retail stores and businesses. These businesses will no longer need to be worried about resource limitations.
- Platform as a Service is a virtual platform over the Internet. PaaS delivery service model as a "ready-to-use" environment that provides a set of tools used to support the entire delivery lifecycle of customer applications. Cloud consumers can use the ready-made environments, develop and deploy the applications specifically for the cloud, by using the application programming interface (API) without having to worry about the platform.
- Software as a Service provides applications that are accessible anytime and anywhere through the Internet on demand. End users do not need to be concerned about software program installation on the computer. The software program comes as a shared cloud service via web browser.

### C. Deployment Models

Cloud deployment model can be divided into four different models, which are: Public cloud, Community cloud, and Private cloud and Hybrid cloud. Each cloud deployment model is distinguished by ownership, size, and access.

- Public cloud is a publicly accessible cloud environment owned by a third party on the cloud servers, storage systems, and networks. Retail stores may rent use of the services that cloud providers prepare through the Internet. A public cloud can offer any kind of service. For example, Amazon Ec2 is a public cloud providing IaaS, Google AppEngine is a public cloud providing an

application development PaaS, and Salesforce.com is a public cloud providing SaaS [10].

- Community cloud is limited for accessibility to a specific community. The infrastructure is shared between several organizations with common concerns, such as their mission, security, policy, and compliance considerations. The community cloud can be jointly owned by the organizations or by a third party. Organizations outside the community are not granted access unless allowed by the community. With this deployment model, a retail store may be a host and managed to make some common resources internally.
- Private cloud is cloud infrastructure owned by a single organization. Cloud members have full access data, services and applications. A retail store can assure to security and quality of service, such as, data integrity, authentication, authorization, and payment system.
- Hybrid cloud is combination of two or more different cloud deployment models. Retail stores may combine multiple public cloud models and private cloud models, which are based on the requirements of budget, policy, and so on.

### III. CLOUD BASED E-RETAILING ARCHITECTURE

Before demonstrating the e-retailing architecture based on cloud computing, the system architecture of an online retailing is given. Fig. 2 shows the high-level system architecture of an online retailing.

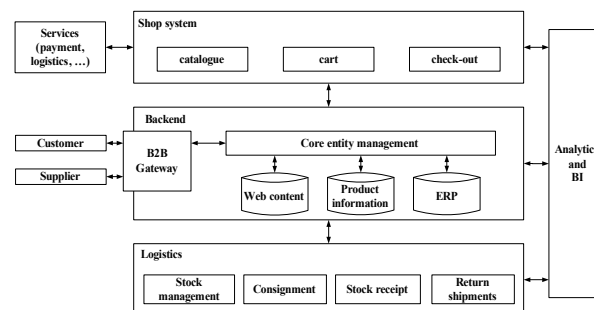


Fig. 2 A high-level system architecture of an online retailing [11]

An e-retailing system's architecture consists of three layers: Logistics layer, Backend layer, and Shop system layer. Firstly, the logistic is the management of the flow of goods, services, and related information from point of origin to point of consumption. Logistic activity is associated with stock management, consignment, stock receipt, and return shipments. Secondly, the backend is where the administrator or retailer can manage web content, catalogue data, keep track of customers, manage enterprise resource planning, and much more. In this layer, customers and suppliers are taking part in the process. Lastly, the shop system or frontend is where customer can process the ordering. The processing begins with the viewing of the product catalogue. Then, the customer chooses a product to cart and checks out the order. This layer includes processing of payment service and logistic service. In

addition, retailers may have to gather, store, analyze, and provide access to data to help enterprise users make better business decisions.

An E-retailing system based on cloud computing is a migration from the traditional e-retailing network to cloud e-retailing, which is a future e-retailing infrastructure. The proposed e-retailing cloud architecture can be divided into three layers: Infrastructure layer, Middleware layer, and Application layer. E-retailing cloud architecture is shown in Fig. 3.

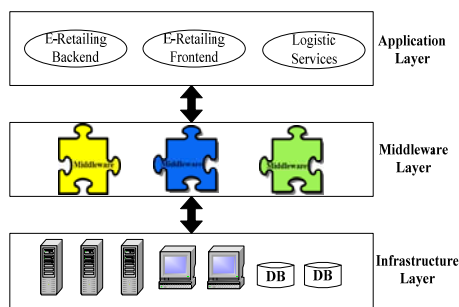


Fig. 3 E-retailing Cloud Architecture

The Infrastructure Layer is located in the lowest level of cloud architecture. The layer is the dynamic and scalable resource pool of an e-retailing system, which is implemented by using a datacenter. Hardware and software virtualization, network, and storage are provided to ensure the stability and reliability of the infrastructure.

The Middleware Layer provides a unified interface for software developers. To alleviate a variety of software resources, they have developed the applications for the cloud by using the standard interface and application program interface (API). Moreover, retailing resources and retailing services can also be part of the layer.

The Application Layer consists of e-retailing services. E-retailing backend provides a software-based for product management, customer management, and enterprise resources planning. E-retailing frontend provides a software-based for a payment system and an ordering system. The most common mechanisms are an electronic catalog; a search engine that helps the customer find products in the catalog; an electronic cart for holding items until checkout; a payment gateway where payment arrangements can be made; and customer services, which include product and warranty information. Logistic service provides a software-based for stock management and shipping arrangements. It also provides functions and interaction interfaces for customers or other programs. Software-based services are obtained via the Internet that user access by a web browser.

#### IV. STRATEGY FOR IMPLEMENTING CLOUD ENVIRONMENT IN E-RETAILING SYSTEM

Moving towards; a long-term strategic of cloud computing needs a well-defined strategy. We propose five basic phases that retailers can implement to define their cloud computing strategy. The strategy for an e-retailing system development

life cycle is shown in Fig. 4.

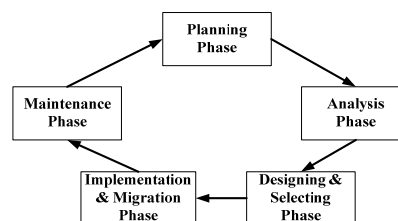


Fig. 4 Strategy for E-retailing through Cloud Computing

- **Planning Phase:** Retailer requirements are gathered in this phase. This phase is the main focus for the store owner, staff, customer, frontend department, backend department, shipping department and so on. This step consists of developing the knowledge about cloud computing. It is necessary to understand the concepts of cloud its benefits, the risks, and best practices. In addition, retailer needs to consider the project feasibility, which is economic and technical feasibility. The SWOT analysis and return on investment analysis is included in this phase.
- **Analysis Phase:** This phase start with the analysis of the categories of users who interact with the existing system. The IT staff can begin to make plans to acquire hardware and software from the perspective of the cloud. In addition, the IT staff must decide the services that need migration and the services that need to be kept with the retailer. Finally, benchmarks for security are set up by comparing the internal practices of the retailer compared with the industry standards.
- **Designing and Selecting Phase:** In this phase IT staff must design all aspects of the system, from hardware and software virtualization, network, storage, retailing resources and retailing services. The IT staff must then decide to select the cloud provider based on benchmarks that are set up in the second phase. Integration of the new system with the existing system is also included in this phase. Finally, retailers make the contract with the cloud provider that meets user requirements.
- **Implementation and Migration Phase:** All layers of e-retailing cloud architecture are implemented in this phase. Then, the IT staff migrate the data and applications to the cloud environment. After the system is implemented it is monitored and controlled against the requirements to ensure successful migration. Finally, the IT department provides adequate training to all users for a successful migration.
- **Maintenance Phase:** Maintenance is necessary to eliminate any errors in the working system during its working life and needs to be solved from time to time. It's quite usual that the retailers will then go back to analysis once it has evaluated an e-retailing cloud system.

## V. THE BENEFITS OF USING CLOUD COMPUTING FOR E-RETAILING SYSTEM

The benefits derived from the proposed architecture include, but are not limited to, the following:

- **Reduced investment cost:** Public cloud providers provide the infrastructure for information technology that is made available to retailers via attractively priced leasing packages. In addition, retailers can save the costs and time of employing professional staff to manage and maintain the system. Cloud computing service providers are responsible for updating software and providing technical support.
- **Increased scalability:** Retailers can scale IT resources to accommodate processing fluctuations and unpredictable periods of peak load automatically or manually. Therefore, retailers can reduce costs by using the power of the scalability of the cloud.
- **Increased reliability:** The reliability of an e-retailing system is an important foundation for customer confidence. Cloud computing can automatically detect the runtime failures and make IT resources highly available at all times. Furthermore, the functional recovery of the system at a glance happens a system failure occurs. This increases the reliability of the system for the customers.
- **Increased security:** One of the major challenges of an e-retailing system is the security issue, which includes confidentiality, integrity, authentication, non-repudiation and authorization. Security is therefore a major element in any cloud computing infrastructure because it is essential to ensure that only authorized access is permitted and secure behavior is expected [12]. Cloud computing can ensure the user's data security using the concept of firewalls, virtual private networks and by implementing other security policies with in its own periphery or perimeter [13].
- **Increased auditing:** Auditing is the process of collecting, investigating and evaluating evidence to determine whether a computer system safeguards assets, maintains data integrity and achieves its organizational goals effectively. There are many threats in an e-retailing system, such as, unauthorized access, theft and fraud. These threats can be controlled by using the information technology services and by responsibility of cloud providers. Cloud computing has a log management system that allows cloud consumers to monitor, debug and troubleshoot their business processes. This can help with applications that are made available and reliable.
- **Increased disaster protection:** Disaster is an event that makes the continuation of normal functions impossible, when customers are shopping and ordering a product on the Internet. Servers process information and store large amounts of data. What do you when your information technology stops working? Disaster recovery is necessary in e-retailing system services. Disaster recovery programs in clouds provide more options than traditional disaster recovery models for organizations to restore information very quickly and effectively [14].

## VI. CONCLUSIONS AND FUTURE RESEARCH

Cloud computing is a style of computing for managing and delivering on-demand computing resources, applications and services over the Internet on a pay-per-use basis. Cloud computing platforms are growing in popularity in every field, such as e-commerce, e-retailing, e-learning, e-government, etc. Cloud computing provides enterprise cost-effectiveness. Cloud consumers can access the services at remotely via the Internet. With the study has been done in this paper, an e-retailing system, based on cloud computing, can be clearly understood. The proposed E-retailing cloud architecture can be divided into three layers: Infrastructure layer, Middleware layer, and Application layer. There are many benefits of using cloud computing for an e-retailing system, such as, reduced investment cost, increased scalability, increased reliability, increased security, increased auditing, increased disaster protection, and so on. In addition, we propose the strategy for an e-retailing system development life cycle that provides a model for the strategic development of cloud computing.

In future research, we will conduct a study regarding the attitude, strategy and challenge of migration to the proposed architecture based on clouds.

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