Web Services and Distributed Computing Technology for Service Oriented Architecture

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Abstract-In the contemporary era, distributed computing technologies prevail in the real world. They are essential different sectors like banking, telecommunications and insurance to mention few. They are based on Service Oriented Architecture (SOA) which provides service orientation to distributed web applications. A set of related businesses are thus integrated to have maximum benefits. The complete chain of businesses need to be successful in many cases in order to achieve worthwhile success. The main focus of this paper is to provide good foundation pertaining service orientation right from the origin of computations and the evolution to the present models. The insights provided in this paper are useful to gain good understanding of technological background of service oriented applications that are realized with web services technology.

Keywords –Service Oriented Architecture (SOA), distributed computing, web services, services integration

1. INTRODUCTION

Computing has undergone many changes. It started with standalone computing. This computing was used in the time where networking was not yet invented. A computer has no connectivity with other computers or devices. After invention of networking, there was centralized computing prevailing. The reason behind this is that in case of centralized computing a host machine is used as server that will serve many dumb terminals. This phenomenon was found cheaper in the presence of costly hardware that time.

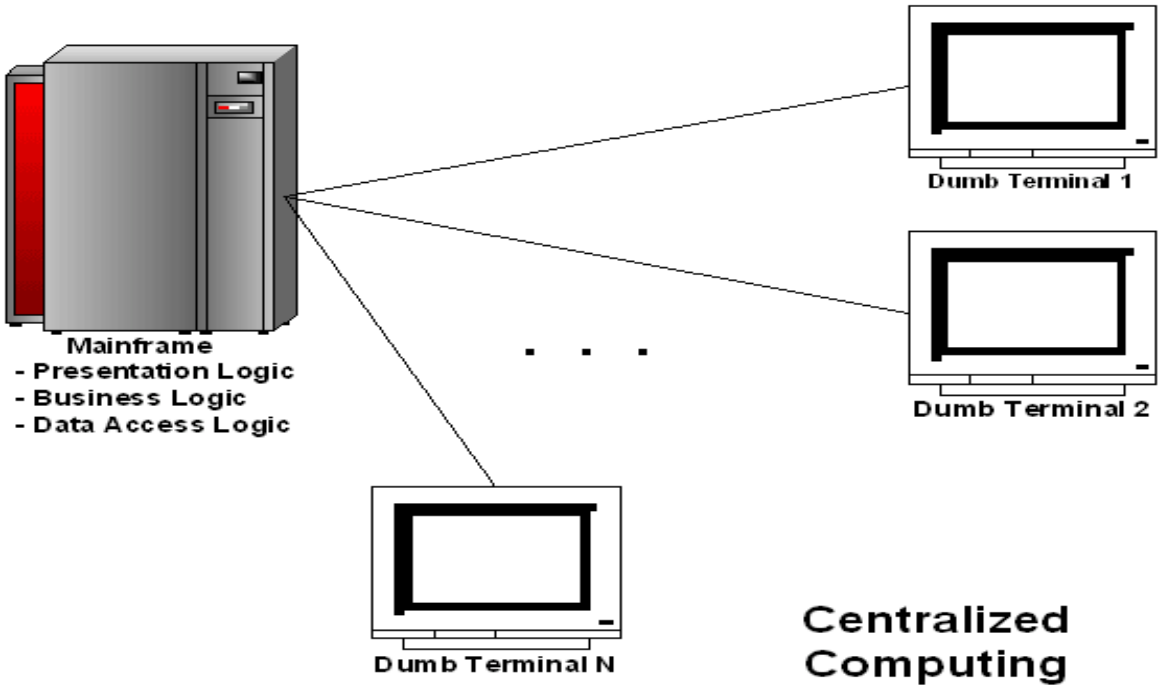

Figure 1: Centralized computing

As the name suggests, the centralized computing uses number of dumb terminals that do not have computational power. They depend on central server for storage and computations. Thus, as presented in Figure 1, the dumb terminals (without CPU of their own) were used to reduce cost. The terminals are used by different users and the service is rendered by the central server. This kind of computing was used for some years until the hardware prices came down and client server model is emerged.

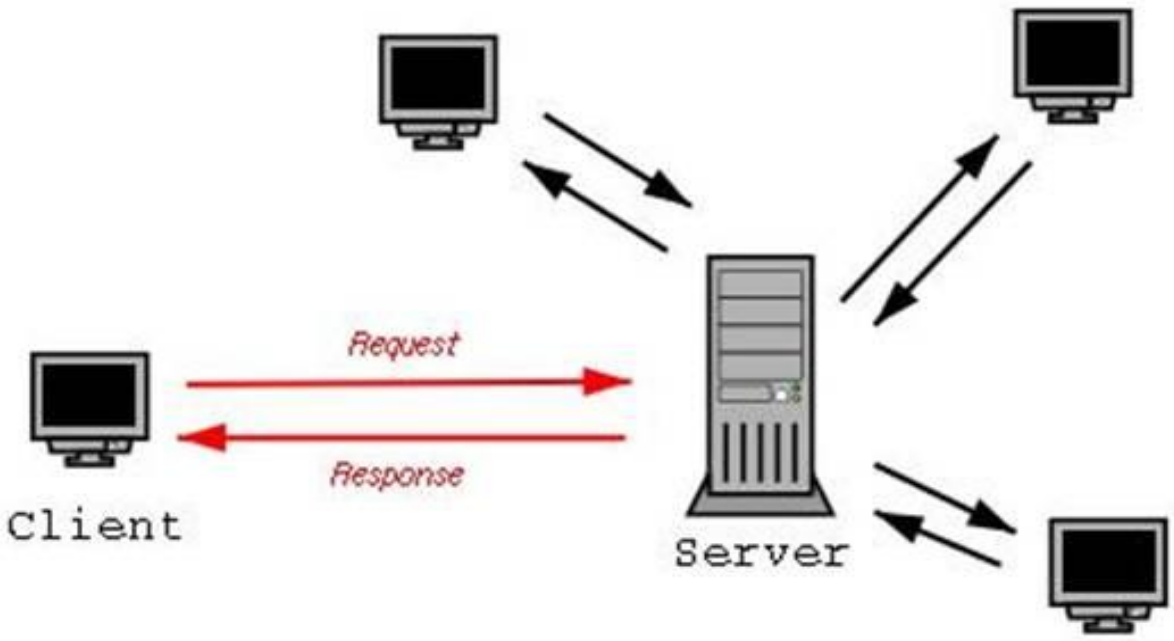

Figure 2: Shows client server computing model

As shown in Figure 2, though there is server machine to provide different services to clients, the client machines are not dumb terminals. Instead, they have their own CPU and they are known as smart terminals. They have storage and processing power. They can share burden of server. Thus this model is efficient as the client machines are highly capable and only depend on certain services like database on the server. The contributions of this paper are as follows. Different models of distributed computing including the web services usage for realizing real world SOA applications are explored with useful insights. The remainder of the paper is structured as follows. Section 2 provides related work. Section 3 presents distributed computing. Section 4 provides web services technology. Section 5 presented applications in distributed technologies and SOA. Section 5 concludes the paper and gives directions for future work.

2. RELATED WORK

This section provides review of literature related to web services and distributed computing besides SOA. There are two kinds of web services. They are known as SOAP based and RESTful web services. These two are explored by Wagh and Thool [1] with different provisions provided by the technologies. Phalke and Jadhav [2] on the other hand used a tool known as Footprint in order to test web services based applications. Sheikh [3] compared web services with the applications built based on CORBA. It is understood that CORBA can be used by different languages while web services also can be used but it is based on XML standard. Aulkemeier et al. [4] explored a SOA based architecture for e-commerce applications. Sucic et al. [5] studied device level SOA middleware that ensures the participation of different applications and devices in SOA.
Web services may have anti-patterns. Ouni et al. [6] focused on different anti-patterns that may arise in the web services applications. Valls et al. [7] focused on reconfiguration of SOA systems at run time in order to adapt to runtime situations. Abolfazli et al. [8] proposed a Market Oriented Architecture (MOA) for mobile cloud computing. It was based on SOA. In [9] explored component based software building and testing with middleware platform and reconfiguration. Saleh et al. [10] threw light on GIS problems in the real world and the feasibility of using SOA. Awadh et al. [11] on the other hand focused on governance based SOA in cloud computing context. An educational SOA architecture is proposed in [12] while Web of Things (WoT) is explored with embedded services in [13]. SOA based model driven development is studied in [4] while gaming is the case study based on SOA used in [15]. Some latest research found in [16], [17], [18] and [19] reinforce the need for web services for developing distributed applications and testing them efficiently.

3. DISTRIBUTED COMPUTING MODEL

This is the kind of computing where many server machines are involved in processing. They servers may be located in different geographical locations. However, they are involved in the distributed computing network that servers greatly to enterprise applications. This kind of computing provides many advantages such as location transparency, load balancing, availability, scalability and so on. These advantages are essential in the contemporary enterprise applications like Google, Facebook etc. This technology enables processing of large number of requests in short span of time and it also exploits parallel processing of high end server machines.

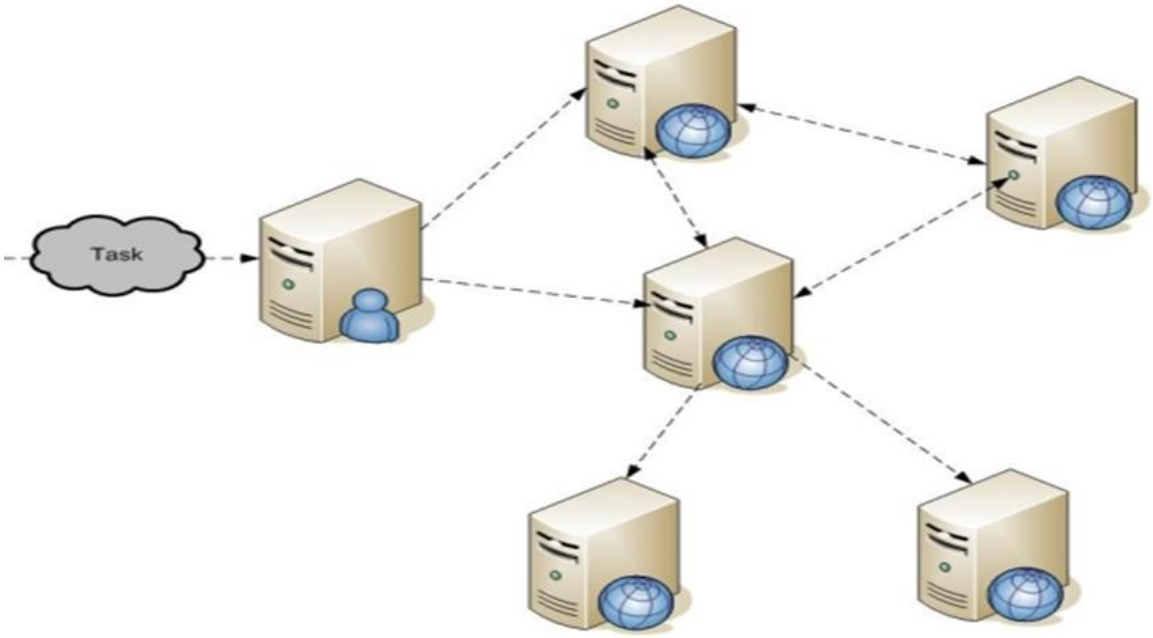

Figure 3: Shows distributed computing model

As presented in Figure 3, the distributed computing model is completely server side phenomenon. It has role to play in serving client requests. It ensures that the servers are efficient in processing requests and load can be balanced. It is also fault tolerant in nature. When any server goes down, other servers will be capable of completing task. There are many distributed computing technologies available. For instance, Remote Method Invocation (RMI) is one of the examples that supports distributed computing. In the same fashion, Java programming platform provides Enterprise Java Beans (EJB) technology and Java Messaging Service (JMS) as distributed technologies. There is distributed technology known as Common Object Request Broker Architecture (CORBA) which can be used by any language. Microsoft .NET platform provides distributed technologies like Windows Communication Foundation (WCF) and Distributed Component Object Model (DCOM).

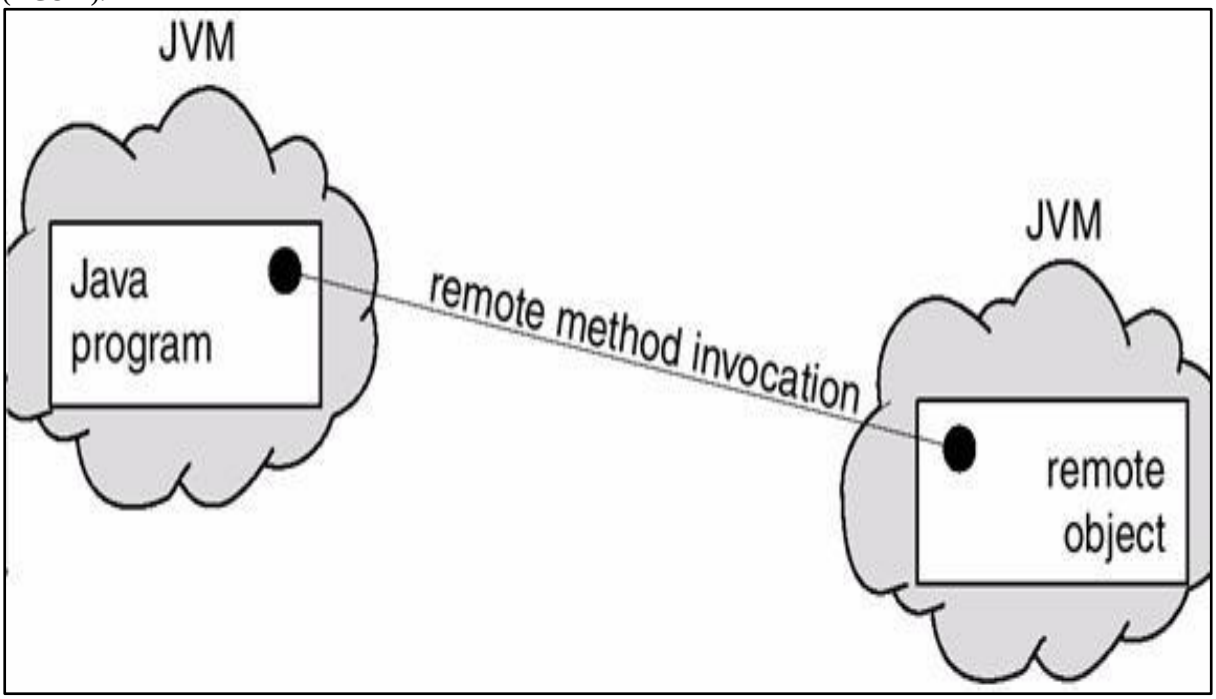

Figure 4:JVM based distributed computing technology supported by Java language
As presented in Figure 4, the two JVMs running in different machines can have objects that call methods from the objects of other JVM. Both JVMs may be running in different systems geographically located. This kind of computing became very essential in the cotemporary era. Applications like e-Commerce and e-Governance are best examples where the potential of distributed computing is realized. Web services is another technology that supports distributed computing among heterogeneous systems. Applications developed in different platforms can be integrated seamlessly with web services technology.

4. WEB SERVICES

As explored in [6], [8], [10] and [14 web services is the technology that is widely used to realize distributed applications. It is used in different domains like education, healthcare, banking, telecommunications and so on. It is the technology based on XML which helps in seamless integration among applications developed in different platforms. Web services technology also enables development of software based components to leverage component technology. This technology uses different standards like Simple Object Access Protocol (SOAP), Web Service Description Language (WSDL), and Universal Description, Discovery, and Integration (UDDI). The SOAP is an application level protocol which is based on XML. WSDL is also an XML standard that is used for providing details of web services. UDDI is required to provide access to web services globally with standard based approach. When multiple applications are integrated, it is possible to have businesses driven by distributed applications.

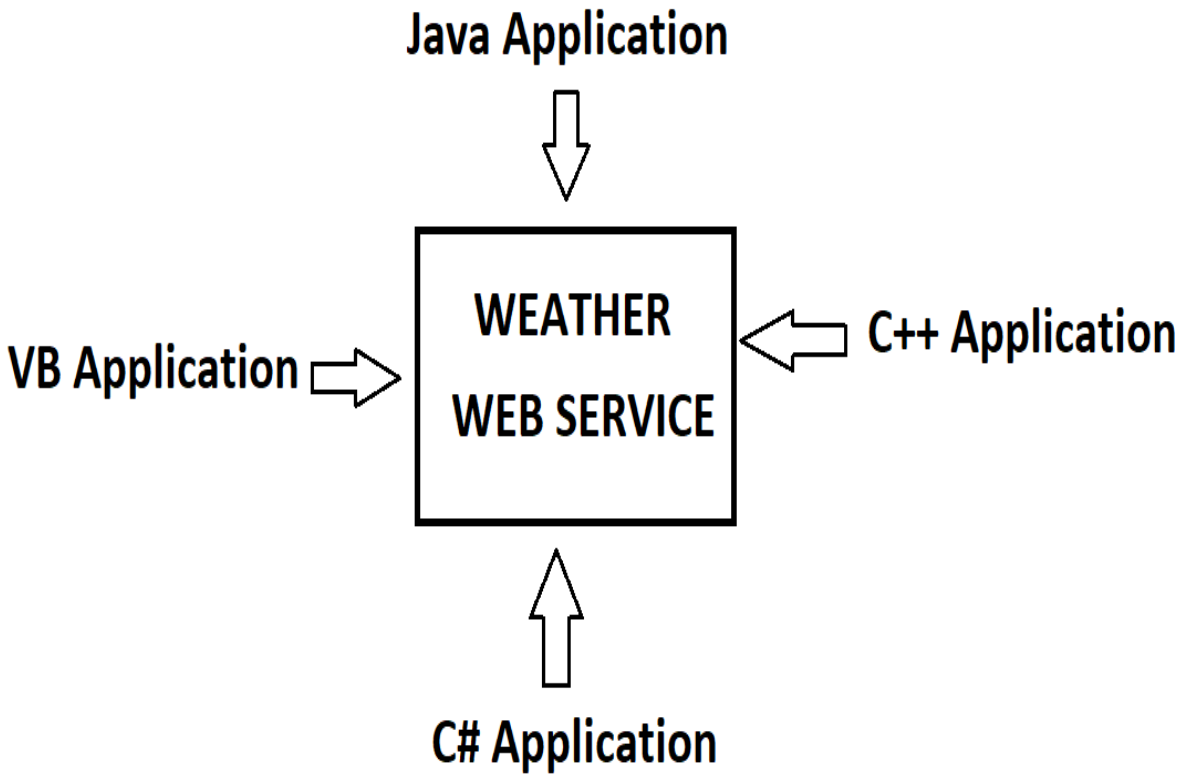

Figure 5: Shows that web service is inter-operable
As shown in Figure 5, an application developed in one language can be integrated with the services rendered by other applications. This approach promotes reusability as much as possible. A Java program (web service) can be called from C# client due to XML based interfacing and standards. The inter-operability is the crucial element in the web services technology. Thus the existing applications can be reused for integration rather than spending money again and reinventing wheel.

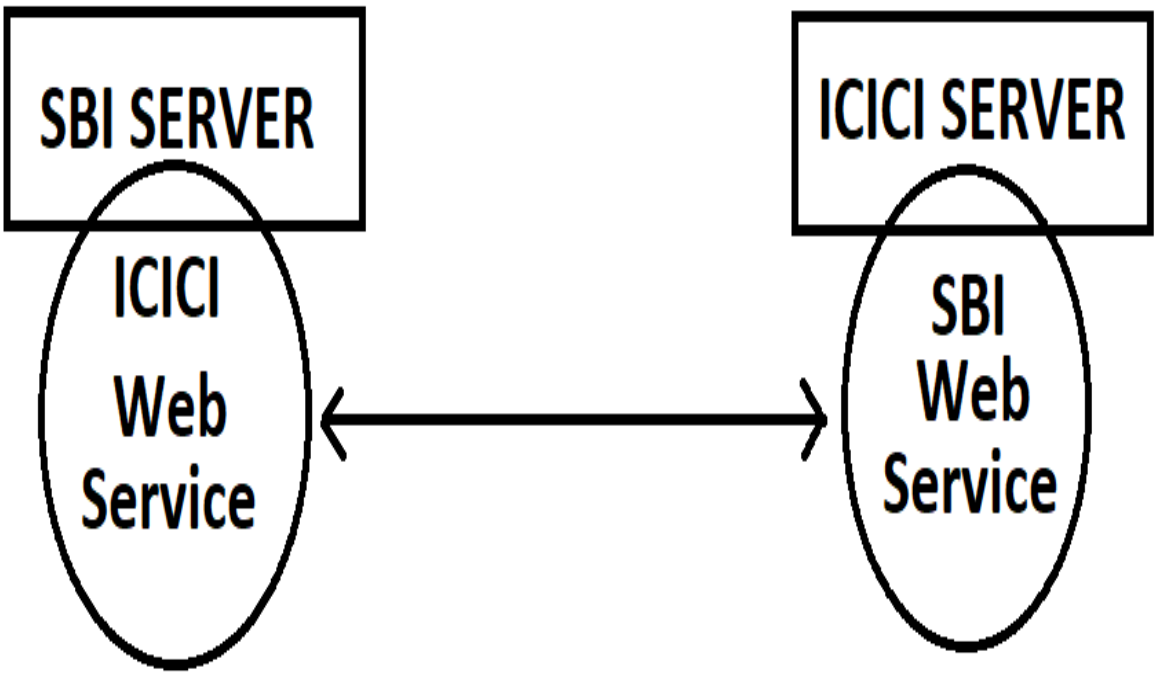

Figure 6: Integration of two remotely running web services

As presented in Figure 6, the integration of two remotely web services are illustrated. The existing applications that are heterogeneous in nature also can be integrated with web services. Two banks can be integrated with web services with inter-operability feature. The different platforms used in different banks can be integrated seamlessly with web services. The SOA is used for realising this.

5. APPLICATIONS THAT NEED SERVICE ORIENTED ARCHITECTURE

There are plenty of use cases in the real world that need SOA based computing. In this section two use cases that need SOA are presented with illustration. Those case studies are net banking and e-commerce which are widely used distributed computing based applications. Both applications need web services technology usage to have business integration. Net banking scenario now is distributed in nature. With respect to ATM based transactions, the distributed approach is illustrated in Figure 7. In this use case, customers of different banks look transactions with ATM as service and they need not worry about which banks ATM they are using.

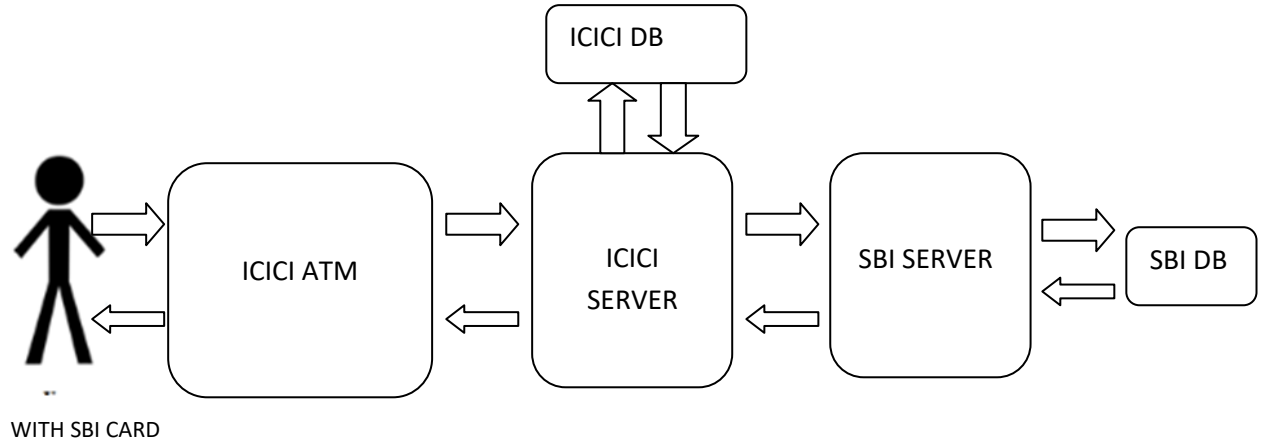

Figure 7:SOA illustration in banking domain

The customers of one bank are able to withdraw money from other bank's ATM. This phenomenon is best example for SOA and distributed computing. There is interaction among different servers in order to complete a single transaction. The technology behind this is important here. It is truly distributed computing and realized with web services. Therefore, web service defined by one bank application can be involved by other bank application. This phenomenon enables services integration irrespective of the platforms in which applications are built. The interaction between ICICI server and SBI server indicated distributed computing. It is essential as the customer is using the SBI card in ICICI bank ATM.

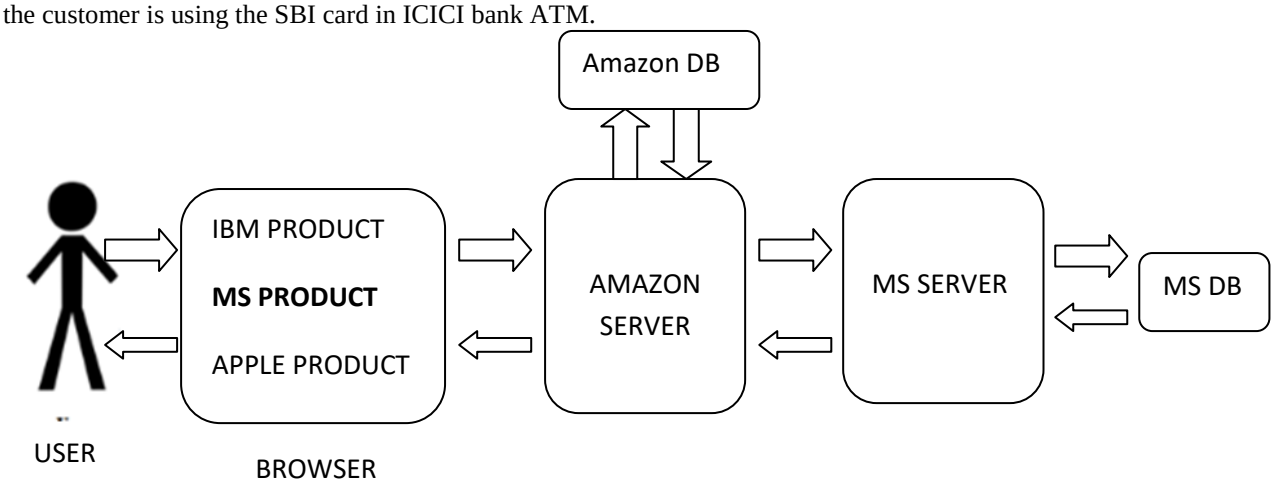

Figure 8: Illustration of e-Commerce use case

As presented in Figure 8, it is understood that the Amazon.com is a distributed application that can interact with different company's servers as part of their business contract. As Amazon is not manufacturing products (but selling) it needs to interact dynamically with other company servers from time to time to pick product details. Thus e-Commerce use case is best example where there is interaction among the servers in the background. This is actually distributed computing behind the scene which brings many advantages like fault tolerance. When customer wants particular company product, Amazon server needs to interact with that company's server and get the data live. Then the Amazon server also interacts with other server for monetary transactions. The transactions are completed based on the mutual contracts among companies. This is the typical case where SOA based applications are essential.

6. CONCLUSIONS AND FUTURE WORK

Distributed computing technology and importance of web services technology is the main focus of this paper. It throws light into different kinds of computing and it illustrates the need for web services and their usage in different real world applications. Two case studies in distributed computing such as banking and e-Commerce are illustrated to show the importance of distributed computing. As the integration of applications provide an

integrated banking or e-commerce service to customers, it is the true realization of SOA. This paper provides technological background behind SOA and web services usage to realize distributed computing applications. In future, we intend to focus on the testing of such SOA based applications.

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