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Survey on the Performance Evaluation of Electronic Marketplaces

Akingbesote, A.O.
Department of Computer Science
Adekunle Ajasin University,
P. M. B 001
Akungba Akoko. Nigeria

ABSTRACT

Market is a place set aside for buying and selling of goods or products. Service or product consumers, service providers and sometimes the brokers are the major role players in the market. The advancement in technology has allowed consumers and providers to move from traditional marketplace to Fog E-marketplace. In this research, a detailed literature review is presented on the work done in the area of performance evaluation of E-Marketplaces. An overview of the key features is given and a systematic strategy towards addressing the shortcomings is then introduced. Finally, some future research issues especially on cloud E-marketplace and Fog market are discussed

Keywords: E-marketplaces; Consumers, Waiting Time Non- Preemptive priority;

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1. INTRODUCTION

The concept of the E-Marketplace started in the early nineteen seventies where some systems were developed in the area of airline reservation systems, for example, United Airlines' Apollo or American Airlines' Sabre [1]. In this system, consumers were able to book flights through an agent which today is referred to as a broker. One major issue was the accessibility to the system which required a specialised expert broker. Another early example was that of J.C. Penney's Telaction Home-shopping System (see in [2]). This was an electronic home-shopping system that allowed consumers to shop via a cable television channel and a push-button phone. These E-Marketplaces had major drawbacks, among which were the lack of competiveness and the inability to create an air of excitement [1]. From these humble beginnings came the evolution of the E-Marketplace that now allows organisations to open their shops on the Internet and also enables millions of consumers to participate in the global online Marketplaces.

Several E- Marketplace definitions have been suggested by various authors as shown in Table 1.

Table 1: Cloud E-Marketplaces: Some Definitions

Author/Reference	Year	Definition
Malone, Yates, and Benjamin [2] [2][2][2][2][2][2]	1989	Networks that let customers compare and order offerings from competing suppliers.
Bailey & Bakos [3]	1991	A market system that allows buyers and sellers to exchange information about market prices and product offerings, thus representing an investment in multilateral information sharing.
Archer and Gebauer [4]	2000	The E-Marketplace is a virtual Marketplace where buyers and suppliers meet to exchange information about product and service offers, and to negotiate and carry out business transactions.
Russ [5]	2001	A Web-based information system, where multiple suppliers and multiple buyers can undertake business transactions via the Internet.

All the definitions in Table 1 have provided the researcher with either the functions or characteristics of E-Marketplaces. For the remainder of this thesis, E-Marketplace is defined as a virtualised global network market that allows the exchange of digital information, sometimes through a broker, for the purpose of conducting and delivering effective business services.
The organisation of this paper is as follows. Section II discusses the evolution of E-Marketplaces. In section III, the state of the art in cloud E-marketplaces is discussed. Section IV discusses the cloud challenges. The issue of Fog E-Marketplaces is discussed in section V. The paper ends with the conclusion in section VI.

1.1 Evolution of E-Marketplaces

The idea of the E-Marketplace did not just come from a vacuum but originated from the Traditional Marketplaces. The Traditional Marketplaces dealt primarily with goods produced or distributed personally by the merchants themselves and were not adaptable to modern mass production and distribution systems [1], [6]. The removal of trade barriers, Industrialization in most parts of the world, the emergence of global markets and the use of Information and Communication Technology (ICT) changed the role of Traditional markets from its dominant position to supplementary as E-Marketplaces come into the main stream.

E-Marketplaces facilitate trading transactions for buyers and sellers through the use of electronic means [7]. Although the idea of E-Marketplaces started in early nineteen seventies, the conceptualisation of this idea evolved in the mid-1940s when Selevision was the E-Market system used in Florida to remote E-Market citrus fruits [8] [7]. But in [9], the impact of the E-Market in improving E-Marketplace transactions started with the initiation of computer-based pilot projects in the 1970s. The next sub sections trace the evolution of Marketplaces, starting with the Traditional Marketplaces and various other E-Marketplace concepts such as the Internet market, Web Service, Grid and Cloud E-Marketplaces as shown in Figure 1.

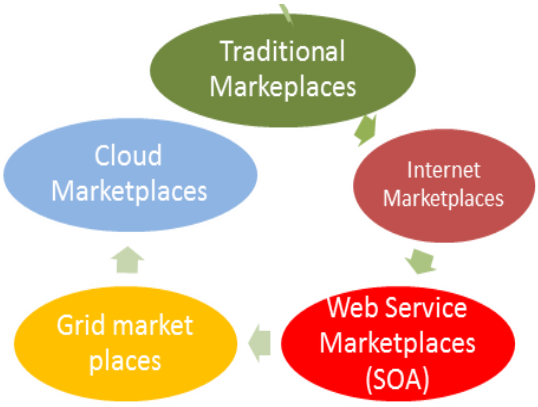

Fig. 1: Evolution of Marketplaces

A. ***Traditional Marketplaces***

Traditional Marketplaces offer places for wholesalers and retailers to co-operate and also offer the consumers the benefit of where to go directly for a given item. These markets allow the buying and selling of goods with both the buyers and the consumers having a direct link. However, a broker or intermediary will sometimes be involved to mediate in price bargaining between the buyer and the consumer, but such an intermediary has to be trusted by both the buyers and the sellers.

These markets have some advantages in that: `

i. They require no special medium before it they can operate. For example, rather than customers going online for a business transaction, such business or service could be brought to potential customers with the use of some Traditional methods.
ii. They give room for price negotiation and bargaining.
iii. In addition, both literates and illiterates can participate in the market.

However, some major limitations of the Traditional Marketplace are:

i. Lack of a good Traditional marketing strategy.
ii. Inability to globalise the market.
iii. Slow uptake of cashless policy.
iv. High risk of products transfer/movement.

The emergence of the Traditional E-Marketplace came about as a result of some of these limitations. The Traditional E-Marketplace is a Web portal where buyers and suppliers come together to explore new business opportunities [10]. These markets allow the buying and selling of goods, with both the buyers and the consumers having direct link. This market uses digital means to brand products or logos. The idea promoted by the Digital markets strategy [11] toward the Traditional E-Marketplace is similar to people finding or getting a particular business through a referral or a network and eventually building a rapport with them. In [10], the author attributed the challenge of Traditional E-Marketplace to that of supporting only a single business model, which is ineffective in dealing with all but the simplest kinds of exchanges. As a result, the Traditional concept of an E-Marketplace having broker mediating between buyer and supplier is not as suitable for every kind of product transactions as was initially expected to overcome this barrier, the concept of the Internet Marketplace was introduced.

B. ***Internet Marketplace***

In [12], electronic Marketplaces is defined as the notion of paperless exchanges of business information using Electronic Data Interchange (EDI), electronic mail (E-mail), electronic bulletin boards, Electronic Funds Transfer (EFT) and other similar technologies. The Internet E-Marketplace allows the full range of using internet technology to fulfill its goal. This goal is to attract the biggest possible number of consumers and providers who will become members of that Internet E-Marketplace. This is done by matching consumers' needs against providers' selling offers [13] [3].

In [14][15], the authors identify three main elements in the structure of an E-Marketplace; these are the owner or the operator of the market place, the type of transaction being offered and the resources being offered to the consumers. Three main types of Internet E-Marketplaces are identified in [14] [10] [16]: the seller-driven market, the buyer-driven market and the open market. In [10], the author defined the seller-driven market as an E-Marketplace promoted by a consortium of suppliers who place offers within the same industry or service sector. The buyer-driven market is maintained by a group of buyers who aggregate purchase needs so as to achieve advantageous conditions when buying from suppliers and the open market is an E-Marketplace owned by an independent third-party.

In addition to these, in [17], the author identifies the fourth one as the technology driven market. This is similar to the independent market but the motive behind the set up may be different from that of Independent market. A typical diagrammatical structure of these is shown in Fig. 2 with detailed explanation given in [10]. The supplier and buyer are similar to the researcher's consumer and producer in this paper.

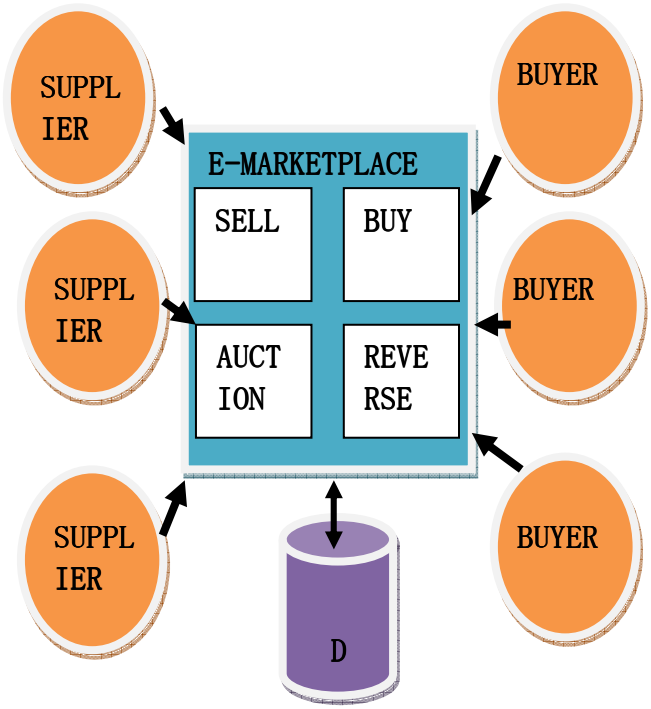

Fig. 1: Architecture of a Typical Traditional E-Marketplace

Source: IJCM 17(3) 2004

Apart from the benefits offered by Traditional Marketplaces, E-Marketplaces generally have some characteristics that make them better than Traditional Marketplaces. Some of these characteristics are richness, cost effectiveness and provisioning of extra value [18]. Also, E-Marketplaces expand the choices available to consumers and give providers access to new consumers, thereby reducing the transaction costs for all participants [19]. Internet E-Marketplaces differ from Traditional Marketplaces in that the business transactions occur in communication networks without the necessity of the clients and the producers seeing each other. This virtual, dynamic and real time platform allows the consumers or the clients and the producers to communicate through the use of Internet technologies. Hence, the Internet E-Marketplaces are regarded as one important part of E-business solutions in the process of enabling supply chain integration to maintain business value and growing competitive necessity [20]. The idea of this paradigm is to reshape the business process by making available various types of products to consumers. It is a paradigm for building distributed computing applications over the Internet [21]. This idea was not fully exploited until the emergence of Service Oriented Architecture (SOA).

The Second evolution of the E-Marketplace is the Web service Marketplaces. This came in as result of the emergence of Service Oriented Architecture (SOA), which is the paradigm of organisational models of systems, aimed at solving large business problems using existing services. This evolution is an update to object-oriented computing.

C. ***Web Services E-Marketplaces***

In [22], Web services are defined as self-contained, self-describing, loosely-coupled computational components designed to support machine interaction via a distributed or centralised network. The web services E-Marketplace is a community that allows producers to advertise their products on the web for the consumer to use. In other words, it is a local community of service providers and service consumers organised in vertical markets and gathered around portals [23]. A number of scholars have worked on specific features of web service Marketplaces, including web service discovery [24], [25], selection [22], [26], [27] [28] [29] 69] [30] [31] [32] [33] [34] and composition[35] [36] [21]. The paper is interested in service selection and critical review on others is left as future work.

A lot of work has been done on the selection of optimal web service. In [29] the authors proposed a new analysis of service selection and evaluated the proposed algorithm. This was done by designing a mixed linear integer program for optimising service compositions based on service response time and energy consumption. In [37], the author uses the QoS-based service selection approach to compose web applications by discovering feasible web services based on functionalities and QoS criteria of user requirements. The results show that the algorithm performs well with increase in system availability and reliability. The use Particle Swam Optimisation (PSO) method was adopted to select the optimal service in [28] . This was done by defining the position, and the velocity equation. While this achieved a considerable solution the issue global convergent was a challenge. This was further improved by using the Niche Particle Swarm Optimisation (NPSO) algorithm that integrates the Simulated Annealing (SA) and niche technique into the Particle Swarm Optimisation algorithm [38].

In [30] the authors proposed a genetic based service selection algorithm where the developed algorithm is compared with the heuristic algorithm based on both time complexity and the non-functional characteristics called reliability rate. The significant contribution to optimal service selection in [73] was made by comparing the two service selection algorithms i.e, the GA and the PSO using response time as the metric with multiple users [31]. The end results indicate that PSO performs better over GA for single and multi user service selections. While optimal selection is achieved in the context of the given set in the domain by these algorithms, there was silence on what happens when there are ties in that set based on service consumers' requests. Furthermore, the associative classification algorithm has been used to classify candidate web services into different QoS levels. Semantic matching is then used to rank the most qualified web services based on their functional quality. In [32], these authors propose a Multi Criteria Approach for Web Service Discovery. In their work, they introduced QoS parameters that allows user to find relevant services that correspond to his/her preferences and enable him/her to also gain in terms of time by minimizing his/her search space. Review of some of the techniques in the context of the QoS based approach was investigated in [33]. This was extended by Priya [34].

One issue that was not addressed in [28], [30][26] is when the competitive differentiation is zero among the selected optimal web services i.e. when there are ties. When this occurs, scholar like [32] only allow client the freedom to choose their own scenario and to gain in terms of processing time. To resolve this, the work in [39] propose a QoS based multi level selection algorithm for a situation where there are ties between optimal web services. The authors consider the Information services and use the non-deterministic Quality of Service metrics. An algorithm was formulated and an experiment conducted using web service data set Quality of Service information as the input parameters. The experimental results show that the proposed model satisfies service consumers' requests based on non-functional requirements. This justification for this approach was based on the evaluation report in [33] that the QoS based approach requires less expensive middleware, it also allows dynamic service selection, is fair to the clients and gives room for QoS extension.

These web service E-Marketplaces provide both the providers and consumers with the following benefits:

i. The use of modern technologies to improve communication between the producers and consumers is allowed.
ii. Purchasing operations are improved. Also, a purchasing community is established and consumer demands are satisfied in more integrated ways.
iii. The opportunity is created for a service provider to deliver value-added, integrated (packaged) services by composing existing E-services possibly offered by different enterprises [40].
iv. Providers get the enabling environment to generate extra sales by providing a way to reach new customers that are difficult to get through Traditional marketing methods.
v. A competitive market is established thereby allowing the springing up of many products of the same function and therefore giving the consumers the opportunity to have a multi-level based selection strategy for selecting services [39].
vi. Room is given for market Service Discovery, Selection and Composition.

While these benefits have had a positive impact on both consumers and providers, there are several challenges faced by this Marketplace. Among these are:

i. The need to see computing as service that is delivered to consumers over the internet from large-scale data centres or the clouds, Rather than purchase of products.
ii. The need for consumers to invest heavily in building and maintaining complex IT infrastructure [41] and
iii. The high costs of maintaining the equipment and human resources.

D. ***Grid Marketplaces***

While the use of the Web Service Marketplace have been successful, especially with the business class, using this market for high computational power is a challenge, as are the high costs of maintaining the equipment and human resources [41] [42]. This led to the creation of the Grid E-Market Technology. This is a market where computational power is purchased by consumers (Consumers/Applications) through the use of middleware or a resource allocation broker. Four major features distinguish the Grid Marketplace from others [43][44].

These are:

i. Collaboration among members of the grid community with the use of powerful middleware.
ii. Integration of different heterogeneous hardware infrastructure.
iii. The distributed paradigm and
iv. Secure access through the use of a powerful security mechanism to grant the right delegation.

The vision of the Grid architects is for consumers to draw computation power from a distributed pool of resources in a way similar to that in which household appliances draw electrical power from a power utility seamlessly and ubiquitously. Basically, Grid market technology consists of clusters of computers under the control of powerful middleware. Although these Grid markets have been viable in terms of high performance, exploitation of underutilised resources, resource balancing and wide- scale distributed computing[45] [46], this market has some challenges, among which are:

i. Lack of a distributed and robust resource allocation mechanism [47][48].
ii. Inability to provide a good accounting mechanism[49].
iii. Inability of the centralised system to scale in proportion to the potential computation power that will be available as high performance networking becomes available[43].
iv. Inability of the architecture to fully cope with the business world[50].

These challenges were already foreseen as far back as 1969, as quoted in [51] : "As of now, computer networks are still in their infancy, but as they grow up and become sophisticated, we will probably see the spread of 'computer utilities' which, like present electric and telephone utilities, will service individual homes and offices across the country".

E. ***Cloud E-Marketplaces***

The vision of Kleinrock [51] and others like Herb Grosch in the 1950s and John McCarthy in the 1960s laid the foundation of the current trends in the computing known as cloud computing by envisioning the transformation of computer usage from a Traditional in-house power generation model into a model that consists of services provided in a manner similar to utilities such as electricity, gas, and water [52],[53]. Three models have been identified for service delivery, namely, IaaS, Saas and PaaS [54]. Also, four deployment modes have been identified by scholars [55][53]. These are: Public, Private, Community and Hybrid. The definitions and explanation are given in [56], [57]. The researcher focuses on SaaS. An illustration of the request for services is depicted in Fig. 2.3 where Cloud consumers send different requests to the cloud through different applications for service provisioning. The basic characteristic of this provisioning model is that the users consume resources and are billed according to their personal demands.

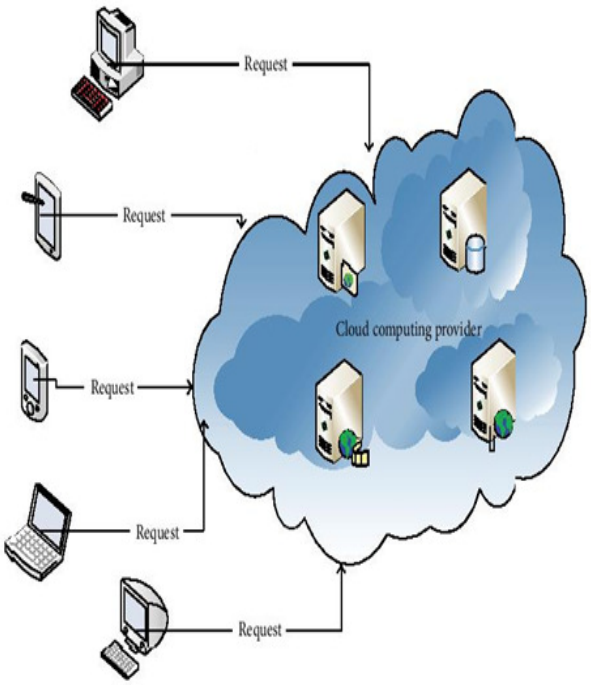

Fig. 2: An Illustration for Request for Services in Cloud E-Marketplaces

Source: JAM Volume(2014, Article ID 756592

The recent innovations in virtualisation and distributed computing, as well as improved access to high-speed Internet is one significant factor that has contributed to the high interest in Cloud E-Marketplaces. There are three major areas in which Cloud E-Marketplaces are different from other E-Marketplaces [58].

These are:

i. Provisioning of on demand services. This may be in minutes or hours.
ii. Elasticity that allows users to have as much or as little of a service as they want at any given time and
iii. The management of the services by Cloud providers

While the features Cost Efficiency, Almost Unlimited Storage, Backup and Recovery, Automatic Software Integration, Easy Access to Information and Quick Deployment have been the benefits of using services from the Cloud E-Marketplaces, the issues of Performance, Security and the vulnerability to external hack **att**acks and threats have been the major challenge and have not been fully addressed [59][60].

In addition, the geographically distributed nature of data centres in Cloud E-Marketplaces and the architectural shift to container-based data centres have added to the challenges in the design, deployment and management of cloud computing platforms. These challenges are closely related to the performance of Cloud E-Marketplace web services. These include the distribution and migration of large volumes of data, the reduction of operational costs, the multi-dimensional allocation of available resources, accurate monitoring and prediction of service qualities, and flexible data centre network architectures. Therefore, for effective delivery of better Quality of Service (QoS) to consumers by the providers in Cloud E-Marketplaces, it is important to understand and improve the performance of cloud computing platforms, so that the performance needs of hosted applications can be satisfied. [54][61].

With the shift to the Cloud E-Marketplace paradigm scholars have concentrated on the issues of security and Privacy [62],[63], Energy [64][65] and Implementation [66]. However, performance has received less attention [54],[67]. The idea behind the Cloud E-Marketplace is that users pay for their used services without the need to spend massive amounts on integration, maintenance, or management of the IT infrastructure. With the growth in cloud E-Marketplaces there is still a shortage of performance evaluation and special measures are required to make it work, especially in the context of consumers' waiting time [54].

2. STATE OF THE ART IN CLOUD E-MARKETPLACE PERFORMANCE

This section studies the state of art of the performance evaluation of Cloud E-Marketplaces. This is narrowed down on consumers' waiting time (response time) and providers' costs. Much work has been done in the area of performance analysis. See [68] [67] [69] [70] [71][72]. For example, in [68], the authors use a generalised idea to address three things, namely, the level of QoS that can be guaranteed given service resources, the number of service resources that are required to ensure that customer services can be guaranteed in terms of the percentile of response time and the number of customers to be supported to ensure that customer services can be guaranteed. Pakbaznia and Pedram [67] proposed the M/G/c to evaluate a cloud server firm with the assumption that the number of server machines is not restricted. The authors demonstrate the manner in which request response time and the number of tasks in the system may be assessed with sufficient accuracy. In Chen and Li [69], the authors model the cloud as M/M/S/k for performance management where web applications are modeled as parallel queues and the service centre as the virtual machines. This work extends that of [64], and [12] by removing the bottleneck of live migration in the packing algorithm based method. In [70], the author uses the M[x]/G/m/m+r to describe a new approximate analytical model for performance evaluation of Cloud data centres with batch task arrivals and shows that important performance indicators such as mean request response time, waiting time in the queue, queue length, blocking probability, probability of immediate service and probability distribution of the number of tasks in the system can be obtained in a wide range of input parameters. This work was based on the so called On-Demand Service.

In [73], the authors propose a preemptive Cloud E-Market policy. The idea is that when an urgent request arrives, it preempts the current request in service and such preempted request is then migrated to another virtual machine if it cannot meet the deadline for completion. But in practice, preemption and migration of virtual machines are costly [74]. In [75], the author removes the scheduling bottleneck from one dimensional to multi-dimensional resources. This is done with the use of Multi-dimensional Resource Integrated Scheduling (MRIS) which is an inquisitive algorithm to obtain the approximate optimal solution. But [76] propose an M/M/m queuing model to develop a synthetic optimisation method to optimise the performance of services in an on Demand service. The simulation result shows that the proposed method can allow less wait time and queue length and more customers to gain the service using a synthetic optimisation function when the numbers of servers increases.

In [77], the authors model the Cloud using the M/M/c/c model with different priority classes with the main goal of studying the rejection probability for different priority classes. But[78] extend Kleinrock's analysis to derive the stationary waiting distribution for each class in a single server accumulating priority queue with Poisson arrival and general distribution service time. In the opinion of the researcher, the M/M/m or the M/G/1 approach may not reflect a typical Cloud E- market because Cloud requests come through a point of entry and they go from there to various service stations for processing which then return the processed requests.

Part of this research is closely related to [71][72] where these authors model the Cloud as a series of queues. What differentiates the researcher's work are:

i. Each of the service stations is modeled as M/M/c/Pr as against the M/M/1 proposed by the authors mentioned above which requires a different mathematical concept.
ii. No dedicated server is given or allocated to any class, thereby reducing consumers' waiting time.

Many researchers have worked on the issue of cost optimisation[79][73],[80][81] [82][12][83], [84]. For example, in [82][12] the author proposes three meta-scheduling online heuristics, namely Min_Min Cost Time Trade-off (MinCTT), Sufferage Cost Time Trade-off (SuffCTT), and Max-Min Cost Time Trade-off (Max- CTT), to manage the trade-off between overall execution time and cost and to minimise them simultaneously on the basis of a tradeoff factor in the context of the utility grid. Also, [31] and [32] propose an algorithm based on convex and resource allocation optimisation methods using IaaS provisioning. But [79] use SLA-Based algorithms to extensively analys and demonstrate how to minimise the Software as a Service(SaaS) provider's cost and the number of SLA violations. The SLA-Based algorithms proposed in Buyya et al and Toosi et al..... [6] [85] extensively analys and demonstrate how to minimise the Software as a Service (SaaS) provider's cost and the number of SLA violations.

The work of these preceding authors presented the researcher with the opportunity to make his own contributions. Although the argument for using the queuing model is based on that of [68][69] [10]. The works of [71][64][70][76] [73] serve the fore-runners of the idea of viewing the Cloud as networks of queues. In[86][87][88][89][90][91], the authors identify some short comings and those short comings present the researchers the opportunity to make their contributions. These short comings include, the idea of generalizing the Cloud like any other Traditional system as proposed in [68] [10]. By viewing the cloud as a single queue may not reflect a typical Cloud E-Market. Therefore the acclaimed response time could not represent the real cloud E-Market response time. This is restructured as networks of queues. Also, the work reported in [13] is based only on simulation without any mathematical proof of concept. This shortcoming is addressed in [86] by proposing the queuing theory solution. The reason for this is that the queuing models predict the theoretical performance behaviours of systems that attempt to provide services for randomly arriving demands [92]. Therefore, ascertaining the degree of correctness of any simulation requires theoretical proof to back it up.

In addition, the issue of considering only On Demand Service by [70] may not reflect the true picture of today's Cloud. This is because most providers are offering different services based on consumer demand. For example, Amazon.com offers three services: the On Demand, Spot, and Reserved [93]. The work in [87][86] considers both On Demand and others with the use of Non Priority and Non-preemptive Priority policies. Other related works, for example [78] [76][94] implement their Non-preemptive policy at the first point of entry alone, whereas the work in [87][86] model the Non-preemptive model at every point of queue. This is because at every point of queue there is a likely tendency that higher priority will arrive when lower one is on the queue. Furthermore, on the issue of cost optimisation algorithms proposed by [31] and [32], the maximisation objective was subjected to many constraints which may become complex to understand. Second, the concept of cost model is based on operating cost rather than on both operational costs and fixed costs. Part of the work (see [91][95]) takes into consideration both operating costs and fixed costs to determine SaaS provisioning using queuing theory.

Finally, the introduction of a dynamic optimisation control mechanism in effective server management proposed in [96] is a great contribution in cloud e-marketplace. This enables Cloud provider to minimize and judiciously utilize the available resources. this is achieved by successfully explored the application of existing and widely adopted theories of the Non-preemptive queue model to the design of a dynamic optimisation control mechanism for effective server management in the context of Cloud E-Marketplaces. Throughout this paper the definitions in Table 2 hold as explained in [84][83][97][92] .

Table 2: Meanings and Definitions of queuing theory terms

Name	Meaning
Consumers:	An application requesting service from the provider
M/M/1/k	A Queue system in which consumers arrive at random rate, exponential service rate, one server and having limited buffer size with FCFS discipline
M/M/c/k	A Queue system in which consumers arrive at random rate, exponential service rate, more than one server and having limited buffer size with FCFS discipline
M/M/1/Pr	A Queue system in which consumers arrive at random rate, exponential service rate, one server and having unlimited buffer size based on Priority
M/M/c/Pr	A Queue system in which consumers arrive at random rate, exponential service rate, more than one server and having unlimited buffer size based on Priority

3. CLOUD CHALLENGES

While this paper could be used as the building block or the foundation to formulate other policies on how to optimise waiting time and costs in Cloud E-Marketplaces the performance issue goes beyond waiting time and cost. Other performance related issues are: SLA compliance, and the Network and Application challenges. Therefore, making Performance Monitoring as Service (PMaaS) would be a great solution to these challenges. It must be stated that traditional server monitoring is quite different from performance monitoring in the Cloud. This is because traditional performance monitoring focuses on specific components rather than having a holistic view of the cloud environment [98]. This could be done through a systematic performance monitoring framework. This framework could be broken down into sub-frameworks to address each of the performance related challenges.
The first of the sub-frameworks could address the issue of SLA, which is the reciprocal agreement between the provider of an IT service and the consumer of that service about the level of service, or QoS, to be delivered [99]. This sub framework could be created to contain some components like the monitoring, processing, data and reporting components. These components can then be integrated through some interface units.

These components should consider the dynamic nature of the cloud E-Markets where resource usage changes. It should also consider the issue of different service offerings provided by different service providers when determining the various QoS requirements. Part of the components should also introduce a third party mechanism that will monitor, checkmate the abuse and non- compliance to the agreed QoS. Another critical area under the SLA is how the consumer-provider information that is used by the components could be loosely coupled such that only necessary information is provided without the detailed information revealed to the receiving end for security sake because of the involvement of a third party. This is because tightly coupled data may not be able to take advantage of many performance-enhancing features of E-Market clouds, such as placing database processing in a series of elastic instances or using a database as a service in the host E-Market cloud [100]. The issue of Network monitoring is also important because slow networks mean slow systems and also poor performance. The other sub-framework should address the issue of network monitoring in cloud E-Marketplaces. This will look into how various fault tolerance mechanisms could be put in place to cater for some network problems like network failure, and attenuation that sometimes has a great effect on the QoS of consumers. In addition, issues like VPN and bandwidth monitoring should be addressed. The researcher's idea of proposing PMaaS is to lift the burden of IT infrastructure from the consumer and at the same time reduce costs and allow service consumers to concentrate on their core business, thereby allowing performance related issues to be handled by cloud E-Market providers.

Apart from the issue of creating performance monitoring as a service, the Modelling structure (M/M/1/c/FCFS, M/M/c/FCFS, M/M/1/c/Pr, M/M/c/Pr) used by the researcher in this thesis could be changed or remodelled to reflect new arrival, service, discipline and population patterns in the cloud E-Marketplaces. This will require a different mathematical queuing theory with different simulation and real life concepts. Different research questions could be generated. Systematic analysis and evaluations could then be carried out to know the level of correctness of such a model and the degree of improvement over the existing ones. For example, the arrival and service patterns of consumers could be remodelled as markovian and General (M/G/c/Pr) for non-preemptive priority operation. This may be General (G/G/c/FCFS) for non-priority FCFS operation depending on the existing service strategy that will strike a good balance between the QoS or parameters under consideration. Apart from these challenges which other researcher can further contribute there come some critical issues in cloud E-Marketplaces that need to be addressed. These includes that of latency, Intermittent Cloud disconnection because of Network failure, and scalability. For example, the concept of latency is based on the fact that Cloud E-market is not closed to the client or consumers. Sometimes the provider of certain service will need to connect to other domain to provide that service for the consumers. There are other challenges that are discussed in the next section. These challenges brought the emergence of Fog Computing.

4. FOG E-MARKETPLACE

Fog E-Marketplace is the architecture that extends the service offered by Cloud E-Marketplace to edge devices. Sometimes it is called the new cloud market and also some scholars say it has come to replace cloud market. But the fact is that Fog market is an evolution of cloud market. This new evolution emanated from the era of mainframe which was then based on client – server solution that was distributive in nature. Technological advancement moves us from client-server solution (Distributive) to cloud solution (Centralized). But today we are back to distributive as we move from cloud based solution to Fog based. A typical architecture of Fog is shown in Fig. 4. This consists of three layers; the cloud layer, the Fog layer and the client layer. The Fog layer extends the cloud. This consists of localized servers that are close to the clients (Applications). These servers use a pro-active method to a forecasts the mobile client's or consumer's demand on information and pre-cache the most desirable contents accordingly[101]. The Fog layer serves as an intermediary between the cloud and the application layer. In this layer several Fog servers can be connected to each other using the IP core technology. For example, the Fog parkland server in location 1 can be connected to the Fog shopping center server and connected to those servers adapted from mobile based station as shown in Fig 4.

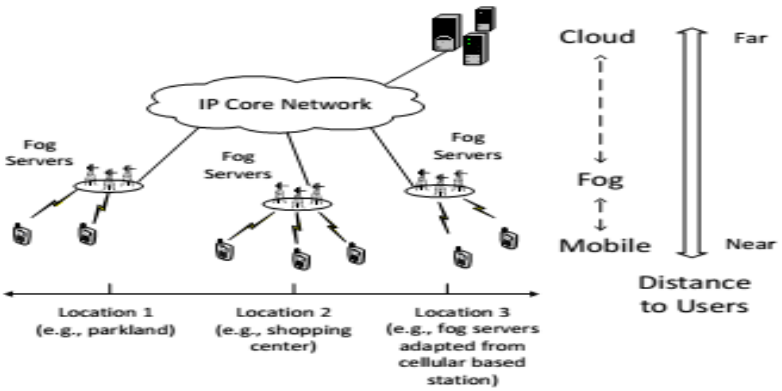

Figure 4: Fog E-Marketplace
Source: eprint arXiv:1502.01815

Fog market allows us to carry out storage, communication services at the distributive level. This differs from the cloud that allows storage and communication to be done at the central level. The main focus of Fog marketplace is to allow light-weight cloud-like facility at the proximity of mobile users; the Fog therefore can serve mobile users with a direct short-fat connection as compared to the long-thin mobile cloud connection[102]. In [103], the authors define Fog market as distributing data and intelligence for resiliency and scale necessary for IoT. From the diagram above one can deduce that:

$$Fog = Cloud + IoT$$

Where IoT = Internet of a thing.

Internet of a thing is the network of physical accessed through the Internet that contain embedded technology to sense or interact with their internal state ot the external environment. This can be represented mathematically as:

$$IoT = Small\ sensors + Big\ data + Action$$

Table 3 enumerates cloud challenges and how Fog has come to help.

Table 3: Cloud challenges and how Fog can help

Cloud Challenges	How Fog can help
1. Critcal Latency Requirement	1. Fewer Network Topology
2. Data Richly Mobility	2. Data located at optimal depth, local caches
3. Geographic Diversity	3. Intelligence localized as appropriate
4. Network Bandwidth Constraints	4. Local processing reduces core Network log.
5. Reliability/ Robustness	5. Fast fail-over; local response in emergency
6. Analythics Challenges	6. Analytics and storage at the right level
7. User data/Geographic privacy	7. Fit can ammonize and aggregate used data

While Fog market has come to stay, there are some challenges. These include:

- How to optimize the extra management and the maintenance costs incurred as a result of the Fog service adaptability to the localized clients [104] .
- The issue of how to customize the clients' applications by the Fog operator.
- Vulnerabilities to system confidentiality, integrity, and availability are challenges [104].
- How Fog servers will forecast and deploy immediately the needed resources needed by localized clients is also a great challenge.

Although the Fog market in it full emergence hope to address several issues like low latency, Geo-distribution, Real-time interactions, location Awareness, Support for mobility. However, the other challenges need to be critically address before the full implementation.

5. CONCLUSION

This paper has presented the trends in Marketplaces. The paper has investigated the Traditional, Internet, Web service, Grid and the Cloud E-Marketplaces. The pros and cons of each marketplace that led to the emergence of other market have been examined. The current state of the art in Cloud E-Marketplaces has been studied and the cloud challenges which led to the evolution of Fog computing have also been identified. In addition, the issue Fog computing is discussed and area of opportunities are further identified. The contribution of this paper is on the critical review carried out that identifies some shortcomings in the E-marketplaces. This will be an opportunities for other researchers to identify or utilized some gaps and further make their contribution.

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REFERENCES

[1] D. N. Dholakia, R. Dholakia, D. Zwick, and M. Laub, "Electronic commerce and the transformation of marketing," *Internet-MarketingPerspektiven und Erfahrungen aus Deutschl. und den USA*, pp. 55–77, 1999.
[2] T. W. Malone, J. Yates, and R. . Benjamin, "The Logic of Electronic Markets - HBR," *Harvard Business Review*, 1989. [Online]. Available: https://hbr.org/1989/05/the-logic-of-electronic-markets. [Accessed: 24-Apr-2015].
[3] J. P. Bailey and Y. Bakos, "An Exploratory Study of the Emerging Role of Electronic Intermediaries," *Int. J. Electron. Commer.*, vol. 1, no. 3, pp. 7–20, 1997.
[4] J. G. Norm Archer, "Managing in the context of the new electronic marketplace," in *Proceedings 1st World Congress on the Management of Electronic Commerce*, 2000.
[5] N. Russ, "E-marketplaces: New Challenges for Enterprise Policy, Competition and Standardisation.," Workshop Report, Brussels Apri 2001.
[6] J. Il Kim, C. M. Lee, and K. H. Ahn, "Dongdaemun, a traditional market place wearing a modern suit: The importance of the social fabric in physical redevelopments," *Habitat Int.*, vol. 28, no. 1, pp. 143–161, 2004.
[7] M. Grieger, "Electronic marketplaces: A literature review and a call for supply chain management research," *Eur. J. Oper. Res.*, vol. 144, no. 2, pp. 280–294, 2003.
[8] D. R. Henderson, "Electronic marketing in principle and practice.," *merican J. Agric. Econ.*, vol. A 66 (5), pp. 848–853, 1984.
[9] J. H. McCoy and M. E. Sarhan, *Livestock and Meat Marketing*. Avi Pub Co, 1988.
[10] D. R. Ferreira and J. Pinto Ferreira, "Building an e-marketplace on a peer-to-peer infrastructure," *Int. J. Comput. Integr. Manuf.*, vol. 17, no. 3, pp. 254–264, 2004.
[11] "Traditional Marketing versus Digital Marketing - Digital Marketing Strategies," *http://digital-marketing-strategy.weebly.com/digital-marketing.html*. [Online]. Available: http://digital-marketing-strategy.weebly.com/digital-marketing.html. [Accessed: 17-Apr-2015].
[12] T. J. Strander and M. J. Shaw, "Characteristics of electronic Markets," *Decis. Support Syst. North-holl.*, vol. 21, no. 3, pp. 185–198, 1997.
[13] J. Y. Bakos, "Reducing search costs : Implications for electronic marketplaces," *Manage. Sci.*, vol. 43, p. 17, 1997.
[14] K. Berryman, L. Harrington, D. Layton-Rodin, and V. Rerolle, "Electronic Commerce: Three Emerging Strategies," *McKinsey Q.*, no. 1, p. 152, Jan. 1998.
[15] R. Stockdale, "Benefits and barriers of electronic marketplace participation: an SME perspective," *J. Enterp. Inf. Manag.*, 2004.
[16] M. Norris and S. West, *eBusiness Essentials*. Chichester, UK: John Wiley & Sons, Ltd, 2001.
[17] R. Nathan, "E-Marketplaces: new challenges for enterprise policy, competition and standardisation," Brussel, pp. 1–28, 2001.
[18] A. Kambil and E. Van Heck, *Making markets: How Firms Can Design and Profit from Online Auctions and Exchanges*. Harvard Business Press, 2002.
[19] A. Pucihar and J. Gričar, "Environmental Factors Defining eMarketplace Adoption : Case of Large Organizations in Slovenia," pp. 1–13, 2005.
[20] W. K. Chong and M. Shafaghi, "Performances of B2B e-Marketplace for SMEs : The Research Methods and Survey Results," *Commun. IBIMA*, vol. 9, no. 22, pp. 185–192, 2009.
[21] Q. Z. Sheng, X. Qiao, A. V. Vasilakos, C. Szabo, S. Bourne, and X. Xu, "Web services composition: A decade's overview," *Inf. Sci. (Ny).*, vol. 280, pp. 218–238, Oct. 2014.
[22] L. Zeng, B. Benatallah, A. H. H. Ngu, M. Dumas, J. Kalagnanam, and H. Chang, "QoS-aware middleware for Web services composition," *IEEE Trans. Softw. Eng.*, vol. 30, no. 5, pp. 311–327, 2004.
[23] P. M. Papazoglou, *Title Principle and Technology*. Edinburgh Gate, England: Pearson Education limited, 2008.
[24] Z. Shen and J. Su, "Web service discovery based on behavior signatures," *2005 IEEE Int. Conf. Serv. Comput.*, vol. 1, 2005.
[25] E. Al-Masri and Q. H. Mahmoud, "QoS-based discovery and ranking of Web services," *Proc. - Int. Conf. Comput. Commun. Networks, ICCCN*, pp. 529–534, 2007.
[26] M. Makhlughian, S. M. Hashemi, and Y. Rastegari, "W Eb Service Selection Based on R Anking of," *Int. J. Web Serv. Comput.*, vol. 3, no. 1, pp. 1–14, 2012.
[27] D. Palanikkumar, "An Algorithmic Evaluation of Optimal Service Selection using BCO," *Eur. J. Sci. Res.*, vol. 68, no. 4, pp. 591–605, 2012.
[28] X. Fan and X. Fang, "On optimal decision for QoS-aware composite service selection," *Inf. Technol. J.*, vol. 9, no. 6, pp. 1207–1211, 2010.
[29] L. Chen, Y. Feng, J. Wu, and Z. Zheng, "An Enhanced QoS Prediction Approach for Service Selection," *2011 IEEE Int. Conf. Serv. Comput.*, no. 3, pp. 727–728, 2011.
[30] N. Sasikaladevi and L. Arockiam, "Genetic Approach for Service Selection problem in Composite Web Service," *Int. J. Comput. Appl.*, vol. 44, no. 4, pp. 22–29, 2012.

[31] D. Palanikkumar and G. Kousalya, "An Evolutionary Algorithmic Approach based Optimal Web Service Selection for Composition with Quality of Service Department of CSE , Anna University of Technology , Coimbatore-47 , Coimbatore Department of CSE , Sri Krishna College of Engineering and Tech," *J. Comput. Sci.*, vol. 8, no. 4, pp. 573–578, 2012.

[32] R. Ben lakhal and W. Chainbi, "A Multi-Criteria Approach for Web Service Discovery," *Procedia Comput. Sci.*, vol. 10, pp. 609–616, Jan. 2012.

[33] M. Sathya and M. Swarnamugi, "Evaluation of QoS Based Web- Service Selection Techniques for Service Composition," *Int. J. Softw. Eng.*, vol. 1, no. 5, pp. 73–90, 2010.

[34] N. H. Priya, "Optimal Selection and Composition of Web Services – a Survey," *Int. J. Comput. Appl.*, vol. 49, no. 2, pp. 1–5, 2012.

[35] D. B. Claro, P. Albers, and J. Hao, "Web services composition," *Semant. Web Serv. Process. Appl.*, pp. 195–225, 2006.

[36] N. Milanovic and M. Malek, "Current solutions for Web service composition," *IEEE Internet Comput.*, vol. 8, no. 6, pp. 51–59, 2004.

[37] C.-F. Lin, R.-K. Sheu, Y.-S. Chang, and S.-M. Yuan, "A relaxable service selection algorithm for QoS-based web service composition," *Inf. Softw. Technol.*, vol. 53, no. 12, pp. 1370–1381, 2011.

[38] N. Li, "Modified Particle Swarm Optimization and Its Application in Multimodal Function," in *2011 International Conference on Transportation, Mechanical, and Electrical Engineering (TMEE) December 16-18, Changchun, China*, 2011, pp. 375–378.

[39] A. O. Akingbesote, M. O. Adigun, J. B. Oladosu, and E. Jembere, "A Quality of Service Aware Multi-Level Strategy for Selection of Optimal Web Service," in *in 5th IEEE ICAST International Conference on Adaptive Science and Technology, Pretorial, South Africa*, 2013, pp. 25–27.

[40] J. Y. J. Yang, M. P. Papazoglou, and W.-J. Van Den Heuvel, "Tackling the challenges of service composition in e-marketplaces," *Proc. Twelfth Int. Work. Res. Issues Data Eng. Eng. E-commerce/e-bus. Syst. RIDE-2EC*, 2002.

[41] R. Buyya, C. S. Yeo, and S. Venugopal, "Market-oriented cloud computing: Vision, hype, and reality for delivering IT services as computing utilities," *Proc. - 10th IEEE Int. Conf. High Perform. Comput. Commun. HPCC 2008*, pp. 5–13, 2008.

[42] R. Buyya, R. Ranjan, and R. N. Calheiros, "Modeling and simulation of scalable Cloud computing environments and the CloudSim toolkit: Challenges and opportunities," *2009 Int. Conf. High Perform. Comput. Simul.*, pp. 1–11, Jun. 2009.

[43] R. Wolski, J. S. Plank, and J. Brevik, "g-Commerce – Building Computational Marketplaces for the Computational Grid," 2000.

[44] L. . Kacsukne and T. Kiss, *Distributed and Parallel Systems*, vol. 777. Boston: Kluwer Academic Publishers, 2005.

[45] I. Foster and N. T. Karonis, "A Grid-Enabled MPI: Message Passing in Heterogeneous Distributed Computing Systems," *Proc. IEEE/ACM SC98 Conf.*, pp. 1–11, 1998.

[46] S. Pardeshi, C. Patil, and S. Dhumale, "Grid Computing Architecture and Benefits," *Ijsrp.Org*, vol. 3, no. 8, pp. 3–6, 2013.

[47] H. Casanova and D. Jack, "A Network Server for Solving Computational Science Problems," in *Proceedings of the 1996 ACM/IEEE Conference on Supercomputing (SC')*, 1996, pp. 1–14.

[48] A. S. Grimshaw, W. a Wulf, J. C. French, A. C. Weaver, P. F. R. Jr, and P. F. Reynolds, "Legion : The Next Logical Step Toward a Nationwide Virtual Computer e pluribus unum -- one out of many Technical Report CS-94-21, University of Virginia," 1994.

[49] D. Thain, T. Tannenbaum, and M. Livny, "Distributed computing in practice: The Condor experience," *Concurr. Comput. Pract. Exp.*, vol. 17, no. 2–4, pp. 323–356, 2005.

[50] K. Nadiminti and R. Buyya, "Enterprise grid computing: State-of-the-art TGrid Computing and Distributed Systems Laboratory, The University of Melbourne," 2005.

[51] L. A. Kleinrock, "vision for the internet.," *ST J. Res.*, vol. 2, no. 1, pp. 2–5, 2005.

[52] A. Joshua and F. Ogwueleka, "Cloud Computing with Related Enabling Technologies," *Int. J. Cloud Comput. Serv. Sci.*, vol. 2, no. 1, pp. 40–49, 2013.

[53] P. Mell and T. Grance, "The NIST Definition of Cloud Computing Recommendations of the National Institute of Standards and Technology," *Nist Spec. Publ.*, vol. 145, p. 7, 2011.

[54] N. Khanghahi and R. Ravanmehr, "Cloud Computing Performance Evaluation : Issues and Challenges," *… J. Cloud Comput. …*, vol. 3, no. 5, pp. 29–41, 2013.

[55] S. M. Habib, S. Hauke, S. Ries, and M. Mühlhäuser, "Trust as a facilitator in cloud computing: a survey," *J. Cloud Comput. Adv. Syst. Appl.*, vol. 1, no. 1, p. 19, 2012.

[56] H. Alhakami, H. Aldabbas, and T. Alwada, "C Omparison B Etween C Loud and G Rid C Omputing : R Eview Paper," vol. 2, no. 4, pp. 1–21, 2012.

[57] S. De Chaves, R. Uriarte, and C. Westphall, "Toward an architecture for monitoring private clouds," *IEEE Commun. Mag.*, vol. 49, no. 12, pp. 130–137, Dec. 2011.

[58] H. Khazaei, J. Misic, and V. B. Misic, "Modelling of Cloud Computing Centers Using M/G/m Queues," *31st Int. Conf. Distrib. Comput. Syst. Work.*, pp. 87–92, Jun. 2011.

[59] K. Popovic and Z. Hocenski, "Cloud computing security issues and challenges," in *MIPRO, 2010 Proceedings of the 33rd International Convention*, 2010, pp. 344–349.
[60] "Available." [Online]. Available: http://mobiledevices.about.com/od/additionnalresources/a/Cloud-Computing-Is-It-Really-All-That-Beneficial.htm,http://www.rickscloud.com/how-performance-issues-impact-cloud-adoption.
[61] "Seedy." [Online]. Available: http://www.comsoc.org/files/Publications/ Magazines/ni/cfp/Cfp.
[62] W. Sun, B. Wang, N. Cao, M. Li, W. Lou, Y. T. Hou, and H. Li, "Privacy-preserving multi-keyword text search in the cloud supporting similarity-based ranking," in *Proceedings of the 8th ACM SIGSAC symposium on Information, computer and communications security - ASIA CCS '13*, 2013, pp. 71–82.
[63] K. Popović and Z. Hocenski, "Cloud computing security issues and challenges," in *proceedings of the 33rd international convention,* 2010, pp. 344–349.
[64] B. Li, J. Li, J. Huai, T. Wo, Q. Li, and L. Zhong, "EnaCloud: An Energy-Saving Application Live Placement Approach for Cloud Computing Environments," in *2009 IEEE International Conference on Cloud Computing*, 2009, pp. 17–24.
[65] K. Le, R. Bianchini, J. Zhang, Y. Jaluria, J. Meng, and T. D. Nguyen, "Reducing electricity cost through virtual machine placement in high performance computing clouds," *Proc. 2011 Int. Conf. High Perform. Comput. Networking, Storage Anal. - SC '11*, p. 22, 2011.
[66] P. Appandairajan, N. Zafar Ali Khan, and M. Madiajagan, "ERP on Cloud: Implementation strategies and challenges," in *Proceedings of 2012 International Conference on Cloud Computing Technologies, Applications and Management, ICCCTAM*, 2012, pp. 56–59.
[67] E. Pakbaznia and M. Pedram, "Minimizing data center cooling and server power costs," in *in Proceedings of the 14th ACM/IEEE international symposium on Low power electronics and design - ISLPED '09*, 2009, pp. 145–150.
[68] K. Xiong and H. Perros, "Service Performance and Analysis in Cloud Computing," *2009 Congr. Serv. - I*, pp. 693–700, Jul. 2009.
[69] H. Chen and S. Li, "A Queueing-based Model for Performance Management on Cloud," in *on Advanced Information Management and Service (IMS), Seoul*, 2010, pp. 83–88.
[70] H. Khazaei, "Performance Modeling of Cloud Computing Centers," *Ph.D Thesis, Univ. Manitoba Winnipeg Manitoba, Canada*, no. January, 2013.
[71] X. Nan, Y. He, and L. Guan, "Optimal resource allocation for multimedia cloud based on queuing model," *2011 IEEE 13th Int. Work. Multimed. Signal Process.*, pp. 1–6, Oct. 2011.
[72] F. Kamoun, "Performance Analysis of Two Priority Queuing Systems in Tandem," vol. 2012, no. November, pp. 509–518, 2012.
[73] R. Santhosh and T. Ravichandran, "Pre-emptive scheduling of on-line real time services with task migration for cloud computing," in *2013 International Conference on Pattern Recognition, Informatics and Mobile Engineering*, 2013, pp. 271–276.
[74] S. T. Maguluri, R. Srikant, and L. Ying, "Stochastic models of load balancing and scheduling in cloud computing clusters," in *2012 Proceedings IEEE INFOCOM*, 2012, pp. 702–710.
[75] S. Nagendram, "Efficient Resource Scheduling in Data Centers using MRIS," *(IJCSE)(IJCSE)*, vol. 2, no. 5, pp. 764–769, 2011.
[76] L. Guo, T. Yan, S. Zhao, and C. Jiang, "Dynamic Performance Optimization for Cloud Computing Using M/M/m Queueing System," *J. Appl. Math.*, vol. 2014, pp. 1–8, 2014.
[77] F. Wang, N. Helian, and G. Akanmu, "User-priority guided Min-Min scheduling algorithm for load balancing in cloud computing," *2013 Natl. Conf. Parallel Comput. Technol.*, pp. 1–8, Feb. 2013.
[78] D. a. Stanford, P. Taylor, and I. Ziedins, "Waiting time distributions in the accumulating priority queue," *Queueing Syst.*, vol. 77, no. 3, pp. 297–330, Dec. 2013.
[79] L. Wu, S. K. Garg, and R. Buyya, "SLA-Based Resource Allocation for Software as a Service Provider (SaaS) in Cloud Computing Environments," *2011 11th IEEE/ACM Int. Symp. Clust. Cloud Grid Comput.*, pp. 195–204, May 2011.
[80] J. Zhao, C. Wu, and Z. Li, "Cost Minimization in Multiple IaaS Clouds : A Double Auction Approach," *arXiv Prepr. arXiv1308.0841*, 2013.
[81] H. Xu and B. Li, "Cost efficient datacenter selection for cloud services," *2012 1st IEEE Int. Conf. Commun. China*, pp. 51–56, Aug. 2012.
[82] Y. C. Lee, C. Wang, A. Y. Zomaya, and B. B. Zhou, "Profit-driven service request scheduling in clouds," in *CCGrid 2010 - 10th IEEE/ACM International Conference on Cluster, Cloud, and Grid Computing*, 2010, pp. 15–24.
[83] H. Goudarzi and M. Pedram, "Multi-dimensional SLA-Based Resource Allocation for Multi-tier Cloud Computing Systems," in *2011 IEEE 4th International Conference on Cloud Computing*, 2011, pp. 324–331.
[84] H. Goudarzi and M. Pedram, "Maximizing Profit in Cloud Computing System via Resource Allocation," *2011 31st Int. Conf. Distrib. Comput. Syst. Work.*, pp. 1–6, Jun. 2011.
[85] A. N. Toosi, R. N. Calheiros, R. K. Thulasiram, and R. Buyya, "Resource Provisioning Policies to Increase IaaS Provider's Profit in a Federated Cloud Environment," in *2011 IEEE International Conference on High Performance Computing and Communications*, 2011, pp. 279–287.

[86] A. . Akingbesote, M. . Adigun, S. . Xulu, M. Sanjay, and I. . Ajayi, "Performance Analysis of Non-Preemptive Priority with Application to Cloud E-marketplaces," in *IEEE International Conference on Adative Technolgy (ICAST)*, 2014, pp. 1–6.

[87] A. O. Akingbesote, M. O. Adigun, S. S. Xu, and E. Jembere, "Performance Evaluation of Cloud E-Marketplaces using Non Preemptive Queuing Model," in *WCST conferece*, 2014, pp. 66–71.

[88] A. . Akingbesote, M. . Adigun, E. Jembere, and J. Oladosu, "Modeling the Cloud e-Marketplaces for Cost Minimization Using Queuing Mode," *Aust. J.Basic & Appl. Sci, 8(4):*, 2014. [Online]. Available: http://ajbasweb.com/old/ajbas/2014/Special/59-67.pdf. [Accessed: 16-Apr-2015].

[89] A. . Akingbesote, M. . Adigun, E. Jembere, M. A. Othman, and I. . Ajayi, "Determination of optimal service level in cloud e-marketplaces based on service offering delay," pp. 283–288.

[90] A. O. Akingbesote, M. O. Adigun, S. Xulu, and E. Jembere, "Performance Modeling of Proposed GUISET Middleware for Mobile Healthcare Services in E-Marketplaces," *J. Appl. Math.*, vol. 2014, p. 9, 2014.

[91] Akingbesote A.O, M. O. Adigun, J. Oladosu, and E. Jembere, "The Trade-off between consumer's satisfaction and resource service level by e-market providers in e-market places," *in International Conference on Information Technology (ICIT)*, 2013. [Online]. Available: http://connection.ebscohost.com/c/articles/95511261/modeling-cloud-e-marketplaces-cost-minimization-using-queuing-model.

[92] D. Gross and F. John, *Fundamentals of Queueing Theory*. John Wiley & Sons, Inc. New York, NY, USA, 1985.

[93] "AWS | Amazon Elastic Compute Cloud (EC2) - Scalable Cloud Hosting." [Online]. Available: http://aws.amazon.com/ec2/. [Accessed: 23-Apr-2015].

[94] J. Walraevens, B. Steyaert, M. Moeneclaey, and H. Bruneel, "Delay Analysis of a HOL Priority Queue," *Telecommun. Syst.*, vol. 30, no. 1–3, pp. 81–98, Nov. 2005.

[95] A. O. Akingbesote, M. O. Adigun, J. Oladosu, E. Jembere, I. Kaseeram, S. Africa, and S. Africa, "Modeling the Cloud e-Marketplaces for Cost Minimization Using Queuing Model," *Aust. J. Basic Appl. Sci.*, vol. 8, no. 4, pp. 59–67, 2014.

[96] "Akingbesote A.O Adigun M.O," *Res. Ann.*, vol. Vol. 6., no. 1, pp. 39–41, 2014.

[97] B. D. Bunday, *An Introduction to Queueing Theory*. Arnold, 1996.

[98] Infosys, "Performance Monitoring in Cloud," *White Pap. www.infosys.com*, 2012.

[99] E. Stahl, P. K. Isom, and T. R. Stockslager, "Performance Implications of Cloud," 2012. [Online]. Available: http://www.redbooks.ibm.com/redpapers/pdfs/redp4875.p df.

[100] "3 rules for getting top enterprise cloud performance | InfoWorld." [Online]. Available: http://www.infoworld.com/article/2612755/cloud-computing/3-rules-for-getting-top-enterprise-cloud-performance.html. [Accessed: 06-Nov-2015].

[101] E. Bagtug, M. Bennis, and M. Debbah, "Living on the Edge: The Role of Proactive Caching in 5G Wireless Networks," *˘IEEE Commun. Mag.*, vol. vol. 52, pp. 82 – 89, 2014.

[102] T. H. Luan, L. Gao, Z. Li, Y. Xiang, and L. Sun, "Fog Computing: Focusing on Mobile Users at the Edge," *eprint arXiv:1502.01815*, pp. 1–11, 2015.

[103] D. P. F. Dr. Ovidu Vermesan, "The Internet of Things The Internet of Things," *River Pulisher Ser. Commun.*, vol. 291, no. July 2012, pp. 1–40, 2015.

[104] J. Shropshire, "Extending the Cloud with Fog : Security Challenges & Opportunities," *Am. Conf. Inf. Syst.*, pp. 1–10, 2014.