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E-COMMERCE WITH FOG-ENABLED CLOUD COMPUTING: FRAMEWORK, OPPORTUNITIES, AND CHALLENGES

SUNEET WALIA[1], RANJIT RAJAK[2], MOHAMMAD SAJID[3]

[1]Department of Business Management, Dr.HarisinghGour Central University, Sagar (M.P.), India
[2]Department of Computer Science and Applications, Dr. HarisinghGour Central University, Sagar (M.P.), India
[3]Department of Computer Science, Aligarh Muslim University, Aligarh (U.P.), India

E-mail: [1]suneetfmsdhgu@gmail.com , [2]ranjit.jnu@gmail.com ,[3]sajid.cst@gmail.com
Corresponding Author: Ranjit Rajak (ranjit.jnu@gmail.com)

ABSTRACT

Competition now covers the geographical distances and stretches to customers irrespective of region, locality, and country. Cloud computing technology has sustained the E-commerce sector with speed, efficacy, and maintaining and serving the extensive customer database. However, speed, data maintenance, and security have become pertinent questions in the e-commerce business and the role of cloud computing. In this work, an E-commerce framework based on Fog-enable cloud computing is proposed, which is helpful to speed up the communication between customers and E-commerce companies due to the involvement of edge nodes as well as fog nodes. The elements, challenges, and role of cloud computing technology in upholding and fulfilling the requirements of e-commerce are also explored and discussed. The proposed E-commerce framework based on Fog-enable cloud computing would enhance the e-commerce business with better customer satisfaction, minimal cost, enhanced security, and easy and secure data maintenance.
Keywords: *E-Commerce, Fog Computing, Cloud Computing, Performance, Security, Privacy*

1. INTRODUCTION

Amidst the Pandemic year 2020, one company that made remarkable profits was Amazon.com which showed an approx. of 43.6% increase in profits [1]. About 60% of Amazon's income was recorded from its 'Amazon Web Service'—the Cloud computing Business Unit of Amazon [1]. The online Retailing business has never been the most wanted platform for purchasing until the break of the Pandemic when local travel was barricaded by the lockdown. Be it grocery, medicines, clothing, or even stationery for children, online platforms were explored, and orders were placed. With this huge emergence of online purchasers, it became imperative for the e-commerce industry to structure its business and set a system where every order placed is fulfilled with speed and efficacy. Maintaining a huge database and catering to each customer demand, everyonline business needs a system to facilitate it with efficacy and speed and provide a competitive service. The solution to these problems was one technology -Cloud Computing. To define Cloud Computing, "Cloud computing describes the hosting and delivery of information and on-demand computing resources on the Internet using a remote network of servers. The alternative is to store, manage or process data on a local server or personal computer" [2]. Cloud computing is "a computing style in which massively scalable IT-related capabilities are offered to numerous external customers 'as a service' utilizing Internet technologies" [3].

Compared to the traditional computer database management system, Cloud computing has excessively made global retailers reach customers beyond geographical boundaries. Moreover, the Cloud technology provides for an 'architecture' that helps the online retailer balance the up-scaling and down-scaling of e-business appropriately and supports keeping the business "in sync with the market scenario" [4]. Cloud computing tends to save the cost of the business organization under the heads of maintaining Software and hardware facilities and IT infrastructure [4].

The digitalization of the industry work process has become necessary to beat the severe market

competition and grab customer loyalty. Siemens has implemented the 'Cloud Connect', which connects different kinds of plants with the Cloud [5]. Cloud Connect provides for quality checks& maintenance of machinery and caters to the customization of product designs as required by individual customers [5]. This Cloud-based server secured better quality, higher productivity, and shorter development cycles [5].

This research paper explores various facets of Cloud Computing technology with special reference to e-commerce. It is based on secondary data, such as Journals, news articles & updates, and online news and articles. It is a descriptive paper that studies the impact and utility of cloud computing on the online retail business in the present scenario. This research article aims to understand the viability of the digitalization of business and its pros & cons. Further, an endeavor is made to construct an e-business model for cost efficiency, keeping the data safe and expeditious fulfillment of the customer requirements. The profundity of this research approach is to highlight the facts and factors affecting e-business and enabling the fact that e-business aims to reach its customers beyond geographical boundaries with cost-effectiveness and on-time delivery. The major contributions are:

- To study the utility of Fog-enabled Cloud Computing as a database management system
- To understand the reliability of Cloud Computing in E-commerce
- To provide an efficient model to manage e-business through Cloud Computing

2. E-COMMERCE

The digitalization of trade & business began in the late 1970s, and eventually, the transactions started happening through electronic mode through the usage of Electronic Data Interchange (EDI) [6].It was the E-Commerce that metamorphosed the physical place for the exchange of goods into a virtual mode [3]

The sale & purchase of goods & services via the Internet is described as E-Commerce. It is structured in two artifacts: (1) The Technical Construction of the Software & hardware work system; (2) The transaction and data management that is done on the system of hardware & software support [6,7]. The structure of E-Commerce (Nair, 2020) [3] is given in Figure 1.

The major objective of E-Business is not only to create and maintain new customers but also to get back the lost customers and enhance their market share; for which they not only need to have an efficient & speedy network system but have to be 'Omnipresent' in all locations [6]. Thus, digitalization has created a market space through the online mode that provides the vendors and purchaser's trade for products, services, and required knowledge [8].

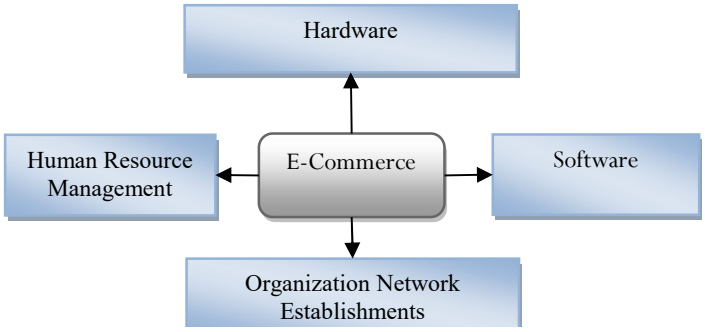

Figure 1: E-Commerce Structure

This Business to Consumer trading is giving a tough competition [9] to the local retailers. Kremez et.al,[9], have elaborated in their research that the B2C through the online mode is a big threat to the Franchising business. McCole and Ramsey [10], highlight in their Research the 'Market-Oriented Behavior' which is influenced by technology and is implemented by organizations. However, the corporate dwells in an uncertain external environment and is affected by its factors. The trick of the trade is to leverage these factors to enhance sales and increase the customer database. Some of the external environmental factors for a B2C market are technological measures, the right infrastructure, Government policies, [10], Delivery agents, and Economic pressures. Figure 2 depicts the external environmental factors.

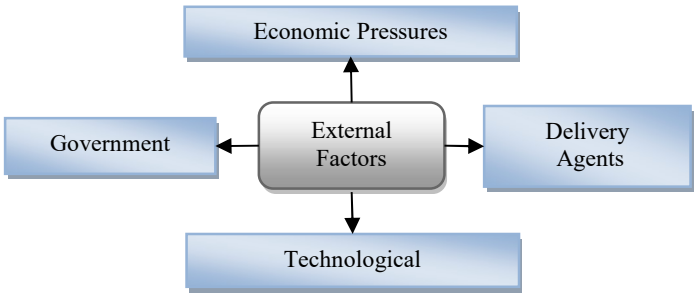

Figure 2: External Environment

To be successful in the e-business and achieve organizational objectives, the organization has to deal with certain internal factors that either stimulate the business or becomes a barricade. Some factors are insufficient customer data, outdated technology, unmotivated workforce, and resource utilization issues [10]. Figure 3 depicts some internal factors.

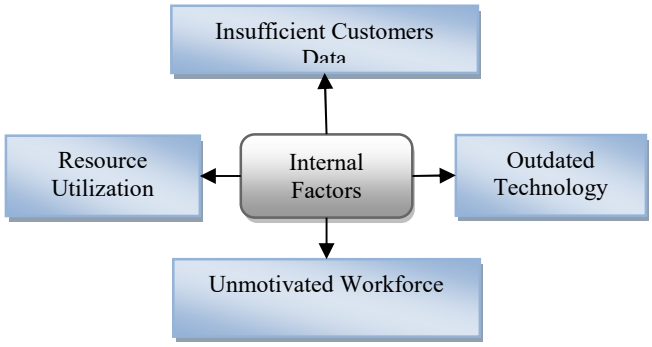

Figure 3: Internal Environment

3. CLASSIFICATION OF E-BUSINESS

Like any business mode, E-business is expanding into various segments. It caters to different categories of customers, dealers, and suppliers. Though done in a virtual mode, E-Business encompasses all modes of business, be it B2B, C2B, B2C, and C2C [11].

Business to Business (B2B) is a form of business that enables "transaction between businesses, such as one involving a manufacturer and wholesaler, or a Wholesaler and a retailer" [12]. Thus, the trade between one business organization and the other business organization, whereby one company's finished or semi-finished goods serve as a raw material for the other. The B2B through the electronic mode has given a new perspective and definition to the relationship between the suppliers and the organization [13]. Among the different e-commerce companies, the majorly required companies are supply and procurement exchanges, Web development, and Infomediaries [13].

Figure 4 shows the major components of an E-commerce company. These components have their role to play, such as Web development supports the development of the websites for the various organizations, Supply and procurement exchanges create a bridge between the vendors, suppliers, and the organization; and last Infomediaries through specific sites creates and exchanges information regarding the companies and its business, customers,etc.[13].

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C2B e-commerce or Consumer-to-Business is a converse of the traditional e-com model. In C2B, the end-user puts forth his demand or proposes a product or service for a particular price to the business organization [14]. A Consumer is leveraging their importance for being a 'Consumer' and hence en-cashing profits by specifying their pricing[14].

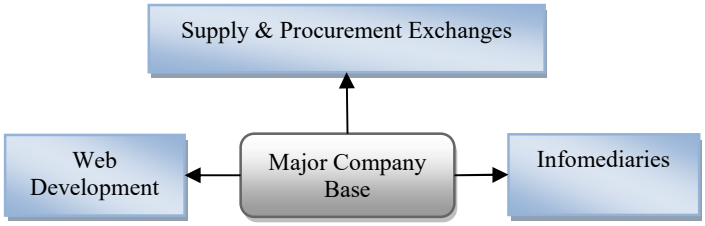

Figure 4: Major E-Commerce Company Base

B2C e-commerce or Business-to-Consumer is the most happening transaction taking place [15], be it Amazon, Myntra, Flipkart, etc. These companies provide ample varieties and choices to all customers with exuberant discounts and deals compared to local markets. Groceries, Clothing brands, footwear to branded ornaments are all available to the respective customers.

C2C or simply Consumer to Consumer can be understood by the most prominent Application/Website of OLX, or eBay, where consumers are given a platform to lease, rent, or even sell their bought products to other customers.

4. ELEMENTS OF E-BUSINESS

The essential elements that encompass an e-business are a digital platform, i.e., a website or an App, Internet connection with the prospective customers, the right products at the right cost, and

delivery with speed [8]. Figure 5 depicts the essential elements of E-business

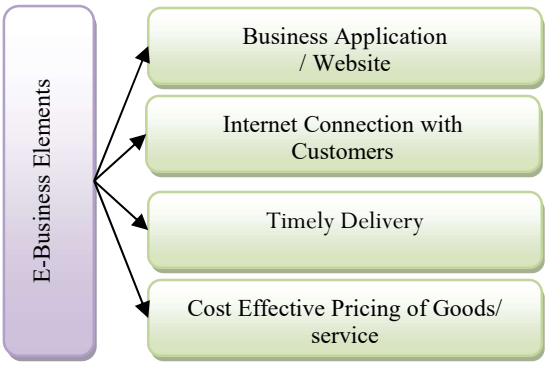

Figure 5. Four Basic Elements of E-Business

5. BENEFITS OF E-COMMERCE

Time has become the most crucial requirement of everyone in the present era. Doing more chores and saving time is the struggle of the hour. Hence when professional work becomes a priority, the household chores become secondary. This is eased through the e-commerce organizations where shoppers purchase as per their time of convenience and do not have to travel physically from one shop to another. Table 1 presents the merits of e-commerce [16].

The major drawbacks of using the IT technology for trade purposes are "Transaction repudiation, Information tampering, Information Capture and steal and Information Fraud" [17].
The digital revolution upsurged in the second half of the twentieth century, and soon the analogue data could be easily morphed with modest pricing [18]. A paradigm shift was observed eventually as now the entire world is dependent upon digital data [18], be it the education industry, hospital industry or the corporate world, and this digital data configures a perilous platform in the Global environment for all the people. Present-day industrial operative functions are instituted to attain and fortify the exclusive & individual data, which is applied to various corporate objectives and further maneuvering 'Consumer Behavior' to their own accord. With this kneading of individual data, a corporation can sell at a discretionary price [18]. It is called "Surveillance Capitalism" [18]. Further, Clarke [18], in his research paper, highlights the concept of "Digital Personae", whereby all decision is reached upon the personal data of the individual consumers. Another drawback of E-Business is that it barricades the face-to-face interaction between the actual seller and buyer, and the possibility of negotiating the price of a product or service becomes nil.

Table 1:Major Benefits of E-Commerce

S.N.	Benefits	Brief Explanation
1.	Global Marketspace	Connecting organizations and customers across geographical boundaries
2.	Least operating cost	Savings on storage, physical shops, etc
3.	Pull-Type Marketing	Customization of individual customer requirements.
4.	Digital product/service	Downloading of Music, movies, or other services of banking through the Internet
5.	No specific work Hours	Customers and suppliers contact &communicate as per their time of Convenience
6.	Medical Service	Online Medical consultation is now possible

6. CLOUD COMPUTING AND E-COMMERCE –VIABILITY

Through the support of Cloud Computing, the retailers are able to customize their customer's demands & requirements and have unique features in their applications and services [19].Moreover, it has been observed that through cloud computing technology, online retailers can expedite the delivery of goods to their customers and intensify their production with lesser operational expenses [19]. It enables the retailers to offer discounts to their customers as compared to the local markets[19]. Cloud computing is cost-effective for the e-commerce business as it helps to save the "cost of IT infrastructure" [16].
The present era is the technological era of the corporate. The innovation in the Information technology sector is booming the growth of trade and business, especially e-commerce. "Cloud Computing" [20,21] is one such technology that is not only leveraging the operative cost minimization but also fosters efficient services, data security, record and disbursement of products, and optimal utilization of resources [22].Further Cloud computing supports the internal working of the organization, such as sending and receiving emails to and from customers and clients, taking care of customer grievances and relationships, sending product information to consumers, and advertising goods & services via the Internet [22].Moreover,

the threat of data leakage is alleviated by using cloud computing technology as the SaaS model provides for an "economically dependable E-commerce system"[23]. Cloud computing eases e-commerce transactions by inducing the following factors, as shown in figure 6[23].

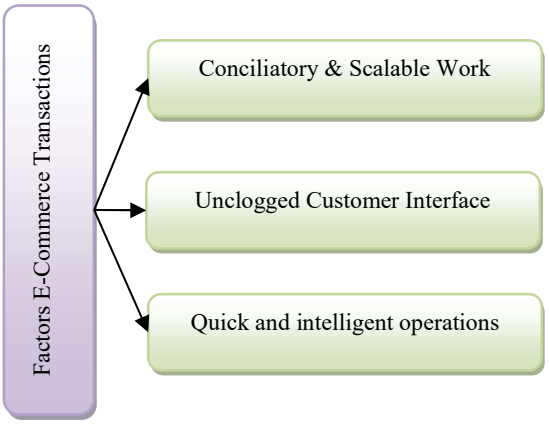

Figure 6: Factors E-Commerce Transactions

It is through Cloud Computing that provides for a conciliatory and scalable work processes within the organization to manage the surge of individual demands and advertisement of their products & services. It also supports the company to act impromptus to facilitate services & delivery in different geographical locations. Moreover, the Cloud Computing technology provides for an unclogged customer interface in terms of ordering and delivery of products and handling grievances, if any. In addition to this, another aspect of cloud computing is being developed, 'interoperability', which will support sharing of information between the 'clouds and communities of cloud', which shall connect the users, marketers, other vendors, and purchasers for varied transactions [24].

7. CLOUD COMPUTING

Almost all the sectors government, semi-government or corporate are adopting the cloud technology in their firms due to two major factors i.e., efficiency and less cost that helps to improve the revenues for the all sectors as said before.

Cloud Computing [20,21] is a set of various concepts based on computation, and it has multiple computers which interact with each other in real-time applications. It works on well-known principles [25] *"pay and use of the resources for the end-users*'', and this end-user experience is boosted while using this resource in real-time. Several facilities [26] are provided by cloud computing, such as data processing servers, web data stores, tremendous computing resources and many more. The concept of cloud computing came in the year 1950s, but this technology was not discussed in a broad sense; lately, it is developing at rapid speed in the entire world of technology. Amazon first discussed cloud computing in the modern erain 2002. Subsequently, other companies such as Yahoo, Google, etc.have set out to use this technology in their organizations and provide services to the customers through it. As per the National Institute of standards and technology (NIST)," the major objective of cloud computing is to maximize the shared resources, and at the same time, the disadvantage is its high infrastructure cost and unnecessary power consumption." [26].

Cloud computing can be realized using four [27,28] *deployment models,* and it offers *services using three different models, a*s shown in **Figure 7**. The deployment model is formally defined as the architecture that uses cloud environments by the customers or end-users. It depends on three factors such as location, availability, and infrastructure. The deployment models are divided into four categories: public, private, community,,and *hybrid* clouds.Service model is associated with customers and corporate requirements; it is sometimes called stack layer architecture which consists of control, security, and reliability at the various levels. Three major classifications of service models such as *Software as a Service (SaaS), Platform as a Service (PaaS),* and *Infrastructure as a Service (IaaS),*as shown in **Figure 7.** The details of the classification of deployment and service models are given in Table 2

Table 2: Cloud Deployment Models

Model Types		Brief Explanation
Deployment Models	Public Cloud	✓ It can be accessed by all, such as the general public, educational institutions, business organizations, government, or semi-government organizations. ✓ It is a common platform based on the principle "pay and use the resources using the Internet connection. ✓ It is controlled by the cloud service provider. ✓ Common examples of public Cloud are email, social networking websites, etc. ✓ Some reputed organizations provide the public cloud platform: Amazon EC2, Sun Cloud, Google cloud, etc.
	Private Cloud	✓ It is mainly used by some organizations where unauthorized accessibility of the Cloud does not allow. ✓ The organization has both the option to control this Cloud either by own or by cloud service provider. ✓ It is also known as corporate Cloud or sometimes internal Cloud because it is used in specific organizations for their internal usages. ✓ It provides more security and privacy than the public Cloud. ✓ Some examples of this category are HP data center and Ubuntu.
	Community Cloud	✓ System and service are two attributes of the Cloud which are shared by the collection of organizations. ✓ The purpose of this Cloud is to share the relevant information among them. ✓ This Cloud is controlled by the cloud service provider or collection of the organization belongs to this Cloud.
	Hybrid Cloud	✓ It is the combination of two cloud categories. ✓ There may consists of complex tasks which is handle by the private Cloud and non-complex tasks is handle by public cloudi.e., the organization keeps the general information on public Cloud which is accessed by general users and confidential information on private Cloud which is accessed within the organization and authorized persons only. ✓ Finance, healthcare, and educational institutions are the primary users of the hybrid Cloud. ✓ This Cloud is controlled and managed by third-party or Cloud service providers such as Amazon, Google, and HP.
Service Models	Software as a Service (SaaS),	✓ Another name for SaaS model is on-demand software model due to all Software as per the requirement of the end-user is accessed over the Internet rather than installed in their system. It helps to reduce the cost of service for end-users. ✓ This model provides four types of service: mail service, social network, document management, and business services. ✓ It works on the "pay-and-use the services" principle. ✓ It has several benefits: easy to use, easy to handle, low maintenance cost and easy to API integration etc. ✓ Security and latency are the major issues of this model. ✓ Mainly this service is provided by Microsoft, Saleforce.com, Google App., NetSuite, and Oracle CRM.
	Platform as a Service (PaaS)	✓ PaaS provides the backend for the end-user, i.e., runtime environment includes programming framework, database management system tools, and some other related tools. ✓ Major cloud service providers are Google App Engine and Azure.
	Infrastructure as a Service (IaaS)	✓ It is also known as the hardware supporting layer. ✓ This model provides four types of service: load balancing, computation, networking infrastructure, and storage. ✓ Two Major issues are security and interoperability.

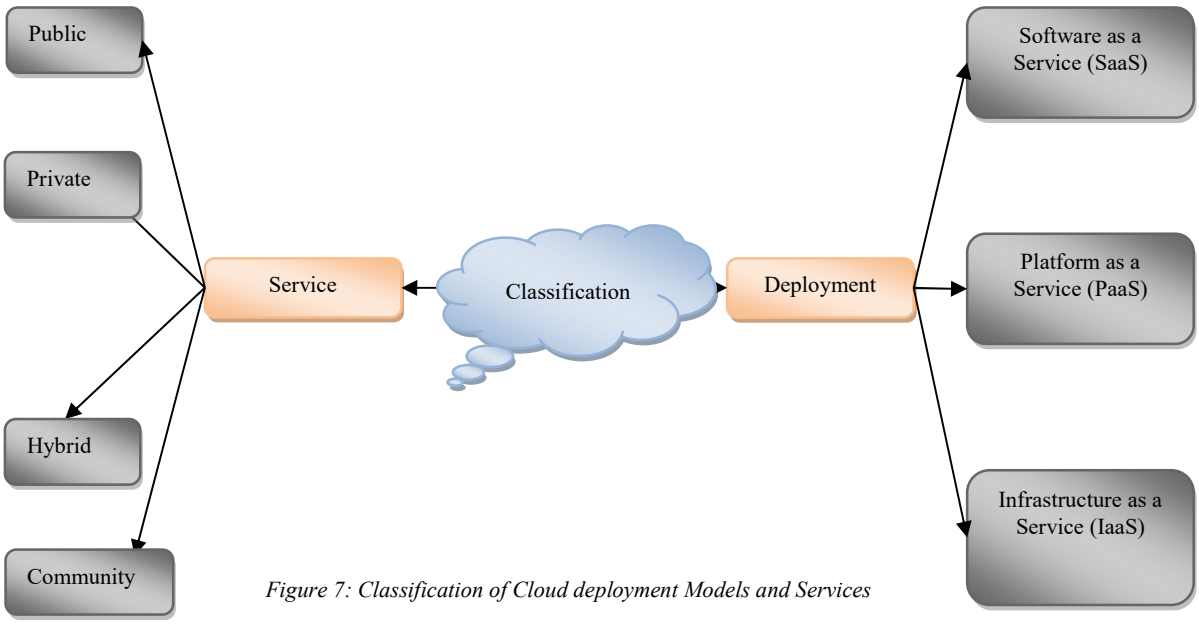

Figure 7: Classification of Cloud deployment Models and Services

8. PROPOSED FOG-ENABLE CLOUD COMPUTING MODEL FOR E-COMMERCE

Online marketing, or simply digital marketing using electronic devices such as personal computers, mobile phones, laptops, and other electronic mediums, was started two decades ago. The primary objectives of online marketing are to improve the products' sales at a faster rate, increase annual income, brand their products on a large scale, and reach the maximum number of customers. Electronic Commerce (E-Commerce) is one of the key examples of digital marketing where they sell and buy the products to the customers as well as perform the transactions of funds from customers over the Internet platform. The efficient design of E-Commerce models provides hassle-free products selling and transactions of funds, which ultimately leads to improved flexibility and higher capital annual income. The conventional E-Commerce model was suggested by Wang [29], which has five major components adopted as abstraction in our proposed model. The components of Wang's E-Commerce model [29] were *hardware supplier, software developer, IT Service Provider or IT Consultant, Internet Service Provider (ISP), and System Integration Provider.*

Our proposed e-commerce model is given in Figure 8. It is challenging to maintain the e-commerce model due to inherent complexity in terms of the number of products, sellers, and customers. Each component has its requirement for maintenance due to the dynamics of products and customer demand.

For example, the hardware devices and Software may fail to perform efficiently due to increased peak traffics on festive sells and some discount, which ultimately leads to reduced credibility and popularity of the business, reduced customer satisfaction, transaction failures, and annual capital income.

To mitigate the upfront investment and risk of failure, cloud computing can be used to support the e-commerce system. Cloud computing reduces almost all the overheads of extra expenses to maintain the E-Commerce backend. It reduces up-front investment, i.e., there is no need to purchase the hardware, advanced Software, or backend IT infrastructure. Here, only pay rent for all infrastructure and platform required for the system, and the rest of the system are maintained by Cloud Service Provider (CSP). This technology is helpful to increase the annual income of the business, and it also improves the operational part of the products. This section proposes a novel e-commerce model for digital marketing. The proposed model includes internet-of-things (IoT) users, Edge Layer Fog layer and cloud layer as well as E-commerce layer.

The proposed model is classified into the following five major levels.

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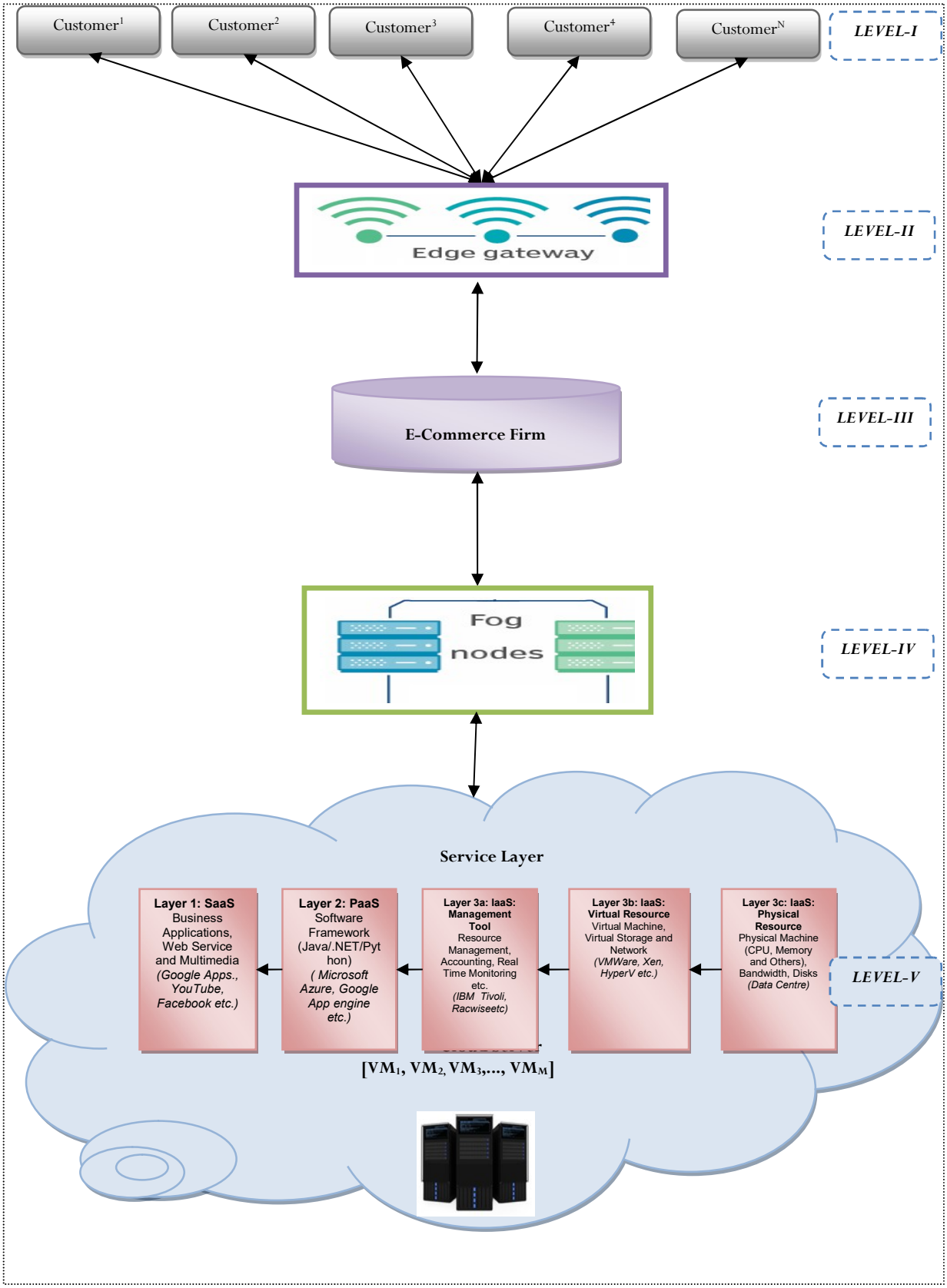

Figure 8: Proposed Framework for E-Commerce with Cloud Platform

- ***Level-I:*** *This is an essential level of this system which consists of a finite N number of customers such as Customer1,Customer2..., Customer N who request products and services from the system. The customers acquire the services using internet-of-things (IoT) devices; therefore, level-I corresponds to internet-of-things (IoT) devices.*
- ***Level-II:*** Due to a greater number of customers, the volume and velocity of data generated increases rapidly, which becomes a major reason for delayed and poor services. Layer II creates a layer of "edge" devices to keep traffic and processing closest to the customer devices. Layer II, i.e., the edge layer, manages the processes on customer devices and is responsible for sensing and acting on other peripheral devices. The layer II nodes create data from IoT devices using communication protocols as per cloud computing standards. The functionalities of this layer are message routing, device monitoring, data clean-up and aggregation, and others.
- ***Level-III:****TheE-commerce firm* is in the third level, which provides the communication end for the customers as the website of the products. Using layer III, the customers can interact with the business organization, place an order for the products or services as per their choices, and perform financial transactions for the service or products. The quality of services offered by the organization depends on the edge layer (layer II), fog layer (layer IV) as well as on cloud server layer (layer V).
- ***Level-IV:*** Layer IV (fog layer) can be placed between edge and e-commerce layers or between e-commerce and cloud server layers. In this work, we propose to place the fog layer between e-commerce and cloud server layers in order to exploit the dual benefits, i.e., this placement will be helpful to analyze the data of transactions performed by customers and e-commerce business organizations. Since financial transactions are required to complete between customers and e-commerce organizations,the fog layer can play a crucial role. Fog computing [34]or fog layer nodes perform heavy real-time processing that the Cloud nodes otherwise do. But, the latency due to round trip to the Cloud may reduce the significance and usefulness required to perform real-time operations. Fog nodes bring real-time analytical processing near to customers, above and beyond the messaging, as well as routing functionality of layer II nodes. This layer's functionalities are real-time analyses of data generated by the nodes of layers I, II, and III.
- ***Level-V***: The level Vis the actual cloud computing, which consists of servers provided by Cloud Service Provider (CSP)on a pay-as-you-go basis. Upon receiving the authorization from CSP, the SaaS, IaaS, and PaaS can be controlled, accessed, and managed remotely as the needs. There are some major tasks of the cloud server such as host, delivery of services, storage, processing of information, and application on cloud environment using the Internet. Cloud computing consists of M number of finite virtual machines such as VM_1, VM_2, VM_3,..., VM_M. The role of VM is to provide fast request processing while multiple requests come simultaneously; that is, it reduces the workloads and provides speedier information processing. It is also associated with a large volume of information storage. This level is directly connected with service layers. The VMs are scheduled and executed on physical servers of cloud computing [30].

9. POTENTIAL BENEFITS OF THE PROPOSED MODEL

E-Commerce based on traditional technologies such as IT infrastructure elevates business growth and increases the number of customers because they can now order their products from anywhere and anytime. But there were various issues such as data security, fast access to the product information, hacking of customer information, online payment transactions security, and many more. These issues are solved using the cloud-based platform, which provides many benefits explained in Table 3 and depicted in Figure 9.

Table 3: Brief Description of benefits of Cloud Computing in E-Commerce

S. No.	Benefits	Brief Description
1.	Cost Saving	✓ Cloud Computing has optimized the companies' costof unnecessary purchasing or IT infrastructure set up in their premises. ✓ All resources related to IT are on rent basic from Cloud Service providers.
2.	Scalability	✓ It is one of the prime benefits of cloud-based e-commerce. ✓ It helps to track the IT resources utilization, which can be high or low. ✓ It allocates the resources when required by the user in the cloud platform, and similarly, it removes the resources when no longer used by the user on the same platform.
3.	Efficiency	✓ It is one of the critical parameters for any business organization. ✓ It is related to the fast capture of the global market for product sales and services. ✓ It is capitalized on business using the latest technology such as Cloud. ✓ It is the business efficiency that is growing using cloud technology.
4.	Easy Handle	✓ It reduced the handling cost of Software, hardware, and infrastructure related to IT. ✓ It is not very complex to handle IT resources because most are on the cloud service provider side.
5.	Availability & Mobility	✓ Both availability and mobility are essential benefits for the customer side. ✓ They follow the famous tag "*anytime and anywhere"* the customers can access various services and products using their smartphone, laptop, or any smart device.
6.	Global Expansion	✓ Business organizations are gaining popularity and expanding their business using this technology because it is spread worldwide where the customer can access their services and products anytime and anywhere. ✓ It helps to reduce both access time and cost for the customer side and the organization.
7.	Interoperability	✓ It is the relationship between the systems where they can exchange their information for the business. ✓ Similarly, they can exchange information within the clouds. ✓ It provides the framework to access the information for customers, vendors, and others within the cloud platform.
8.	Quality of E-Commerce	✓ Quality is a core parameter for E-Commerce, and it depends on the computing service. ✓ Computing services should be allowed to access the products or services 24x7 for customers from any corner of the world. ✓ There is three leadingQuality of Service (QoS) parameters: reliability, scalability, and flexibility.
9.	Redundancy	✓ Redundancy in cloud-based E-commerce is concerned with the fast recovery of losses of customers and organizations due to disaster or some accidental. ✓ It helps to fast access, backed-up and secure data. ✓ It helps to smooth the running of the business without fear of data loss.
10.	Speed	✓ It is an essential parameter of the business world for both products and services for the customers. ✓ A cloud-based E-commerce platform is easy and fast to install and execute.
11.	Security	✓ The cloud-based platform provides the security and accuracy of data by third-party certification. ✓ It includes biometrics screening and data encryption.
12.	Trust	✓ Trust is associated with the platform used for product sales, and purchases are secure or not. Due to online transaction of payment and selecting the right choice of products are correct or not. ✓ The cloud-based platform provides this trust.

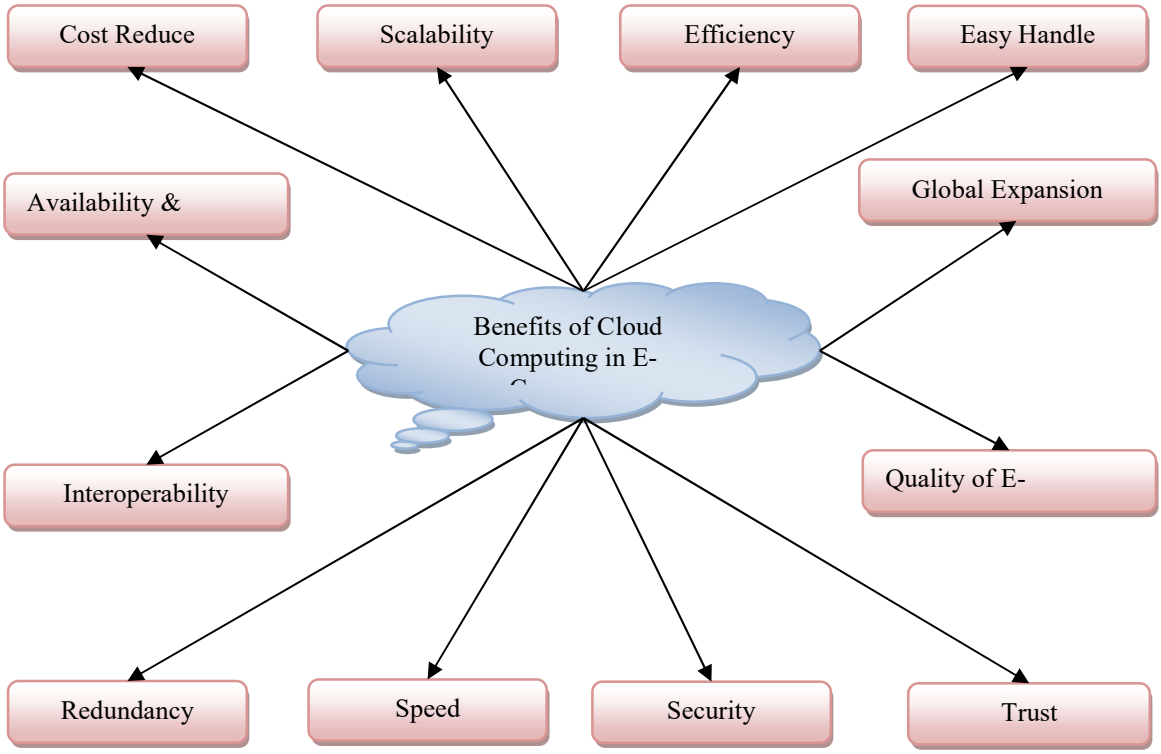

Figure 9: Benefits Cloud in E-Commerce

10. MAJOR ISSUES OF E-COMMERCE ON CLOUD PLATFORM

Data are the primary concern of both customers and associated companies in the business world. Data associated with the customer, such as account information, transaction information, purchase information, etc., should be secured and hidden from unauthorized persons.

Similarly, data associated with companies such as product supply information, product demands information, number of customers related to that companies, daily transaction information, etc. This information's security is generally provided by Cloud Service Providers (CSP) in the cloud computing platform. The following issues [17,31] of E-Commerce in a cloud computing platform are shown in Figure 10 and their brief details in Table 4.

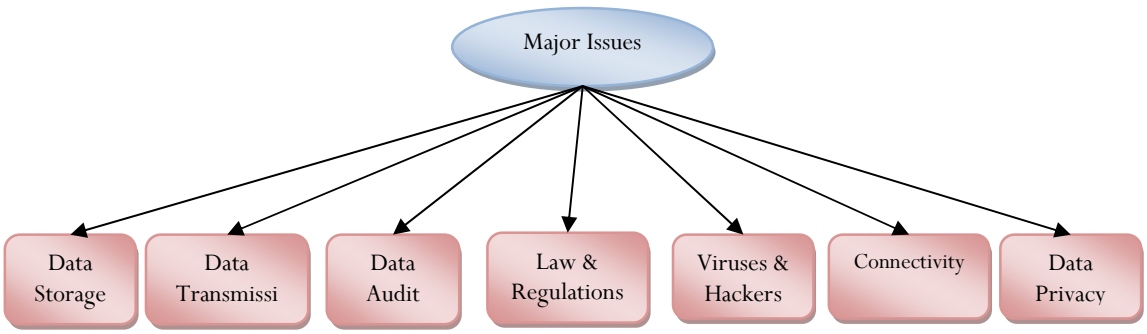

Figure 10: Major issues of E-Commerce in Cloud Platform

Table 4: Major Issues

S.No.	Issues	Brief Explanations
1.	Data Storage	✓ It is one of the primary concerns associated with two levels: customer and corporate business levels. ✓ Their information is enormous and stored in the data center of the cloud platform. ✓ E-commerce corporate is abstracted about their data storage and their location in the cloud platform. ✓ This corporate is mainly concerned with the operational part of using cloud platforms even though any natural disasters happen. ✓ Data security is also one of the parameters in data storage.
2.	Data Transmission	✓ The transmission between the customer and corporate in cloud platform via Internet. ✓ It is one of the issues where data encryption should be ensured that both the customer and corporate are secured enough. ✓ It should be banned the unauthorized access tothe customer and corporate information.
3.	Data Audit	✓ Auditing data is an essential issue in the corporate, and it is general practice to ensure data accuracy. ✓ It is done by the certification of a third-party. ✓ Safety, security, and accuracy of data in the cloud platform. It provides to the third party for certification prior take permission from the concerned corporate. i.e., it provides security risk.
4.	Law & Regulation	✓ Both law and regulation are the major concernsin the recent era of the technological world. Otherwise, everyday fraud will be happening in the IT world. ✓ E-commerce in cloud computing platforms is very recent, and it has many risk factors with it. ✓ To control all the risks of this platform by the cloud service providers. ✓ Definitely, there may be various disputes between the customers and corporate, which has made some laws and regulations to solve disputes.
5.	Viruses & Hackers	✓ Protecting e-commerce in the cloud platform from viruses and hackers is a challenging issue. ✓ The hacker's major objective is to make a malicious application program to attack emerging technology and try to access all confidential information. ✓ It is challenging to identify and remove.
6.	Connectivity	✓ The essential component of cloud technology is Internet Connectivity and its speed. ✓ Connectivity is one of the major issues for this platform because all the customers can use e-commerce in a cloud platform using the Internet.
7.	Data Privacy	✓ It is very challenging to protect the customer's data, such as their purchase details, transaction details, and the mode of transaction. ✓ Today, there is no 100% technical solution for the data protection of the customers.

11. CONCLUSION

E-Businesses,i.e., B2B, C2B, B2C, or C2C, have gained prominence in the present era especially due to COVID-19 lockdown. The connectivity via the Internet has enhanced the selling experience. It has also created a platform of the direct and indirect interface between the actual customer and the seller/manufacturer through the different web-based applications. From physical goods to the supply of raw materials, from music and movie downloads to medical consultation, customer requirements and demands are being fulfilled by e-commerce companies. The problem of creating and maintaining an extensive customer database with their purchase preferences is solved through cloud computing technology. This paper proposes a novel e-commerce framework based on fog-enabled cloud computing. The elements, benefits, service models, deployment models, and major challenges are highlighted. The essential feature of cloud computing is that it creates 'communities of cloud' to establish efficient connectivity between the manufacturers, sellers, buyers, and actual vendors and customize each customer's preference. Cloud computing technology working through the public, private, community, and hybrid cloud deployment models; SaaS, PaaS, and IaaS service models makes the complex task easier, reduces the cost of

service so provided, supports programming, and facilitates security and interoperability. The proposed fog-enabled cloud computing model can support E-commerce organizations in every business domain.

In the future, we will explore different load balancing and scheduling techniques to execute the workload of E-Bussiness on realize Fog-enabled cloud computing [35-37].

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