Market-oriented Internet of Thing and Computing utilities of Future Directions

Dr. Ashish Tiwari Apoorv Pachori Akash Shukla

Computer Science & Engineering Computer Science & Engineering Computer Science & Engineering

Amity University Lucknow, India Amity University Lucknow, India Amity University Lucknow, India

Atiwari3@lko.amity.edu apoorv.pachori0803@gmail.com akashshukla2311@gmail.com

Pragya Sharma Prachi Dubey

Information Technology Computer Science & Engineering

Amity University Lucknow, India Amity University Lucknow, India

pragya.sharma6@s.amity.edu dprachi807@gmail.com

## ABSTRACT

Cloud computing, in simple words is known as a service where a per-son/organization can rent the computing services such as servers, storage, databases, software, etc. over the internet instead of buying them and managing them by our own. All these services are provided by the company beforehand. The paper discusses the concept of cloud computing and its potential to become the fifth utility, alongside water, electricity, gas, and telephony. It explores different computing paradigms like cluster computing, grid computing, and cloud computing. The authors define cloud computing and propose an architecture for creating cloud environments with market-oriented resource allocation using virtual machines (VMs). They also discuss market-based resource management strategies and the interconnection of clouds for creating global cloud exchanges and markets. The paper highlights representative cloud platforms and the authors' work on market-oriented resource allocation. It emphasizes the need for convergence among competing IT paradigms to achieve the vision of computing as a utility in the 21st century.

**Keywords**— Cloud computing, parameters, management of services, IoT Applications

## INTRODUCTION

Cloud computing is an approach in which computing services are provided in a way such as basic utility things such as electricity, water, etc. are provided. The user can access his data from anywhere and anytime and these services are made feasible by the service provider. Big companies such as Google, Microsoft, etc. have made their data centers all around the world. Cloud Computing services are much cheaper from other utility things such as electricity and water. The required guarantee is provided through SLAs by the service provider to the customers [1]. The users can receive the cloud compu-ting services according to their needs without investing in complex IT infrastructure. This vision can be a result of various computer paradigms such as Grid Computing, P2P Computing, Service Computing and Market oriented Computing. Grid computing solves large scale problems by providing the pooling of the distributed resources. P2P computing allows direct content exchange corporate activities. Market oriented computing provides the economic model for resource allocation. Cloud computing services are provided by the Data centers and the user can access the data from anywhere. Cloud Com-puting services seems rise exponentially [2].

Cluster computing, Grid Computing and Cloud Computing are clusters of networked computers that operate as a single resource. With the help of Grid we are able to share and select the distributed resources across multiple domain. Cloud computing refers to next-generation data centers with virtualized computers that are distributed based on service level agreements. Cloud Computing combines the qualities of clusters and grids and provides virtualization composable ser-vices and supports for third party services. According to a Web search cluster computing was popular in 1990’s, after-wards Grid computing and in present the cloud computing. Several news events related to Cloud Computing is being ac-crued from years which shows the growth in this business. The trends shown in figure 1 towards computing provide defi-nitions and characteristics of clusters, grids, and clouds in the context of computing systems. They define clusters as a collection of interconnected computers working together as a single computing resource. Grids are defined as distributed systems that enable the sharing and aggregation of geographically distributed resources based on their availability and performance [3].

Figure 1. Computing exporing services.

Clouds, on the other hand, are defined as distributed systems consisting of interconnected and virtualized computers that are dynamically provisioned based on service-level agreements. The authors highlight that clouds are next-generation data centers with virtualized nodes, provisioned on demand, and accessible as composable services via web service technolo-gies. The article also discusses the characteristics that distinguish clusters, grids, and clouds. Clusters have resources lo-cated in a single administrative domain and are managed by a single entity [4]. Grids, on the other hand, have geograph-ically distributed resources across multiple administrative domains with their own management policies. In terms of re-source scheduling, cluster systems focus on enhancing overall system performance, while grid systems prioritize meeting the quality-of-service requirements of specific applications. Cloud computing platforms combine characteristics of both clusters and grids and offer support for virtualization, dynamically composable services, and the creation of value-added services [1]. The authors further analyze web search trends related to cluster computing, grid computing, and cloud com-puting, indicating the popularity of these paradigms over time. They also provide a high-level architecture for mar-ket-oriented resource allocation in data centers and clouds, involving entities such as users/brokers, SLA resource alloca-tor, VMs, and physical machines.

The article emphasizes the need for market-oriented resource management in cloud computing to meet specific QoS pa-rameters negotiated in service-level agreements, provide economic incentives for consumers and providers, and differen-tiate service requests based on their utility[2]. This paper provides a comprehensive survey of the Internet of Things (IoT) by focusing on enabling technologies, protocols, and application issues. It explores the concept of IoT, where physical ob-jects are connected to the Internet and collaborate without human involvement. The paper discusses the latest develop-ments in RFID, smart sensors, communication technologies, and Internet protocols that enable the IoT. It emphasizes the potential applications of IoT in various domains such as smart homes, transportation, healthcare, industrial automation, and emergency response. The survey summarizes relevant protocols and application issues, aiming to provide a thorough understanding without requiring readers to delve into technical specifications. Additionally, it highlights the challenges faced by IoT and its relation to emerging technologies like big data analytics, cloud computing, and fog computing. The need for better horizontal integration among IoT services is discussed, and detailed use-cases illustrate how different protocols can work together to deliver desired IoT services. The paper concludes with insights, lessons learned, and future directions for IoT research and development [8].

Lastly, the authors mention the importance of customer-driven service management, computational risk management, market-based resource management strategies, autonomic resource management, and the use of VM technology in mar-ket-oriented cloud offerings to satisfy service requirements and ensure SLA-oriented resource allocation [4]. The Internet in its initial times tried to connect human beings like we can talk to our friends, family, and relative sitting anywhere and anytime. We can call this “Internet of Humans”. Similarly, if we look at IOT, all the electronic devices consisting of various hardware and software and when connected to the internet form the Internet of things (IOT). The Internet of Things (IoT) is a concept in which the physical objects are connected to the internet. It includes smart home devices such as thermo-stats and HVAC systems as well as applications in transportation, healthcare, industrial automation, and emergency re-sponse. The Internet of Things allows these items to connect with one another, share information, and in decision making. Residents living in smart houses, for example, can open their doors automatically, regulate climate systems and run ap-pliances. New technologies should be created to fulfil market demands and customer expectations to support the expan-sion of the IoT. It is also important to standardize the architecture and solve security and privacy concerns [12].

For equipment manufacturers, internet service providers, and application developers, the Internet of Things (IoT) repre-sents a significant business opportunity. It was estimated that many IoT smart objects would come in use, globally till the end of 2020, and M2M (Machine-to-Machine) communication would account for a significant amount of internet traffic. The expansion of IoT-based services is expected to have a significant economic impact, especially in the healthcare and manufacturing sectors. Few examples of healthcare applications are Mobile health and telecare. Healthcare applications and services like mobile health and telecare are predicted to generate an annual revenue of trillions of dollars for the global economy. The industrial Internet and building automation systems are also expected to grow rapidly. These figures show the rapid increase of the Internet of Things in the future. It would create chances for traditional manufacturers to transform their products into smart gadgets. For the promotion of global development of the IoT, Internet service provid-ers should modify their networks to support the different traffic flows of M2M, person-to-machine, and person-to-person communication [15].

## MANAGEMENT OF SERVICES

The paper discusses resource management strategies for market-oriented clouds. It emphasizes the importance of cus-tomer satisfaction and proposes SLA-oriented resource management strategies that focus on personalized attention to customers, trust-building measures, and understanding specific customer needs. The paper also explores the use of risk analysis in managing risks associated with utility-based resource management. Additionally, it highlights the role of virtu-alization in dynamically allocating resources to meet changing user demands [18]. The paper further discusses the concept of global cloud exchanges and markets, which aim to create a standardized interface for cloud services and enable trading in services. It presents a market infrastructure model and describes the roles of consumers, providers, and brokers in such markets. The challenges and considerations for implementing utility markets for computing resources are also discussed. The summary discusses emerging cloud platforms and compares six representative cloud platforms with industrial link-ages: Amazon Elastic Compute Cloud (EC2), Google App Engine, Microsoft Azure, Sun Grid, Aneka, and a .NET-based ser-vice-oriented resource management platform called Aneka. The summary highlights the potential of cloud computing, which is projected to be a $160-billion market opportunity according to industry analysts. It mentions the shift towards providing Platform as a Service (PaaS) and Software as a Service (SaaS) for consumers and enterprises. The six cloud plat-forms are described briefly, highlighting their features and functionalities [12]. For example, Amazon EC2 provides a virtu-al computing environment, Google App Engine allows running web applications, Microsoft Azure offers a comprehensive development and hosting environment, Sun Grid enables running various applications, and Aneka is a .NET-based re-source management platform. The summary also introduces the concept of market-oriented resource pricing and alloca-tion in the Aneka Cloud. It explains the bi-hierarchical advance reservation mechanism and describes how pricing and al-location decisions are made based on user requirements and available resources. The performance evaluation section discusses the use of Aneka Cloud for High-Performance Computing (HPC) and Internet-based services workloads. Overall, shown by figure 2 the summary provides an overview of emerging cloud platforms and highlights the features and pricing mechanisms of the Aneka Cloud platform. The Internet of Things (IoT) presents a significant market opportunity for equipment manufacturers, internet service providers, and application developers. The deployment of IoT smart objects is projected to reach 212 billion entities globally by the end of 2020. M2M (machine-to-machine) traffic flows are expected to account for up to 45% of internet traffic by 2022. The number of connected machines has grown by 300% in the past five years [2].

Figure 2. Computing management system.

The economic impact of IoT-based services is substantial, particularly in healthcare and manufacturing. Healthcare appli-cations and related IoT services are estimated to generate $1.1–$2.5 trillion in annual growth for the global economy by 2025. The overall economic impact of the IoT is predicted to range from $2.7 trillion to $6.2 trillion by 2025. The industri-al Internet is also expected to create significant value, with a projected worth of $1,279 billion in 2020. Additionally, the Building Automation Systems market is anticipated to experience a 60% increase from $58.1 billion in 2013 to $100.8 billion by 2021. These statistics indicate a substantial growth opportunity for the IoT and related industries. Traditional equipment manufacturers have the chance to transform their products into smart devices. To facilitate global IoT adop-tion, internet service providers need to provision their networks to ensure quality of service (QoS) for various traffic flows, including M2M, person-to-machine (P2M), and person-to-person (P2P) communication. The future of cyber security is closely linked to the future of computing, particularly with the increasing popularity of cloud computing. This shift to-wards cloud-based systems has significant implications for cyber security practices. Instead of focusing on securing indi-vidual user machines, preventing malware access, and managing removable media, a cloud-based security approach must prioritize secure communication with remote systems.

One of the key challenges in cloud security is safeguarding the data stored on cloud servers. Cloud service providers han-dle large amounts of data, making them attractive targets for attackers. It is crucial to protect these servers while still maintaining the flexibility to support services for clients. Another important aspect is client authentication. Clients need to regularly authenticate themselves to various remote service providers. The current approach of using passwords for authentication is not scalable and often leads to poor security practices. Therefore, there is a need to develop a more ef-fective authentication method.

## PARAMETERS OF COMPUTING

The Meta-Negotiation Middleware (MNM) is a prototype implementation for establishing a global Cloud exchange and market infrastructure for trading services. It enables negotiations between different service providers and consumers by bridging the gap between proprietary service interfaces and negotiation strategies. The MNM utilizes meta-negotiation documents to define the negotiation prerequisites, protocols, and conditions for agreement establishment. It involves the use of a registry to publish and discover negotiation documents. The Aneka Clouds system acts as the service provider, while the Gridbus Broker serves as the service consumer. The MNM facilitates the integration of the meta-negotiation framework into existing client and service infrastructure.

MetaCDN is a system that leverages existing infrastructure provided by "Storage Cloud" providers to create a low-cost, high-performance content delivery network (CDN). It utilizes multiple storage providers based on quality of service, cov-erage, and budget preferences to deliver content in a transparent and fast manner. MetaCDN provides a single namespace that spans all supported storage providers, making integration into origin websites easy. It offers an alternative to tradi-tional CDN providers like Akamai and Mirror Image, with lower costs and no ongoing contracts. Storage Cloud providers like Amazon S3 and Nirvanix SDN are used to provide storage and delivery capabilities. The MetaCDN system is accessible through a web portal or RESTful web services and offers connectors to interact with each storage provider. The Internet of Things (IoT) requires a flexible layered architecture to connect heterogeneous objects through the internet. Various pro-posed architectures exist, but a common reference model is yet to emerge. One widely used model is the 5-layer archi-tecture, which includes the Objects Layer (physical sensors), Object Abstraction Layer (data transfer and management), Service Management Layer (middleware for pairing services), Application Layer (provides requested services), and Busi-ness Layer (manages system activities and services). The 5-layer model accommodates different technologies, supports decision-making processes based on big data analysis, and enables interaction with end-users. It is considered the most applicable architecture for IoT applications due to its simplicity and scalability. The IoT (Internet of Things) is composed of various elements that work together to deliver its functionality. These elements include: Identification: Identification methods, such as electronic product codes (EPC) and ubiquitous codes (uCode), are used to name and match services with their demand. Addressing methods, such as IPv6 and IPv4, differentiate between object ID (name) and address within a communication network. Sensing: IoT sensors gather data from objects within the network and send it to a data ware-house, database, or cloud. Smart sensors, actuators, and wearable sensing devices are examples of IoT sensors. Commu-nication: IoT communication technologies connect heterogeneous objects to deliver smart services. Communication pro-tocols like WiFi, Bluetooth, RFID, and LTE-Advanced enable communication between IoT nodes. Each protocol has its own range, data rate, and characteristics suited for different IoT applications. Computation: Processing units (microcontrollers, microprocessors, SOCs, etc.) and software applications form the computational backbone of the IoT. Hardware platforms like Arduino, Raspberry Pi, and software platforms like Contiki RTOS and TinyOS are utilized for IoT applications. Cloud platforms play a vital role in processing big data collected from smart objects. Services: IoT services can be categorized into identity-related services, information aggregation services, collaborative-aware services, and ubiquitous services. These services enable real-world objects to be brought into the virtual world and provide various functionalities for dif-ferent IoT applications such as smart home, smart buildings, intelligent transportation systems, industrial automation, smart healthcare, and smart grids. Semantics: Semantic technologies allow machines to extract knowledge and make sense of data to provide the required services. Semantic Web technologies like RDF and OWL enable the exchange and modeling of information in the IoT. Efficient XML Interchange (EXI) format is designed to optimize XML applications for resource-constrained environments in the IoT. Understanding these IoT elements is crucial for developing and deploying IoT applications effectively. Interoperability and standardization challenges arise due to the diversity of protocols and technologies used in the IoT, requiring solutions to ensure seamless integration and realization of ubiquitous IoT services.

## APPLICATION OF COMPUTING SYSTEM

Cloud computing systems have become increasingly vulnerable to attacks. Additionally, while these providers may cur-rently be trustworthy, they are not immune to business failures. In the event of a cloud provider's business failure, user data may be sold off as an organizational asset. Furthermore, if a cloud provider is acquired by another organization, the acquiring entity would gain access to the user's information. Currently, most cloud data is stored either in an unencrypted format or in an encrypted format where the cloud provider holds the encryption/decryption keys. To address this, it is proposed to restrict cloud data stores to handling only encrypted data and require explicit user approval for data access. Instead of involving the user in encryption/decryption processes, a third-party broker could be used to provide unlocking support to the cloud, allowing the cloud to decrypt specific data pieces required to fulfill a user's request. This approach ensures that resource-constrained devices can interact with the cloud while maintaining data security. It also prevents insiders or external attackers at the organization from accessing user data that is not actively being processed by the cloud.

The continued adoption and advancement of security mechanisms in cloud computing will likely impact various aspects of computation, networking, and the cybersecurity landscape. This shift may influence the usage of malware, organizational auditing and insider threat detection, social engineering attacks, and traditional revenue streams for Internet Service Pro-viders (ISPs). Advancements in virtual machine isolation, homomorphic encryption, client authentication, resource man-agement, and secure opportunistic computing will facilitate the adoption of cloud computing while ensuring enhanced security and privacy for users. This newly created file, highlights all of the contents and import your prepared text file. You are now ready to style your paper.

Figure 3. Computing management trending years.

The Internet of Things (IoT) necessitates the implementation of security and privacy measures due to the diverse range of interconnected objects and the capability to monitor and control physical objects. CoAP is a secure protocol that en-sures message integrity and confidentiality through DTLS. IEEE 802.15.4 is a protocol designed for low-rate wireless per-sonal area networks. It provides reliable communication, low power consumption, low data rates, affordability, high mes-sage throughput, and robust security Features. When developing IoT applications, it is important to consider factors be-yond just standards and protocols. Security and interoperability are also crucial considerations. Conventional security protocols used on the Internet may not be adequate to secure the new features and mechanisms of the IoT. Therefore, new protocols and architectures are required to address security concerns at all layers. Codo is a security solution de-signed for the Contiki OS that improves performance by caching data for bulk encryption and decryption [18]. The IEEE 802.15.4 security protocol provides mechanisms to protect communication between neighboring devices at the link layer, ensuring secure transmission of data. TLS is commonly used to provide security for TCP communications, whereas DTLS is typically used to secure UDP communications. Security solutions at the application layer often rely on security protocols implemented at the transport layer. Lithe is a CoAP security solution that utilizes a compressed version of DTLS. MQTT security solutions typically rely on TLS/SSL protocols, but a standard is being developed by the OASIS MQTT security sub-committee. Both XMPP and AMQP utilize TLS and SASL protocols to secure their communications. Intrusion Detection Systems may be necessary to address wireless vulnerabilities in IoT (Internet of Things) environments. As shown in figure 3 realization of the IoT vision poses several challenges, including ensuring availability, reliability, mobility, performance, scalability, interoperability, security, management, and trustworthiness. The management of a large number of smart de-vices necessitates the development of lightweight management protocols. The absence of a unified standard and archi-tecture for IoT security poses a significant challenge. Heterogeneous networks make it difficult to ensure security and pri-vacy [22]. Distributing keys among devices remains an unresolved issue in IoT security. Securing cloud-based IoT services can be challenging due to variations in security mechanisms. Security services can be delegated to gateways to ensure traffic confidentiality, authenticity, and integrity. Gateways can also enable localized autonomic management of IoT de-vices without requiring human intervention. Self-management capabilities for Fault, Configuration, Accounting, Perfor-mance, and Security (FCAPS) are essential for successful IoT deployment in real-world scenarios. Security and privacy are the top priorities for IoT applications, followed closely by performance, reliability, and management [27].

## CONCLUSION AND FUTURE USE

The computing world is rapidly transforming towards developing software rather than running on their individual com-puters. Its infrastructure consists of data centres that are maintained by content providers. Cloud services providers mo-tivate to make profits by charging consumers. Cloud applications are important for the core businesses. Service Legal Ar-guments are issued between the providers and consumers. Latest paradigms of cloud computing promise reliable service to be delivered through next generation that are built on storage technologies and virtualized computation. Cloud infra-structure is very strong and can be available at any time. Consumers indicate the required quality of service providers. Cloud computing posses’ characteristics of both clusters ang grids with its own capabilities and attributes such as virtual-ization. It has a market-oriented cloud architecture. It is important to regulate the supply and demand to achieve market equilibrium. Global cloud exchanges are used to improve the scalability of services and to deal in resource demands. Mi-crosoft Azure aims is to provide hosting, common cloud computing so that software developers can easily create, host, manage, scale etc. It supports comprehensive collection. IOT offers a great market opportunity to the manufacturers, ser-vice providers, application developers. IOT architecture has several layers such as object layers, object abstraction layer, service management layer, application layer, business layer. IOT blocks help in gaining a better insight into the real mean-ing and functionality. Identification is crucial for IOT to name and match services for demand. IOT sensing means to gather the data from the related objects within the network and to send it back to the data warehouse. Communication is really required to connect objects together to deliver specific smart services. Processing units and software applications repre-sent the brain and the computation ability of IOT. Key challenges include availability, reliability, mobility, performance, scalability, interoperability, security, management etc. Connecting a large number of physical objects like human, animals, smart phones etc equipped with sensors to the internet generates what is “big data.” IOT devices are classified into two categories which are resource constrained and resource rich devices. Resource rich devices are those that have both hardware and software capability to support IP protocol. The devices that do not require the support of IP protocol are resource constrained devices. Wireless sensor networks, Service Discovery, cloud computing are several IOT projects. The emerging idea of IOT is rapidly finding its path throughout our modern life, aiming to improve the quality of life by con-necting many smart devices technologies and applications. It provides a good foundation for the researchers who are interested in gaining the insight into IOT technologies to understand the overall architecture and role components of IOT.

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