IoT Cloud Simulation Managing Resources: An Overview

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Abstract— This paper is an overview of the cloud management resources for the Internet of Things data. The IoT model is facilitating the development of our stream environment towards improved services especially in areas such as home appliances, smart grid, automated environmental pollution control and healthcare among others. It is well known that these applications often generate huge amount of data which makes necessitates the need for storage and analysis. However, data aggregation and scheduling are still some of the major challenges for cloud infrastructure to attain minimized latency with maximized throughput. This paper aims to present the prospective role of simulation resource management in IoT Cloud. Hence the Objective of the paper is to discuss the issues and challenges to resource management for data aggregation and scheduling resources by reviewing the literature. This search identified 33 reviewed studies in resource management domain. Based on the result gathered, 18 studies have been highlighted with respect to data aggregation and scheduling. This paper provides useful comparison for technique of data aggregation and scheduling.

Keywords— Internet of Things, Cloud Computing, Simulation, Resource Management, Data aggregation, Scheduling.

1. Introduction

The Internet of Things is a recent key to emergent technology which serves to enhance the quality of human life. However, it is important to investigate approaches to big data analysis in the IoT application to flow of data [1]. It is well known that IoT helps in connecting several billion of objects through the internet from different access networks. Moreover, the sensor nodes uses information by inspecting the real-life atmosphere and relaying them to sink node [2]. Cloud platforms are available for manufacturing and academic environment which depend on user requirements. These Infrastructure as a Services (IaaS) [3] contains a set of virtual computing resources such as CPU, network, and storage component. Moreover, the Cloud users can circulate and execute their own systems and the software applications by using that as resources [4]. Currently, there are lots of IoT applications such as Healthcare based IoT which provides cloud storage, connection and interaction among managers such as a hospital, patient, examination labs and urgent services. As regards health for instance, IoT" eHealth" system contains four layers: sensing layer, interface layer, service layer, and network layer.

However, the data emanates from medical sensors which are attached by a human. The Fog admin oversees and monitors data exchange between the fog and cloud computing [5]. Generally, the resources in IoT comprises of two phases. The first one is the physical components such as memory, energy, network bandwidth and CPU. The second ones are the software components such as functions or procedures to process the data. In the context of heterogeneous factors, good knowledge is an important requirement of IoT systems. This would provide the needed approach to display the information depending on the type of applications. Hence, this requirement for suitable knowledge and heterogeneity makes resource management a bit more challenging [6]. Therefore, there is need for data aggregation in order to enhance extensive transmissions of data. In addition, it would help to lengthen the network's lifespan, to reduce power consumption, to eliminate traffic congestion and to minimize the latency.

Likewise, IoT networks uses data aggregation methods to decrease the amount of data load previously transmitted it to the base station. Thus, the data aggregation technique is a way of integrating and summarizing data from sensors nodes in WSNs. The simulation results can help in the comparison of data aggregation techniques for certain selected parameters. This can then be analyzed in order to ascertain the performance metrics. Two protocols may be used to achieve more energy efficiency in WSNs when the Cluster Head (CH) aggregate receives information from typical nodes. These are LEACH and LEACH-C which are capable of increasing the network's lifespan, and to maximize throughput [2]. In order for the application to detect the run time, as well as take and make decisions, scheduling is of high importance. It enables efficient usage of the CPU time as well as appropriate allocation of resources to programs. The most important task performed by the Scheduler is deciding the best process to run in the subsequent step among the sets of application processes available [7].

In this paper, we compare 33studies on resource management in IoT Cloud Simulation to show the impact of minimizing latency and maximize throughput of network by aggregating data and scheduling resources. The paper aims to prospect the role of simulation resource management in IoT Cloud.

2. METHODOLOGY

The methodology of this paper is shown in Figure 1. The methodology is structured to first present an overview of Internet of Things and Cloud computing. This is followed by resource management wherein the importance of RM and the best approach to dealing with data aggregation and scheduling are presented. Subsequently, some of the related researches that highlight the impact RM are presented followed by IoT simulation whereby cloud computing simulators are summarized from 33 papers. Based on the information presented, conclusions were drawn, and recommendations were made for further studies.

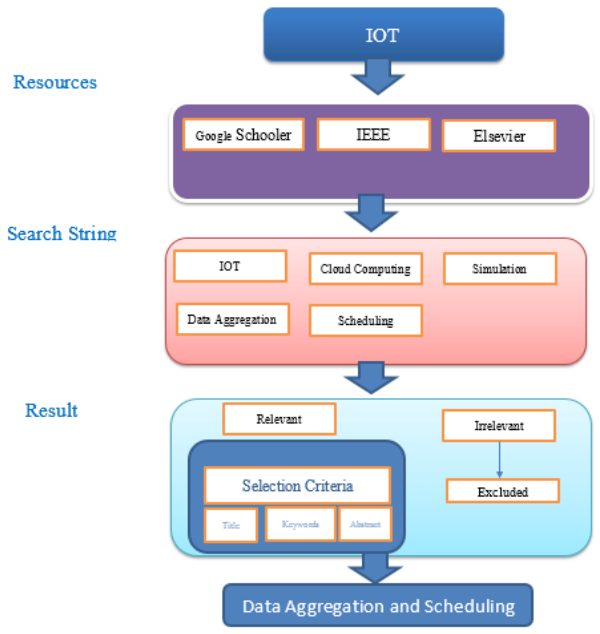

Figure 1: Methodology Design.

3. INTERNET OF THINGS AND CLOUD COMPUTING

A Cloud computing is a novel Information Technology with computing infrastructure which can execute applications and software services at a reasonably reduced cost. A lot of cloud workers such as Amazon Web, Google, IBM, Services Microsoft, and others provide advanced services to cater for the need of clients. Notably, the combination of cloud and IoT had brought in a new paradigm of universal and pervasive computing approach known as Cloud of Things (CoT). Hence, CoT is an IoT associated product managing solution, which facilitates the client's device connection to any cloud data center (CDC) [8].

Several studies have highlighted the role of cloud computing technologies in supporting and enabling IoT. This has led to observable increases in the number of IoT compliant devices. Invariably, this would trigger the generation of massive data volumes which are being processed, stored or simply accessed by end clients. As such, hosted services, data, and applications can be universally retrieved. Recently, the growth of connected smart devices has been exponential. In fact, it is predicted by Cisco that by the year 2020, the number of IoT devices that are connected to the internet would have reached almost 50 billion [8].

Based on the aforementioned, IoT requires orchestrated processing and well-structured decision-making approach. For instance, in a cloud -based system, collected data should be conducted to the cloud with good time and cost effectiveness. Unfortunately, processing in the cloud sometimes result into much of delays and bottlenecks for the amount of data collected by end devices and sensor. This form of unwarranted delays especially in applications related to sensitive cases in medical care can cause a patient's death or cause or other undesirable side effects [7]. For the purpose of clarity, the relationship between IoT and Cloud Computing is depicted in Figure 2 [9].

Figure 2: IoT and Cloud Computing.

On the other hand, IoT devices often have limited computing and processing capacity. In addition, they are unable to perform progressive processes, or to store large amounts of data. Cloud computing seem to be the most suitable approach to meet shelter the drawbacks of IoT. However, the cloud platform is faces with peculiar limitations especially with respect to receptiveness, latency, and general performance for processing an accessing IoT stream of traffic data. Notably, it is time-consuming especially for a huge data which are set to lightweight back and forth processes between client and cloud [8]. Hence, the backbone for the streaming of data through network devices is through resource management.

4. RESOURCE MANAGEMENT

It is well known that research management (RM) is important to minimize latency and maximize throughput of network. It can provide suitable mechanism to determine and schedule resources for monitoring the environment to achieve QoS. Hence, the features of RML can be translated IoT resources by designing the resources that require such applications. This could be possible if the run-time of RML can use resource information for decision-making. Therefore, the application may help in scheduling and executing effective communication and when the task is to take place. On the other hand, the resources in the IoT monitoring system helps to track and record the history of the data consumed with the help of the application [6].

A. *Data Aggregation:*

Data aggregation is trustworthy for rising the boosting the lifespan of network, and to reduce energy consumption. Moreover, it can be used to eliminate redundant data from rows and communication thereby reducing costs [10]. Therefore, data aggregation helps to improve redundant transmissions of data which will in turn lengthen the network's lifespan. It reduces power consumption, traffic congestion and also lessens latency. Based on this, IoT networks uses data aggregation methods to reduce the amount of data load before they are transmitted to the base station. Hence, data aggregation technique is a process of capable of integrating and summarizing data from sensors nodes in WSN [2].

B. *Scheduling:*

Scheduling of resources is a medium through which the environment could be monitored in order to achieve QoS. It is an important resources needed by the application to take note of the run time in order to take and make any decisions [6]. It enables maximum usage of the CPU time as well as appropriate allocation of resources to programs. The most important task performed by the Scheduler is deciding the best process to run in the subsequent step among the sets of application processes available. Its objective comprises of how to determine the energy consumption, cost, VM utilization, workload maximization, reliability awareness and security awareness. [7].

5. Related Work

Health-care Industrial IoT (HealthIIoT) is a model for monitoring emerging progresses in health-care services such as improving access to patient information. Moreover, the HealthIIoT is can help to save the lives of people through the avoidance death ensuing from hospitals errors. In view of this, data protection is an important integral part of the Health-care system, to benchmark and authenticate data in any HealthIIoT system. The data protection is very important especially when essential datasets are to be accessed and simulated at various locations and data centers. Therefore the imitation atmosphere would include cloud topology and ECG data access pattern by a healthcare expert so as to minimize latency and increase transparency [11].

The simulation methods on the other hand enable clients to test their services, improve the environment and adjust to the traffic network before they are deployed on real Clouds. Therefore, the simulation tools are used to achieve high performance and low application costs. The simulation assists the developers to control their resources allocation and scheduling algorithms. On the other hand, Hadoop is used to configure large data set to assist users to selectively adopt a suitable application to analyze their data. Therefore, the simulation result enhances a better efficient business opportunity for analytic data with Hadoop cluster [12].

The simulation is a strong tool that imitates processes and activities in the emergency departments of the hospitals. The Simulation model in hospitals automatically captures BD of activities and monitors them in the Emergency Department (ED). The IoT technology concepts may also be used with other models such as RFID for capturing patient activities in (ED) so as to observe the impact of performance and for decision making. Thus, simulation is developed on (ED) to process patient activities and capture the best form of treatment. As such, the simulation enables the capture of data at a higher degree of accuracy from RFID as well as enable Infrastructure as a Services (IaaS) [13].

According to [14] the author suggested “Hit Rate Geographical Location Analysis Algorithm “(HIRGLAA) based on the dynamic election of the cluster head. HIRGLAA could be used to break down the rate of analysis performance. Then the managed Big Data infrastructure is geologically placed in a unified cloud data center [15]. Therefore, the Quality of Services (QoS) such as increase consistency and energy efficiency is used to validate simulation result. Moreover, the algorithms features are used to reduce the storage, access time as well as the energy consumption. However, they evaluate the algorithms by using Cloud Sim tools to simulate cloud computing components which improve the energy consumption, networks resources and storage.

IoT systems require new approaches such as the simulator to understand the behaviour of systems at earlier unique scale. The existing simulators are too detailed and are not suitable to support new scenarios. Interestingly, simulating with cloud model general IoT sensors-based XML has been observed to facilitate detailed description of the behaviour of different sensors and for quick prototype of simulations. Thus the approach has been used to validate meteorological service of five various scenarios using IoT system [16]. Some of the notable techniques as gathered from literature is presented in Table 1.

Table 1: Comparison between Exiting Technique.

Author	Source	Solution	Minimize latency	Year
[17]	Elsevier	6LoWPAN	✓	2018
[18]	Elsevier	VM	✓	2018
[4]	IEEE	testbed		2017
[19]	Elsevier	PHR		2017
[16]	IEEE	XML based representation		2017
[20]	IEEE ICC	NB-IoT	✓	2017
[21]	IEEE ICC	cloudlet		2017
[10]	Elsevier	cluster-based mechanisms	✓	2017
[8]	Springer Science	Load balancer	✓	2017
[22]	IEEE	YARN	✓	2017
[23]	Elsevier	CEPSim	✓	2016
[11]	Elsevier	DWT	✓	2016
[12]	IEEE	Big Data	✓	2015
[24]	IEEE TRANSACTIONS	CloudSched		2015
[13]	IEEE Proceeding	RFID		2015
[25]	Springer	LTE	✓	2014
[26]	Wiley	QoS	✓	2010
[27]	Wiley	Gridlet		2002

6. IoT Simulation

IoT simulate is essential for both qualitative and quantitative types of services. The main goals of IOT simulate is the Parallel and Distributed Simulation (PADS) approaches for scalability at a highly detailed level. Therefore, the simulation techniques provide a means to simulate wide geographical areas [3]. Notably, simulation is one powerful explanatory tool that may serve to imitate processes and activities in the emergency departments of the hospitals. As stated earlier, the simulation is developed on (ED) to process patient activities and captures the best form of treatment. Therefore, the simulation enables the capturing of the data at a higher degree of accuracy from RFID as well as enable Infrastructure as a Services (IaaS) [13]. Going forward, Internet of Simulation (IoS) could improve IoT through combination of model simulator and original facilities in an industrial manufacture set-up [28]. Some notable IoT simulators are presented in Table 2, with their properties, parameter and limitations.

Table 2: Comparison on IoT simulator.

Simulator	Properties	Year	Parameter	Limitation
IOTSim[29]	Big data application in IoT for processing data	2017	Data centre, Broker, Job-Tracker and TaskTracker. VMs, multiple user-defined MapReduce jobs	Stream processing technique
GreenCloud[30]	Accomplished of modelling performances of switched, network links, gateways	2012	Data center, cloud user, network, manage memory module, switches	Workload and traffic aggregation techniques
iCanCloud[31]	Simulation of cloud computing system	2012	Memory system, CPU system, Networks system, no. VMs, jobs.	Power consumption estimation module
Cloudsim[26]	Create VM in IoT application	2011	Datacenter, Sensors, virtual machines, power consumption	Energy efficiency
SmartSim[32]	Prepared set of devices in home	2016	Organize model operations - time	Data analytic
iFogSim[33]	Resource management for low latency.	2017	Datacenter, sensors, camera	Resource management, power consumption, modeling and virtualization

7. Conclusion and Recommendations

The Internet of things is the emerging technology which facilitates the development of the Smart World whereby a whole lot of things are associated or connected to one network. However, data latency has been a persistent major problem across resource management in most IoT system. Meanwhile, IoT is among the most significant area in which we need concerted efforts towards data aggregation and data scheduling, which have been a notable challenge to data. Hence the suitable approach to overcome the issues associated with data aggregation and data management of IoT data is through simulation. This is because simulation is one of the elements that can simulate the IoT data in cloud infrastructure layer such that latency may be reduced, and throughput of network is maximised. In this paper, issues relating to data aggregations and data scheduling in the cloud infrastructure layer is presented. This would help to provide ideas on how to reduce the latency. Resource management which include data aggregation, data scheduling and heterogeneous data requires development. These subject matters are potential areas to research in IoT data management.

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