BIG IOT DATA ANALYTICS USING FOG COMPUTING

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Abstract—**Wireless technologies are now used to deliver the majority of private and environmental services. Furthermore, government agencies take advantage of the latest tools to improve services. Correspondence, intelligence gathering, protection, communications, new platforms, defense, smart regions, and among many of the services and apps offered are a plethora of others. These implementations have historically been linked to the Internet of Things (IoT), mobile cloud platforms, fog cloud, edge cloud, and cloud technology. For improved and performance-aware interactions, some of these rollouts require an efficient and quality computer network, as well as the spawning of areas of study in their respective domains. In the Internet of Things, smart devices and objects are interconnected wirelessly for authentic information transmission and interaction. Software solution delivery is now incorporated on smartphones and other electronic devices, which is referred to as mobile cloud computing. Based on wireless sensor implementations have multiplied to the point of producing enormous amounts of data, necessitating extremely efficient data processing techniques. However, there are protocol constraints in the various IoT architectures and Smart sensors device layers, which create challenges when creating smart IoT adaptation. Due to this challenge, previous IoT sensor solutions could not be adapted to new IoT sensor applications. This article examines the data that IoT sensors provide for big data analytics and underlines the difficulties that intelligent solutions currently face.**

Keywords—**Mobile Cloud computing, Big Data, IoT, ifogSim, real-time applications.**

I. INTRODUCTION

The term "mobile cloud computing" describes the provision, a focus on the integration of handheld devices, such as handsets, tablet devices, and other devices, of computing systems through Web channels [1]. PaaS, IaaS, and SaaS the different services, and numerous more related service delivery models are just a few of the services provided by cloud computing, is used to maintain the remote data centers. When it comes to cloud computing, there is a significant reliance on the Internet connection and its capacity and channel speed. Cloud computing depends on Internet connectivity and speed, which may not be very good everywhere [2]. IoT systems' ability to comprehend, create, and distribute information on their own is constrained. Ontology's, which are repositories that a categorize objects by their features and associations, are used in Application scenarios to fix their flaws in IoT. By enabling, locating the IoT remedies to obtain details or rules linked into other devices or the cloud, this present work describes application systems. The broad adoption of fog computing to create intelligent application, it is challenging to apply fog computing to other industry. The edge network of the internet is becoming the new logical channel for application domains, data, and services as a result of edge computing, fog networking, also referred to as fogging. The fog communication network aims to establish control, setting, and administration over the Network infrastructure rather than being primarily controlled by switches, routers, and gateways that are integrated into the LTE network. With the aid of edge server nodes, the fog computing architecture can be described as a highly virtualized computing environment that offers hierarchical computing capabilities. In order to evaluate and store data adjacent to target consumers, integrated fog nodes coordinate a variety of options and programs. Sometimes, the phrases edge technology and fog technology are used synonymously. Though, there is a very insignificant variation involving the theory. Both technology edge and fog requires bringing intelligence and computing power closer to the information source. The placement of the computational and intellectual power is the key distinction between the two designs. The same physical resources, such as turbines, circuits, actuators, sensors, etc., send data to both structures. In this universe, each of those gadgets completes a physical purpose, such as running integrated devices, pumping systems, toggling, or monitoring activity around them. Making the IoT concept obvious is crucial. IoT is regarded as a series of global transformations brought about by connected gadgets. The question of why it is necessary to construct that Concept of internet of things has therefore been raised. The answer is to locate, access, and assess the previously available data. Every piece of information produced by the surroundings has variants, which are not data. This knowledge could be put to use when parking or making a call to home. When those things are connected, an Internet address can be used to accurately address and identify them. Electronic information can be created from this information through online purchases; software downloads, and net communication. The data that have been transcribed digitally are not only faster reactive, but they also present new opportunities for analysis in the sectors of technology and business, generated near to the edge of the network, this notion won't always be effective for analyzing the data. A decentralized computer environment is created via fog computing. Using this manner, local systems (nodes) and to deliver services, space, apps, data and analytics, a remote data centre is linked. By doing so, the user can access the resources they are actually using without having to use the Internet for everything. Thus order to avoid difficulties with network capacity, latency, hindrance, and jitter, fog cloud acts as a middle layer between the consumer and a faraway cloud. It improves the network environment's general performance.

Fog Computing = Cloud Computing + IoT

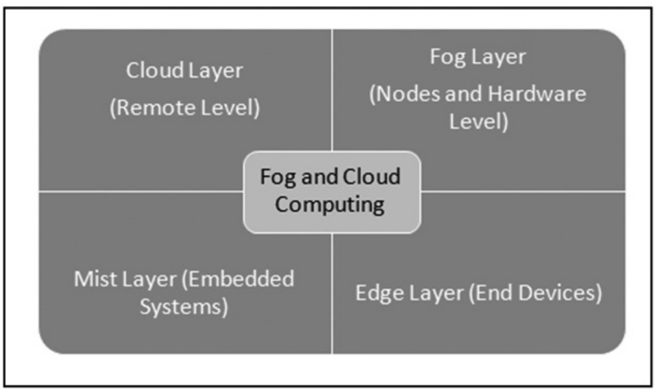

Figure 1: Next Generation layered structure of Fog and Cloud Computing

It is possible to model the ecosystems for edge of the network, the network of things, and edge devices and simulated using the high performance toolkit known as iFogSim. Strategies for managing resources are included into iFogSim and can be further tailored to the research field.

With the help of the merging of technical elements and services that may be viable in the future, such as green infrastructure, connected automobiles, and home automation, fog computing offers a multilayer distributed approach. Fog structure networks must be installed at the network's interface in order to execute sophisticated algorithms, massive data analysis for improved predictive processing, and identification of unusual and dangerous phenomena. Therefore, in this developing stage of the fog ecosystem, the fog computing concept should be clarified. Concepts from provide a comprehensive overview of fog computing; however they are unable to highlight the specific similarities to the cloud. Here is our definition, which is necessary to define and contrast all of the features of fog with existing architecture.

Edge computing is an architecture and design innovation of computing with a pool of resources with one or several widely dispersed, decentralized node(s) are activated for possibly working collaboratively and connecting with one another or sending data collectively at the extraordinary device level only, without the assistance of cloud operations. An rising variety of devices, users, or consumers nearby are processed by fog nodes collectively in a hierarchical context. They also enable processing flexibility, offers countless opportunities, disk usage, and many more new market services. Figure 1 illustrates how fog is a cloud computing infrastructure that complements cloud computing in order to provide QoS at the edge of the internet backbone through the provision of reliable computing services. To combat the difficulties of conventional CC, the extension of web services to IoT device edges is known as fog computing. Edge nodes' primary goals are to sense, monitor, and manage Iot systems. Edge nodes are used to maintain security and avoid tampering in this illustration could be driven at millisecond or every second. The example's cloud level components concentrate on compression techniques, processing, analysis, and transformation. Each of them is capable of functioning and computation in the cloud. The edge level insights needed for crucial real-time computations will be provided by these tiny cloudlets.

Fog computing is a highly virtualized platform that offers networking, storage, and computation services between endpoints and conventional cloud data centers, which are often but not always situated near the network's edge. The compute, storage, and networking resources that make up the cloud are also present in the fog. The Fog, on the other hand, has several unique qualities factors increase its suitability for applications requiring low delay, support for mobile devices, authentic communication, digital analytics, and service interaction. So how cloud security differs from traditional security [16]. Despite the fact that data size is rapidly expanding, enterprises may archive their acquired data thanks to declining processing and storage costs as well as expanding network capacity. Instead of transmitting all of the data to the cloud, a peripheral software or device system may perform an initial evaluation and send an overview of the information (or metadata). Google, for instance, employs cloud computing to classify images for its Google Photos app. The program automatically learns and categorizes for photos that are shot and uploaded to Google Photos based on the context of the image. This technology is widely embraced by the market as a result of its numerous distinctive characteristics, such as on-demand delivery, resource sharing, and data security. Presently, two prominent challenges exist, namely limited storage capacity and factors associated with data retrieval within data storage systems [17].

II. RELATED WORKS

Tang et al. [3] Fog-based architecture that is structured, flexible, decentralized, and facilitates the incorporation of a sizable objects and suggested services for use in big data analytics in smart buildings. The architecture different layers:

in which layer-4, which is at the network's edge and has a lot of sensors; layer-3, which analyses the raw data with a significant number of high-performance and limited nodes; which identifies possible risks with transitional computing nodes is layer-2; which is the cloud and offers centralized control and surveillance is layer-1.

In [4], FogGIS is a framework for mining insights from geographical data that is based on fog computing. FogGIS had been utilized for early analysis, which included compression and overlay analysis. Approaches had also been used to cut down on the amount of data that was transmitted to the cloud. As enterprises add more linked devices to their health IT ecosystem, fog computing is likewise growing in popularity in the healthcare sector [5]. In order to create scalability IoT data services, Cisco has unveiled Fog Data Services.

Further research project [6] has been discussed and tested at the program RECEP, that utilizes data redundancy and caches erroneous findings for asset reuse and need reduction. It can increase mobile CEP system scalability and reduce delay.

A novel solution has been put up by Gazis et al. [7] as an industry point of view for a structured fog computing architecture that offers adaptability for different working procedures.

By using connected mobile device architecture and a dimension indicates mobile cloud, Femtocloud by Habak et al. [8] has made cloud services available at the edge. This viewpoint offers logically resourceful processing capabilities, according to the examination. The amount of data being gathered and analyzed grows exponentially in complex organizations, yet the central cloud strategy is also no longer enough.

Bonomi et al. [9] analysis of these disturbances led to the proposal of a multilayered differentiated framework that extends security and dependability to the fog computing core network's edge nodes. Additionally, an STL framework and solar farm technologies were thoroughly explained in the context of fog computing.

According to Osanaiye et al. [10-11], fog computing can produce location and prior to providing services to end customers or mobile devices (e.g., parking, vehicular, and bus application services in networks using fog) and also extends the trustworthiness of relocation with a conceptual smart pre specified migration of VM.

Fog's ability to function in a hybrid environment which offers flexible and trustworthy services for fog in the vicinity of the intended 5G network was established by Lee et al. [12]. The authors discuss the development of vehicular fog network, connected autonomous vehicles, and smart grid for intelligent vehicles. The idea will aid in the development of the "Internet of Cars" or "vehicular fog," which will be analogous to the existing "Internet cloud" for cars.

For the security of sensitive and vital information, Zhou et al. [13] have extended privacy protection of transited data. Their efforts guarantee that unauthorized users cannot access confidential user information. In contrast, when fog computing components are deployed at the periphery of the foundation network, a hierarchical hazard in privacy is created. The deployment of significant privacy risks in fog nodes and applications, including privacy of data, location, and use [14]

III. SIMULATION ENVIRONMENT

Together with CloudSim, iFogSim simulator simulates different conditions. CloudSim is a well-known program for simulating cloud-based settings and management system. To manage the interactions between the iFogSim-based components of fog computing, the layer of CloudSim was created [15].

The iFogSim classes needed to mimic the fog network are listed below.

- Fog gadget
- Sensing Device
- Device Actuator
- Other Tuple
- Software Application
- Edge Monitoring
- Service for Resource Management

The iFogSim library is available as a free download at https://github.com/Cloudslab/iFogSim. The JDK is necessary for modification and use the kit because the iFogSim library is built in Java. The "iFogSim-master" new folder after the "compression toolkit" in zip format has been downloaded and extracted. Any Java-based Development Environment (ide) like IntelliJ IDEA, Netbeans, JCreator, Eclipse, or another comparable IDE can run the iFogSim library. We start a new project in the IDE to combine iFogSim with Eclipse. The folder organization of iFogSim can be seen in Eclipse IDE under Project Name -> src after the library has been configured. There are a variety of bundles with Java code for various IoT, edge, and fog computing implementations. The file FogGUI.java in org.fog.gui.example can be used to interact with iFogSim in Graphical User Interface (GUI) Mode. This file is run directly in the IDE, cloud and fog elements that can be inserted in the modeling work place.

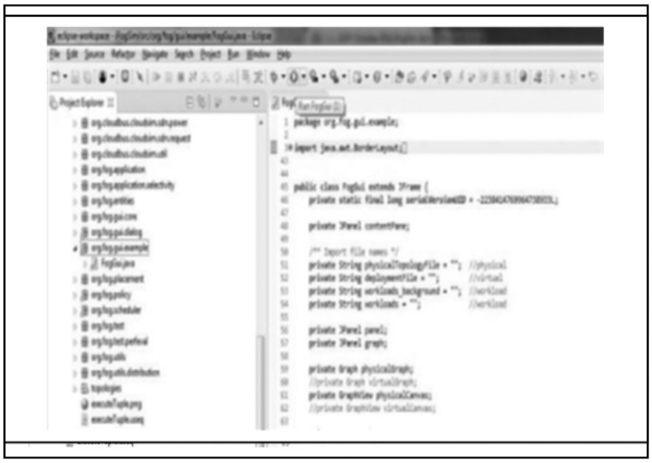

Figure 2: Opening FogGui.Java in Eclipse

There is indeed a graph Menu in Fog Topological Creator. There seems to be a topologies import option.

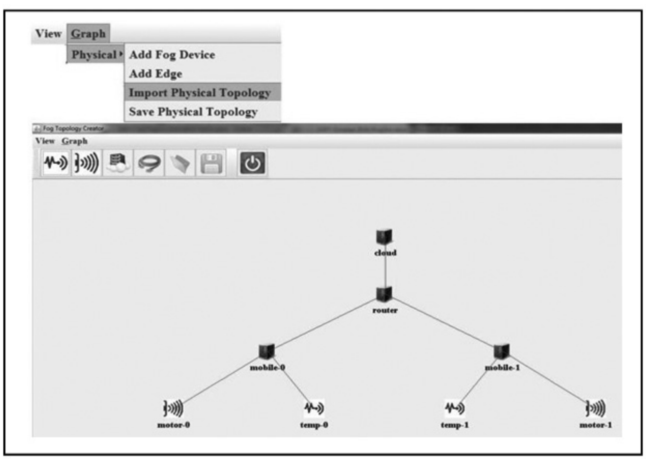

Figure 3: The GUI of iFogSim with Topology

After processing, the output can be seen in the Eclipse IDE's Console. Multiple alternatives for numerous applications, especially Software Defined Network (SDN) with convergence of cloud and fog computing, can be simulated in iFogSim. There are several established and planned case studies in the iFogSim basic implementation. For instance, org.fog.test.perfeval contains a case study on Intelligent Surveillance. Following its execution, many metrics, such as Performance, Cost Involved, Camera Accuracy, and others, can be evaluated.

These are completely adaptable libraries that can be enhanced even more with advanced algorithms. The effectiveness of the suggested or novel method can be evaluated on a surroundings using iFogSim by programming the new algorithms into the program's current libraries.

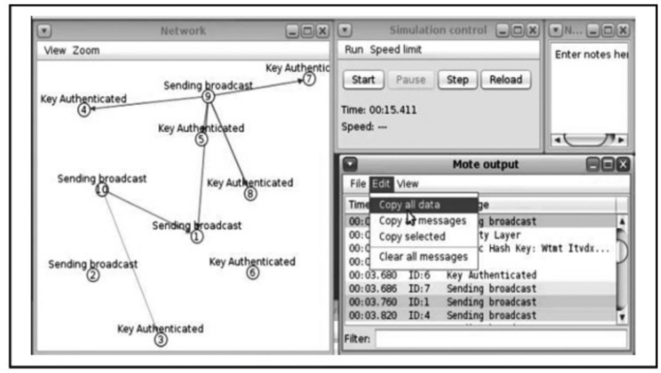

Figure 4: Security based Key Exchange in Mobile Cloud

IV. RESULT ANALYSIS

When it comes to the speed of processing, query serving, and security testing, iFogsim simulation shows superior outcomes from simulation it can be interpreted.

Employing iFogsim allows for thorough scrutiny of Big IoT Data concerning security and authentication, proving efficient for requests of similar data sizes as well as those of diverse data sizes.

V. CONCLUSION

In fog existing smart modern cloud networks, there are many problems to solve and areas of research to explore, such as Assurance, Secrecy and Authenticity, Integrity Models and Verification, Aggregation Of data and Network Management, Connectivity Switchover Improvements, IoT reliability, energy refinement and resource management, smart fog nodes, and excellent customer experience (QoE), Techniques for Micro grid Improvement, Offloading in Fog Networking, Relocation Modeling, and Incorporation with Machine Learning. We have highlighted the goals and essential features of fog computing, a technology that will offer a wide range of fresh systems and applications at the network's edge. The topic includes a variety of inspiring examples, from existing point resolution designs to speculative concepts. We want the Fog to be a platform that unifies all apps and is robust enough to deliver this new generation of emergent services and support the creation of new ones.

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