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Study of Fog Computing & their features

Ms. Pallavi Marathe[1]
[1]*Assistant Professor, Computer Engineering, Vishwatmak Om Gurudev College of Engineering, Aghai, Thane [M.S.], India*

Abstract: Fog computing is an extension of Cloud Computing and their services in the network.There is a lot of confusion on its precise definition, role and application. Fog computing provides data, compute, storage and application services to end users like Cloud Computing. This is a new platform for users which provide web services and application, by exploring cloud platform. In this model data, processing & application concentrated in device at the network edge rather than existing almost entirely on the cloud. Fog computing is a introduced by Cisco that refers to increasing cloud computing to the enterprise's network edge, also called fogging or Edge Computing. This paper describes the various features of Fog Computing and difference between cloud computing and fog computing.

Keywords: Fog Computing, Cloud Computing and Data Centers

I. WHAT IS FOG COMPUTING?

Fog Computing, also known as fogging, is a distributed computing infrastructure in which some application services are handled at the network edge in a smart device and some application services are handled in a remote data center in the cloud. The goal of fogging is to reduce the workload and increase the efficiency of data that needs to be transfer to the cloud for data processing, analysis and storage. This is often done for efficiency reasons but it may also have advantage of security and compliances.
In a fog computing environment , much of the processing work take place in a data hub on a smart device or on the edge of the network in smart router. This distributed approach is growing in popularity because of the Internet of Things (IoT) and the amount of data that sensors generate. It is simply inefficient to transmit all the data bundle of sensors create to the cloud for processing and analysis. for that requires a great deal of bandwidth and all the type of communication between the sensors and the

cloud can negatively impact network performance. The fog computing is often associated with cisco. Cisco Fog Computing is a registered name; “fog computing” is open to the community at large. The choice of the word fog is meant to convey the idea that the advantages of cloud computing can and should be brought closer to the data source. Fog Computing allows computing, decision making and action taking to happen via IoT devices and only pushes relevant data to the cloud.

II. CHARACTERISTICS OF FOG COMPUTING

1) *Possessing edge location:* The origins of fog can be traced to early proposals to support end point with rich services at the end of the network.
2) *Location awareness:* To find the location of every user or to provide service to every user at every end of network.
3) *latency-sensitivity:* fog computing provide services and application with low latency requirements.
4) *Geographically distributed:* in contrast to centralized cloud, services and applications targeted by the fog demand widely distributed deployment. Fog provide high quality streaming for moving vehicles through proxies and end points positioned along highway and tracks.
5) *Comprising large-scale sensor networks and a large number of nodes:* To monitor the environment and smart grid are other example of inherently distributed system, requiring distributed computing and storage services.
6) *Real-time interactions:* Some fog application required real-time interaction rather than batch processing.
7) *Heterogeneity:* Fog computing is highly virtualized platform that provides compute, storage and networking services between end devices and traditional cloud computing data centers, typically, but not exclusively located at the edge of network. Compute, storage and networking are the main building block of cloud and fog. Edge of the network implies a number of characteristics that make a fog non trivial extension of cloud.
8) *Interoperability and federation:* seamless support of certain services requires cooperation of different providers. Fog component must be interoperate and services must be federated across domain.
9) *Online analytics and interplay with the cloud*

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III. DIFFERENCE BETWEEN CLOUD COMPUTING AND FOG COMPUTING

Requirement	Cloud Computing	Fog computing
Latency	High	Low
Delay Jitter	High	Very Low
Location of server nodes	within the internet	at the edge of local network
Distance between the client and server	Multiple hops	One hop
Security	Undefined	Can be defined
Attack on data	High probability	Low probability
Location awareness	No	Yes
Geographical distribution	Centralized	Distributed
Number of server nodes	Few	Very Large
Support for mobility	Limited	Supported
Real time interaction	Supported	Supported
Type of connectivity	Leased line	Wireless

A. Fog Computing Issues

1) *Fog Networking:* fog network is heterogeneous because it is located at the edge of internet. The duty of fog network is to connect every component of the fog. However managing such a network, maintaining connectivity, and providing services upon that especially in the scenario of Internet of Things(IoT) at large scale, is not easy. Software-defined networking (SDN) is an umbrella term encompassing several kinds of network technology aimed at making the network as agile and flexible as the virtualized server and storage infrastructure of the modern data center. The goal of SDN is to allow network engineers and administrators to respond quickly to changing business requirements. In a software defined network, a network administrator can shape traffic from a centralized control console without having to touch individual switches and can deliver services to wherever they are needed in the network, without regard to what specific devices a server or other hardware components are connected to.

2) *Connectivity:* In the case of a heterogeneous fog network, network relaying, partitioning and clustering provide new opportunities for reducing cost, trimming data and expanding connectivity. For example, an ad-hoc wireless sensor network can be partitioned into several clusters due to the coverage of rich-resource fog nodes (cloudlet, sink node, powerful smartphone, etc.). Work proposes an online AP association strategy that not only achieves a minimal throughput but efficiency in computational overhead. Similarly, the selection of fog node from end user will heavily impact the performance. We can dynamically select a subset of fog nodes as relay nodes for optimization goals of maximal availability of fog services for a certain area or a single user, with constraints such as delay, throughput, connectivity, and energy consumption.

3) *Reliability:* Normally, reliability can be improved through periodical check-pointing to resume after failure, rescheduling of failed tasks or replication to exploit executing in parallel. But checkpointing and rescheduling may not suit the highly dynamic

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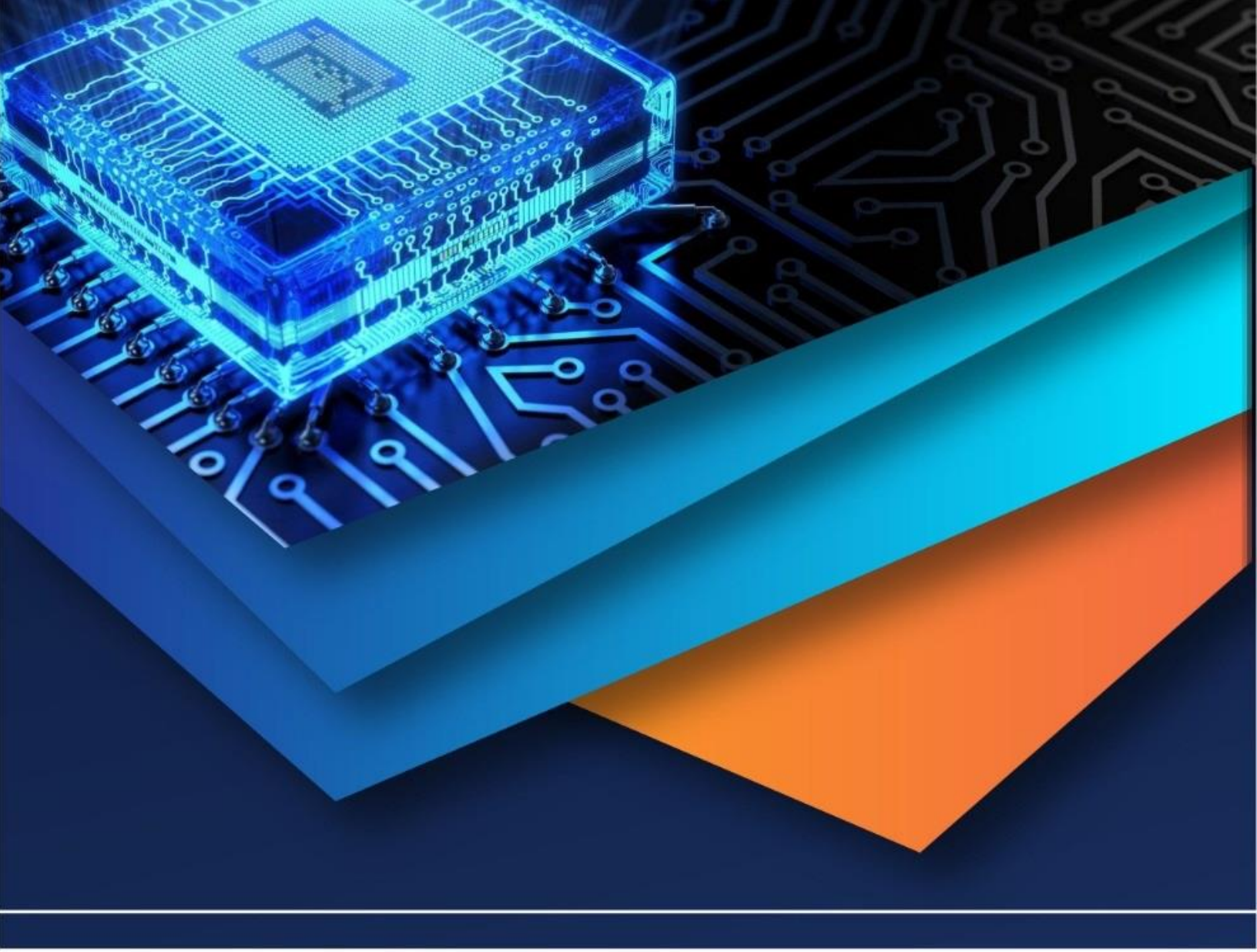
fog computing environment since there will be latency, and cannot adapt to changes. Replication seems more promising but it relies on multiple fog nodes to work together.

4) *Discovery:* Resource discovery and sharing are critical for application performance in fog. Work proposed method dynamically select centralized and flooding strategies to save energy in heterogeneous networks, while there are more constraints to take into consideration in fog computing, such as latency, density, and mobility.

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