A NOVEL REAL TIME TECHNOLOGY FOR ANALYSE OF IOT DATA IN FOG

Dr. L. ARUNA

Abstract.

In the era computing data to be analyze is enormous and ever growing, which also leads to faster response and feedback is mandatory especially for real time systems, as it requires immediate action for saving from millions of data and people from drastic hazards. The problems may be from a traffic problem to any atomic reactor controllers from bursting out, causing heavy destruction. Hence it necessary to collect, analyses, process and response to the situation which needs, faster than cloud based IOT. Here comes the role of Fog Computing has emerged to meet the demand of speed, security, efficiency and reliability.

Keywords: Fog Computing, Edge,

I. Introduction

The term fog computing or fogging in IOT has been now related to cloud computing. The term fog was coined by Cisco in 2014, fog and cloud computing are interconnected. In nature, fog is closer to the earth than clouds; in the technological world, it is just the same, fog is closer to end-users, bringing cloud capabilities down to the ground. This can also be define as : fog is the extension of cloud computing that consists of multiple *edge nodes* directly connected to physical devices. The goal of fogging is to improve efficiency and reduce the amount of data transported to the cloud for processing, analysis and storage. This is often done to improve efficiency, though it may also be used for security and compliance reasons. Popular fog computing applications include smart grid, smart city, smart home, smart industrial system, vehicle networks wireless sensor networks, software-defined networks (SDN) and so on.

The goal of this is to bring basic analytic services to the network edge, improving performance by positioning computing resources closer to where they are needed, thereby reducing the distance that data needs to be transported on the network, improving overall network efficiency and performance.

Fog computing can also be deployed for security reasons, as it has the ability to segment bandwidth traffic, and introduce additional firewalls to a network for higher security. Fog computing has its origins as an extension of cloud computing, which is the paradigm to have the data, storage and applications on a distant server, and not hosted locally. With the cloud computing model, the client can purchase the services from a provider, which delivers not only the service, but also the maintenance and upgrades, with the plus that they can be accessed anywhere, and facilitating work by teams.

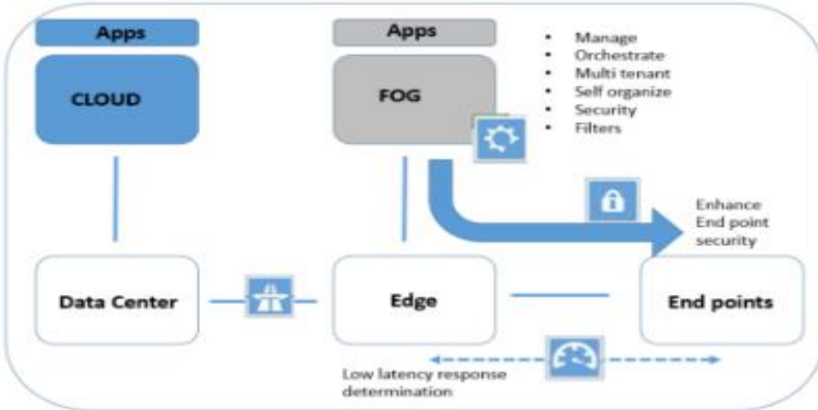

Figure1. Cloud, Edge and Fog Computing Linking architecture.

II. Need for fog computing

Deploying on the real time networks, IoT requires a new kind of infrastructure. Today's cloud models are not designed for the volume, variety, and velocity of data that the real time data has been generated is billions of IoT data. It has been estimated that more than two extra bytes from the previous scenario of unconnected devices for cloud data from IOT. The IoT speeds up awareness and response to real time events. In industries such as manufacturing, oil and gas, utilities, transportation, mining, and the public sector, faster response time can improve output, boost service levels; hence increase safety and security through real time computing.

Connecting new kinds of things to the Internet also creates new business opportunities. Examples include pay-as you drive vehicle insurance, lighting-as-a-service, and machine-as-a-service (Maas). Traditional cloud computing architectures do not meet all of these requirements. The prevailing approach is meant for centralized approach moving all data from the network edge to the data center for processing which may add latency in real time data.

Traffic from thousands of devices for real time data needs very high bandwidth capacity without any alternative to the cloud architecture. The industry regulations and privacy concerns prohibit offsite storage of certain types of data for security purpose and it also demands immediate response also.

In addition, cloud servers communicate only with IP, not the countless other protocols used by IoT devices. The ideal place to analyze most IoT data is near the devices that produce and act on that data.

Here comes the necessity to include one more architectural development between the actual cloud -edge, and the devices on the ground, fog interface or cloudlets even more close to the smart devices to provide rapid and consistent response without time consuming or latency for real time events.

III .Architectural design of fog computing

Fog computing, or "fogging", is a distributed infrastructure in which certain application processes or services are managed at the edge of the network by a smart device, but others are still managed in the cloud. It is, essentially, a middle layer between the cloud and the hardware to enable more efficient real time data processing, analysis and storage, which is achieved by reducing the amount of data which needs to be transported to the cloud.

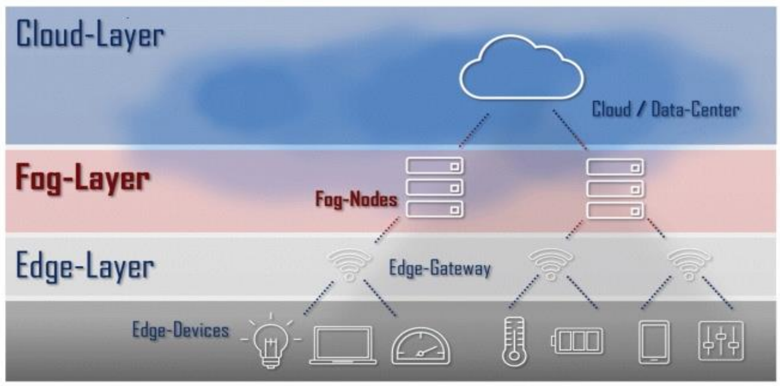

Figure 2: Fog computing architecture

Analyzing IoT data close to where it is collected minimizes latency. It offloads gigabytes of network traffic from the core network. And it keeps sensitive data inside the network. Fog networking is a virtualized, decentralized approach consisting of control plane and a data plane, where most of the processing takes place in the data plane of a smart mobile or on the edge of the network in a gateway device.

This approach utilizes a virtual fog layer with the help of a cloud which orchestrates the resources and services of the virtual fog layer so as to ensure resilient and robust operability.

A fog node or many computation nodes that are connected jointly can be used to build fog computing infrastructure. The connected fog computing nodes can significantly that improves scalability, redundancy, and elasticity, and when more computing is required, it is possible to add more fog nodes.

The fog nodes, can be deployed anywhere with a network connection. Developers either port or write IoT applications for fog nodes at the network edge ie, commonly known as edges. The fog nodes closest to the network edge ingest the data from IoT devices.

3.1. Characteristics of the Fog computing:

- Low latency and location awareness.
- Wide-spread geographical distribution.
- Mobility.
- Very large number of nodes.
- Predominant role of wireless access.
- Strong presence of streaming and real time applications.
- Het-erogeneity of data and applications.

Fog server from initiation to deployment as a management server that can be used for multicasting a data stream to hundreds of PCs or a single one. Fog Client is across platform computer management software. With it, Linux, Mac, and Windows machines can easily be managed by a remote server. Fog storage, can be given as view as: both cloud computing and fog computing provide storage, applications, and data to end-users.

Also known as Edge Computing or fogging, fog computing facilitates the operation of compute, storage, and networking services between end devices and cloud computing data centers. Examples: Temperature sensor on factory floor sends readings to repair the machine, sensor provides input, as a response the pumps slow down to avoid disaster. Locking a door, changing equipment settings, applying the brakes on a train, zooming a video camera, opening a valve in response to a pressure reading, creating a bar chart, and sending an alert to a technician to make a preventive repair etc.

Figure 3. Depict of Fog computing scenario.

Then the fog IoT application directs different types of data to the optimal place for real time analysis, as:

● The most time-sensitive data is analyzed on the fog node closest to the things generating the real time sensitive requires to verify that protection and control loops operating instantly and reliably. Therefore, the fog nodes closest to the grid sensors can look for signs of problems and then prevent them by ending control commands to actuators.

● Real time needs response at micro second instead of waiting for action to be passed along to an aggregation node for analysis and action. It utilizes fog where, each substation might have its own aggregation node that reports the operational status of each downstream feeder and lateral.

● The processed data from thousands of fog nodes might send periodic summaries of grid data to the cloud for historical analysis and storage.

IV. Fog computing versus edge computing

The fog computing and edge computing are sometime interchangeably used by most of the users, as both involve bringing intelligence and processing closer to where the data is created.

But they posses unique characteristics that, are in locating the smart devices and their computational capacity. In a fog environment, intelligence is at the local area network. Data is transmitted from endpoints to a gateway where it is then transmitted to sources for processing and return transmission.

In edge computing, intelligence and power of the edge gateway or appliance are in devices such as programmable automation controllers. Though it has proponents edge computing is known for its reduction of points of failure, as each device independently operates and determines which data to store locally and which data to send to the cloud for further analysis. Proponents of fog computing over edge computing say it is more scalable and gives a better big-picture view of the network as multiple data points feed data into it.

The real potential of multi-tier edge computing can be achieved by using shared resources. But it the distributed data-intensive computing was applied by using a number of optimizations including location-aware data and computation placement, replication, and recovery. Fog Computing is a distributed infrastructure in which certain application processes or services are managed at the edge of the network by a smart device other data are placed in the cloud itself. The middle layer between the cloud and the hardware enables more efficient data processing, analysis and storage they are achieved by reducing the amount of data which needs to be transported to the cloud.

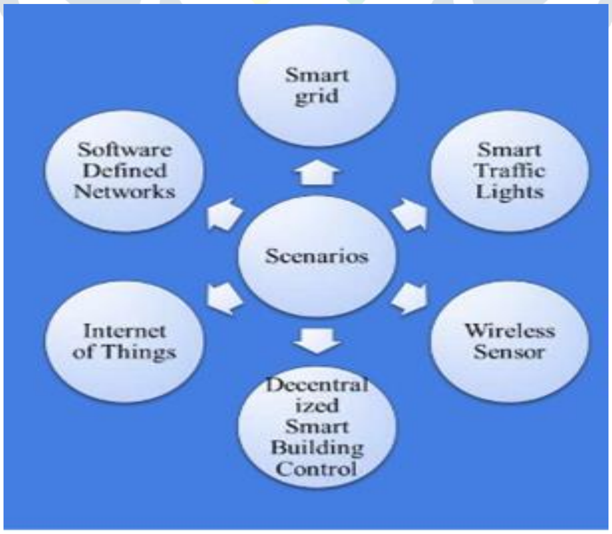

Figure 4. Illustrate of fog computing scenario

V. Significance of fog computing

This era of information technology necessitates computation and analysis of huge volume of heterogeneous real time data, that needs rapid response to prevent drastic hazards either for human life or to the environment, ultimately both flora and fauna are endanger.

Hence it is mandatory to connect all those devices that are continuously producing voluminous real time data. The fog computing is being highly dynamic challenges:

● **Minimum latency:** Milliseconds matter when trying to prevent manufacturing line shutdowns or restore electrical service. Analyzing data close to the device that collected the data can make the difference between averting disaster and a cascading system failure.

● **Widening network bandwidth**: Offshore oilrigs, Commercial jets & flights, Gasoline pipes, Atomic reactor sensor, Smart city traffic management, Military radars & missiles, etc data needs to be transported it may accounts to vast amounts of data from thousands or hundreds of thousands of edge devices to the cloud.

● **High security:** IoT data needs to be protected both in transit and at rest. This requires monitoring and automated response for each and every second.

● **Reliability**: It is mandatory for real time IoT data to highly reliable with rapid timely response, as it may results in jeopardizing the entire globe. The essential infrastructure and service is highly crucial.

● **Consistent assembling and analysis:** the real time data may be generated all distributed fog node throughout the global area to avoid any kind of endanger.

● **Reliable and consistent secure storage:** Processing the real time data need to be processed and decision has to be taken in rapid manner. Extremely time-sensitive decisions should be made closer to the things producing and acting on the data. In contrast, big data analytics on historical data needs the computing and storage resources of the cloud.

VI. Comparison between cloud and fog

Both the cloud and fog cannot replace each other in certain sensitive and non sensitive applications; with cloud fog cannot satisfy all the requirements of public and private sectors.

Particulars	Cloud	Fog
Architecture	Centralized	Distributed
Communication with devices	From a distance	Directly from the edge
Data processing	Far from the source of information	Close to the source of information
Computing capabilities	Higher	Lower
Number of nodes	Few	Very large
Analysis	Long-term	Short-term
Latency	High	Low
Connectivity	Internet	Various protocols and standards
Security	Lower	Higher

VII. Advantages of fog computing

The fog computing approach has many benefits for Internet of Things, Big Data and real-time analytics. The main advantages of fog computing is over cloud computing:

- **Low latency.**

  Fog is geographically closer to users and is able to provide instant responses.

- **No problems with bandwidth.**

  Every pieces of information are aggregated at different points instead of sending that information together to single center via one channel.

- **High Security.**

  Security of data to be processed by a huge number of nodes in a complex distributed system is needed.

- **Improved user experience.**

  Fog always provides instant responses and no downtimes to satisfy users.

- **Power-efficiency**

  Edge nodes run power-efficient protocols such as Bluetooth, Zigbee or Z-Wave, etc.

VIII. Conclusion

In today's world, both the small business and a large enterprise, needs to store and access becomes a great challenge, as the data is growing in extra bytes. Carrying the data on a physical device has become old fashioned now and with the rapid growth of World Wide Web network, users can virtually connect with any data that they have access for, anywhere in the world. In this article we will understand how fog computing has emerged and has advanced to meet the demand of speed, security, efficiency and reliability.

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