AIM : Case Study on Fog Computing

THEORY :

1. What is fog computing?

Fog computing or fog networking, also known as fogging is an architecture that uses edge devices to carry out a substantial amount of computation, storage, and communication locally and routed over the Internet backbone. It is the concept of a network fabric that stretches from the outer edges of where data is created to where it will eventually be stored, whether that's in the cloud or in a customer’s data center.

Fog is another layer of a distributed network environment and is closely associated with cloud computing and the internet of things (IoT). Public infrastructure as a service (IaaS) cloud vendors can be thought of as a high-level, global endpoint for data; the edge of the network is where data from IoT devices is created.

2. Implementation of fog computing.

A fog computing framework can have a variety of components and functions depending on its application. It could include computing gateways that accept data from data sources or diverse collection endpoints such as routers and switches connecting assets within a network.

The process of transferring data through fog computing architecture in an IoT environment includes the following steps:

1. Signals from IoT devices are read by an automation controller.
2. The controller executes the system program needed to automate the IoT devices.
3. The control system program sends data through to a standard OPC Foundation server or through other gateway protocols. (OPC is the interoperability standard for data exchange in IoT.)
4. This data is converted into a protocol understood by internet-based service providers such as MQTT or HTTP(S).
5. Once converted, the data is sent to a fog node or IoT gateway. These endpoints collect the data for further analysis or transfer the data sets to the cloud for broader use.

3. Applications of fog computing.

<u>Retail Sector :</u>

Internet of Things (IoT) is allowing innovative ways for brick-and-mortar stores to enhance the overall customer experience. In-store staff can use handheld devices to provide customers with additional product information, check stock or perform on the spot payment transactions to reduce check-out queues.Reducing network delay is crucial for these real-time customer services.

Real-time analytics : From manufacturing systems that need to be able to react to events as they happen, to financial institutions that use real-time data to inform trading decisions or monitor for fraud. Fog computing deployments can help facilitate the transfer of data between where its created and a variety of places where it needs to go.

Manufacturing Sector :

Fog computing can greatly reduce the overall network delay for IoT devices responsible or collecting and analyzing real-time manufacturing data.

This can increase overall manufacturing efficiency as IoT sensors can now gather (and analyze) data locally in real-time. For example, the current condition of any part of the manufacturing process can now be automatically adjusted, refined and alerted on.

Healthcare Sector :

The benefits of edge and fog computing can be used to increase the performance of remote healthcare services by reducing latency. Wearable or implanted IoT devices can now be deployed to gather, monitor and analyse real-time patient data.

Patents are able to stay at home with their wearable IoT devices transmitting all required patient data directly to the hospital IT systems. This helps to reduce hospital waiting times and increase the overall patient experience.

Transportation Sector :

Real-time data processing allows for data being collected across a city to be processed faster. Services such as traffic management to be greatly enhanced.Traffic management systems can use edge and fog computing for real-time data analysis to alter traffic lights and intelligent road signs the moment an accident or road blockage occurs.

The advent of semi-autonomous and self-driving cars will only increase the already large amount of data vehicles create. Having cars operate independently requires a capability to locally analyze certain data in real-time, such as surroundings, driving conditions and directions. Other data may need to be sent back to a manufacturer to help improve vehicle maintenance or track vehicle usage. A fog computing environment would enable communications for all of these data sources both at the edge (in the car), and to its end point (the manufacturer).

4. Security and privacy issues in fog computing.

1. Limited Network Visibility
2. Ineffective ways of attack detection
3. Absence of user selective data collection
4. Virtualization issues
5. Multitenancy issues
6. Malicious fog node issues

5. Advantage and limitation of computing.

Advantages :

1. Latency Reduction.
2. Improved Response Time.
3. Enhanced Compliance.
4. Increased Security.
5. Greater Data Privacy.
6. Reduced Cost Of Bandwidth.
7. Overall Increase In Speed and Efficiency.
8. Less Reliance on WAN Services.
9. Greater Up-time of Critical Systems
10. Enhanced Services for Remote Locations

Limitations :

1. Increased Design Complexity : The use of more sophisticated edge IoT, user devices, and fog nodes on your network will increase complexity and overall support requirements
2. Physical Security Considerations : Fog nodes may be located in less secure environments than a central cloud platform in a secure data centre can provide.
3. Decentralised Design : The centralised model that cloud computing provides will make overall platform management and provisioning of hardware more time-intensive.
4. Maintenance : Unlike cloud architecture, where maintenance is made seamless, it is not so in fog. Since controllers and storages are distributed across various locations in the network it needs more maintenance. The fog architecture is decentralized for processing.
5. Power Consumption : The number of fog nodes present in a fog environment is directly proportional to the energy consumption of them. Which means that these fog nodes require high amount of energy for them to function. As there are more fog nodes in a fog infrastructure there are more power consumption as well. Most companies often try to lower their cost using these fog nodes.

CONCLUSION :

- From this experiment we learnt about Fog computing. It is a decentralized computing infrastructure or process in which computing resources are located between the data source and the cloud or any other data center.
- Cloud computing and fog computing are pretty similar but they do have some differences as mentioned below :
    - Cloud architecture is centralized and consists of large data centers that can be located around the globe, a thousand miles away from client devices. Fog architecture is distributed and consists of millions of small nodes located as close to client devices as possible.
    - In cloud computing, data processing takes place in remote data centers. Fog processing and storage are done on the edge of the network close to the source of information, which is crucial for real-time control.
    - Cloud is more powerful than fog regarding computing capabilities and storage capacity. The cloud consists of a few large server nodes while Fog includes millions of small nodes.
    - Fog performs short-term edge analysis due to instant responsiveness, while the cloud aims for long-term deep analysis due to slower responsiveness.
    - Fog provides low latency; cloud — high latency.
    - A cloud system collapses without an Internet connection. Fog computing uses various protocols and standards, so the risk of failure is much lower.
    - Fog is a more secure system than the cloud due to its distributed architecture.
- Finally we understood how fog computing is implemented, where it is implement as in its applications, its advantages, limitations also the security issues in fog computing.

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