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EXP-1

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Assignment - 1

Q1. What is fog computing and explain the need of fog computing

Ans. Fog computing also known fog networking or fogging, a decentralized computing structure that uses edge devices to store, compute and communicate data. Fog computing places data, compute, storage and applications closer to the user or IOT devices. This reduces the need for cloud based resources, which improves performance and reduces latency.

The term "fog" comes from the meterological term for a cloud close to the ground.

⇒ Key components :-

- Edge devices - These devices such as sensors, actuators, and IOT devices that generate data.
- Fog nodes - Intermediate computing nodes located close to the edge devices. They perform data processing, storage and network functions.
- Cloud - The centralized data processing and storage hub, used for tasks that cannot be performed at the edge.

⇒ Needs for fog computing :-

- Low latency - By processing data closeo to the edge, fog computing reduces latency which is critical for real-time applications like autonomous vehicles.

- Bandwidth Efficiency - Fog computing reduces the amount of data that needs to be transmitted to the cloud, saving bandwidth and reducing costs.
- Privacy and Security - Keeping sensitive data at the edge enhances privacy and security by reducing exposure to potential threats during data transmission.
- Scalability - Fog computing allows for the scaling of computing resources based on demand, leading to efficient resource utilization.
- Reliability - distributing computing resources improves system reliability by reducing the impact of failures in individual components.

Q2. Explain the architecture of Fog Computing -

Fog architecture involves using services of end devices (switches, routers, multiplexers, etc) for computational, storage and processing purposes. It consists of physical as well as logical elements of the network, software and hardware to form a complete network of a large number of interconnectivity devices. Fog node distribution (physical as well as geographical) along with the topology & protocols used form key architectural features of fog architecture.

2) Fog layer -

- Fog layer includes devices like routers, gate access, points, base stations, specific fog servers, etc called as fog nodes.
- Fog nodes are located at the edge of a network. An edge can be a hop distance from the end devices. The fog nodes one situated in-between end devices & cloud data centre.
- Fog nodes can be static eg located in a bus terminal or a coffee shop or they can be moving.
- Fog nodes & cloud data center connections are enabled by the IP core networks, providing interaction and co-operation with the cloud for enhancing processing and storage capabilities.

3) Cloud layer -

- This layer consists of devices that can provide large storage & machine (servers) with high performance
- This layer performs computation analysis & stores data, permanently, for back-up & Permanent access to users.
- This layer has high storage and powerful computing capabilities.
- The data centers provide all the basic characteristics of cloud computing to the user. The data centers are both scalable & provide compute resources on demand basics.

- It lies at the extreme end of the overall fog architecture. It acts as a back-up as well as provides permanent storage for data in a fog architecture. Usually the data that isn't required at the user proximity is stored in a cloud layer.

Q4) Compare Fog and Cloud Computing.

- Cloud Computing:- The delivery of on-demand computing services is known as cloud computing We can use applications to storage and processing power over the internet. It is a pay as you go services. Without owning any compting infrastructure or any data centers, anyone can rent access to anything from applications to storage from a cloud service provider. We can provide the complexity of owning and maintaining infrastructure by using cloud computing services and pay for what we use. In turn, cloud computing services providers can benefit from significant economies of scale by delivering the same services to a wide range of customers.

Fog Computing:- Fog Computing 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.

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Fog computing is a paradigm that provides services to user requests at the edge networks. The devices at the fog layer usually perform operations related to networking as routers, gateways, bridges and hubs. Researcher envision these devices to be capable of performing both computational and networking operations, simultaneously. Although these devices are resource-constrained compared to the cloud servers, the geological spread and decentralized nature help in offering reliable services with coverage over a wide area. Fog computing is the physical location of the devices, which are much closer to the users than the cloud servers.

Feature	Cloud Computing	Fog Computing
Latency	High latency compared to fog computing	Has low latency.
Capacity	It does not provide any reduction in data while sending or transforming data.	Fog computing reduces the amt of data sent to cloud computing
Responsiveness	Response time of the system is low.	Response time is high.

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Security	It has less security compared to fog computing	Has high security
Data integration	Multiple data sources can be integrated	Multiple data sources and devices can be integrated.
Mobility	Mobility is limited	Mobility is supported.
Location awareness	Partially supported	Supported fully.
Number of server nodes	Few number of server nodes	Large number of server nodes.
Geographical Distribution	It is centralized	Decentralized and distributed.
Location of service	Provided within internet.	Provided at the edge of local network.
Working environment	Specific data center building with air-conditioning systems.	Outdoor or indoor.
Communication mode	IP network	wireless communication

Q5 Case study on fog computing-

- Overview -

Cisco's connected Roadway solution is an eg. of how fog computing can be applied to improve traffic management and road safety in smart cities. The solution leverages fog computing to process data from various sensors and devices deployed along roadways to provide real-time insights and enable intelligent transportation systems.

- Implementation :-

- Sensors and Cameras :- Cisco deployed a network of sensors and cameras along roadways to collect data on traffic flow, vehicle speed and road conditions.

- Fog nodes - Fog computing nodes were installed at intersections and along highways to process the data collected by the sensors and cameras in real time.

- Data processing - The fog nodes processed the data logically to detect traffic congestion, accidents and other events that could make impact on traffic flow.

- Decision making - Based on the processed data, the fog nodes made real-time decisions, such as adjusting traffic signal timings, rerouting vehicles and notifying emergency services.

* Benefits -:

- Reduced Congestion - By processing data locally and making real-time decisions, the solution helped reduce traffic congestion and improve traffic flow.

- Improved Safety - The solution enabled quicker detection of accidents and other safety hazards, allowing for faster response times and improved safety.

- Efficient Resource Utilization: Fog computing enabled efficient use of network resources by processing data locally and reducing the need to transmit large amounts of data to centralized servers.

* Conclusion:- Cisco's connected railway solution demonstrates the potential of fog computing in improving traffic management & road safety. By processing data locally at the edge of nlw, solution was able to provide real-time insights and enable intelligent transportation systems, leading to reduced congestion, improved safety & more efficient resource utilization.