
EDGE
COMPUTING
Edge
Computing

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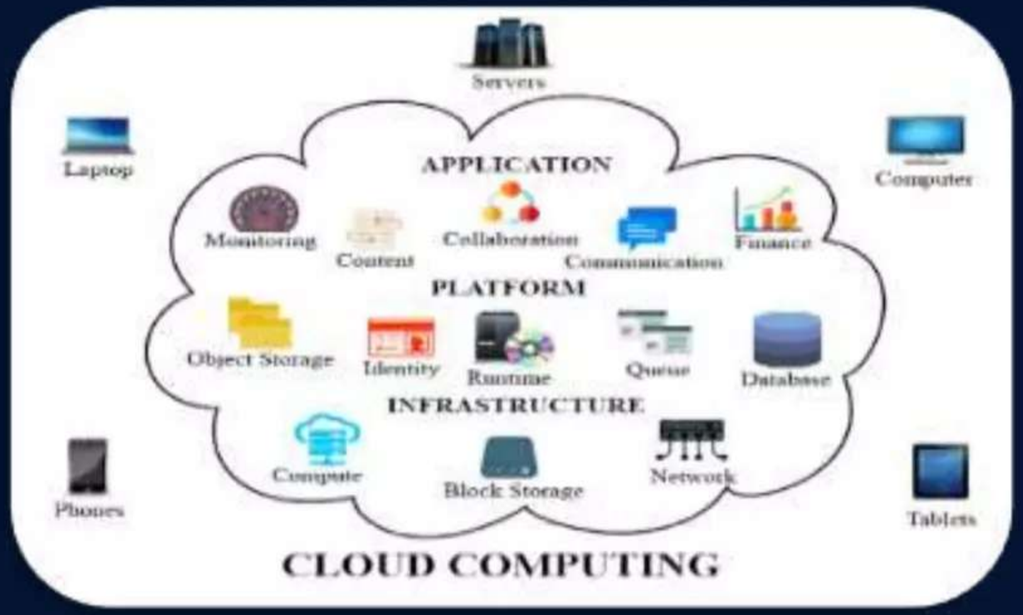
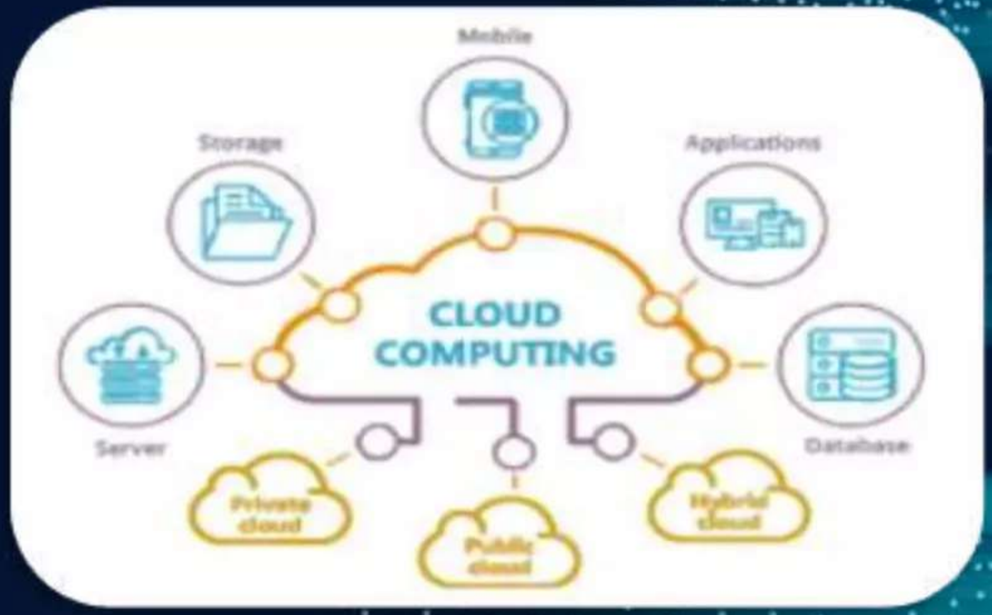
Cloud Computing

- Cloud computing is a infrastructure and software system that allows for access to shared network of storage, server and application over the internet.
- With Cloud Computing users can access database resources via the internet from anywhere for as long as they need without worrying about any maintenance and management of actual resources.



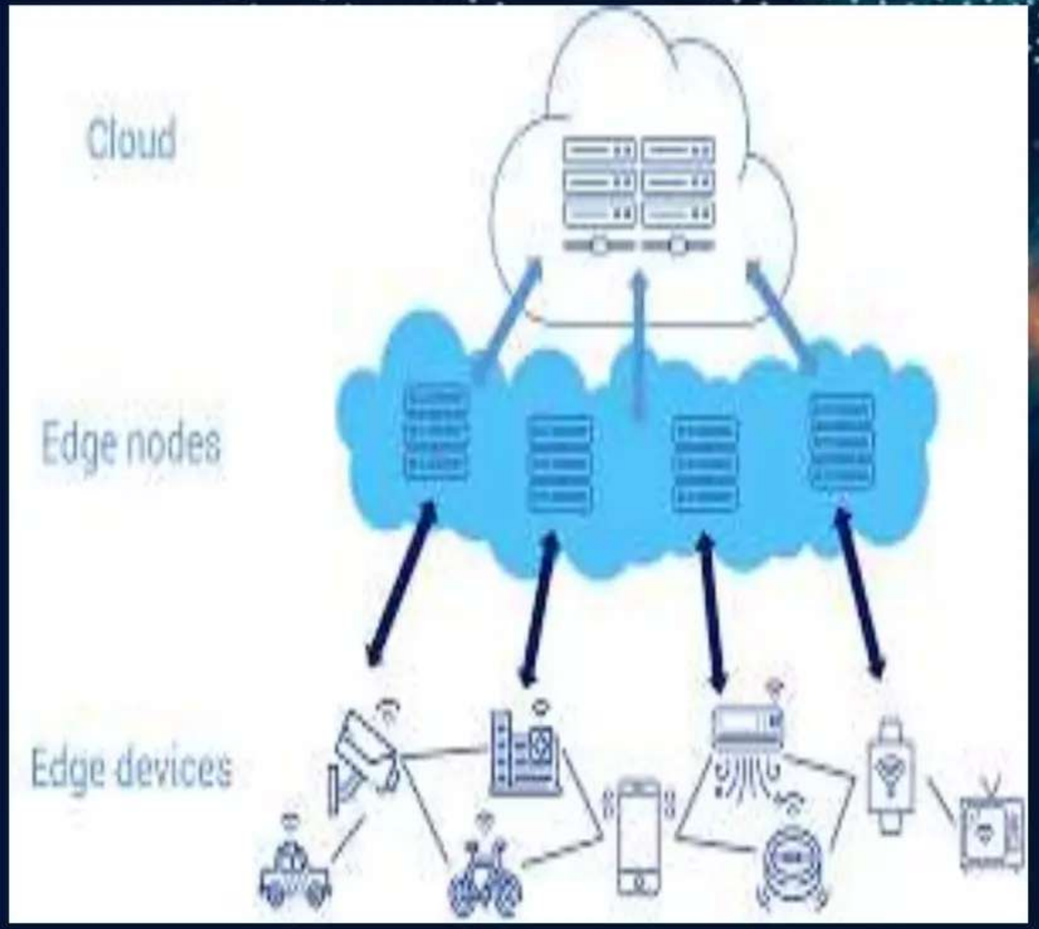


Limitations of Cloud Computing

- **Latency:** In the traditional cloud computing model applications send data to the data Centre and obtain a response, which increases the system latency. For e.g. High speed autonomous driving vehicles require milliseconds of response time.
- **Bandwidth:** Transmitting large amount of data generated by edge devices to the cloud in real time manner will cause great pressure on bandwidth.
- **Availability:** As more and more Internet services are deployed on the cloud, the availability of the services has become an integral part of daily life. Therefore, it is a big challenge for cloud service providers to keep the 24*7 promise.
- **Energy:** With the increasing amount of computation and transmission, energy consumption will become a bottleneck restricting the development of cloud computing centres.

What is Edge Computing?

- **Definition:** Edge computing is a distributed information technology (IT) architecture in which client data is processed at the periphery of the network, as close to the originating source as possible.
- No need to move to and fro from cloud centre.
- Here, rather than transmitting data to a central data center for processing and analysis, the work is performed where the data is actually generated whether it's a retail store, a factory floor or across a smart city.



Need For Edge Computing

Powers the next industrial revolution, transforming manufacturing and services

Optimizes data capture and analysis at the edge to create actionable business intelligence.

Creates a flexible, scalable, secure, and more automated technology, systems, and core business process environment.

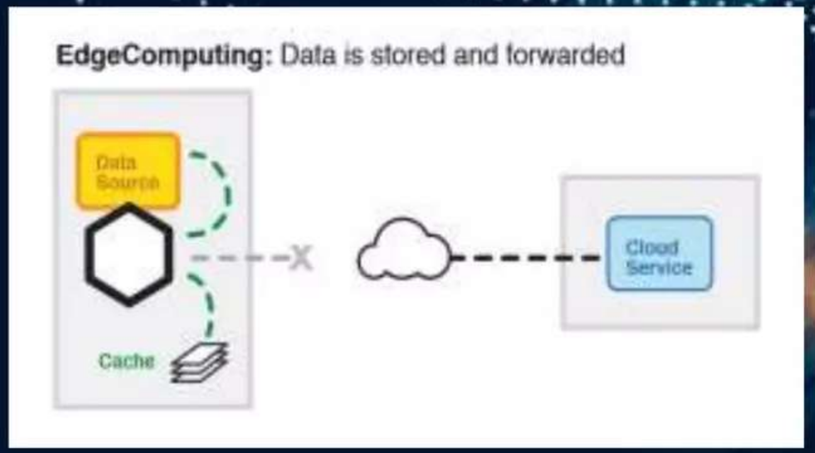
Developed due to the exponential growth of IoT devices, which connect to the internet for managing information over cloud.

Promotes an agile business ecosystem that is more efficient, performs faster, saves costs, and is easier to manage and maintain

Edge Computing Terms and Definitions

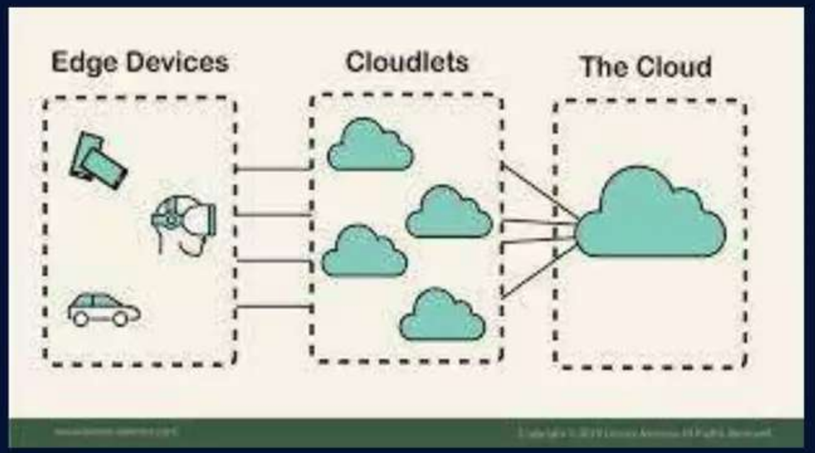
Edge

- It highly depends on the use cases.
- Like in telecommunication, it may be a cell phone or cell tower.
- Similarly, in the automotive example, it could be a car.
- In manufacturing, it could be a machine, and
- In the Information Technology field, it could be a laptop.



Edge Devices

A device which produces data is edge devices like machines and sensors, or any devices through which information is collected and delivered.



Edge Gateway

- It’s a buffer where edge computing processing is done.
- The gateway is the window into the environment beyond the edge of the network.

Edge Server

A computer located in a facility close to the edge device. These machines run application workloads and shared services, so they need more computing power than edge devices

Edge node

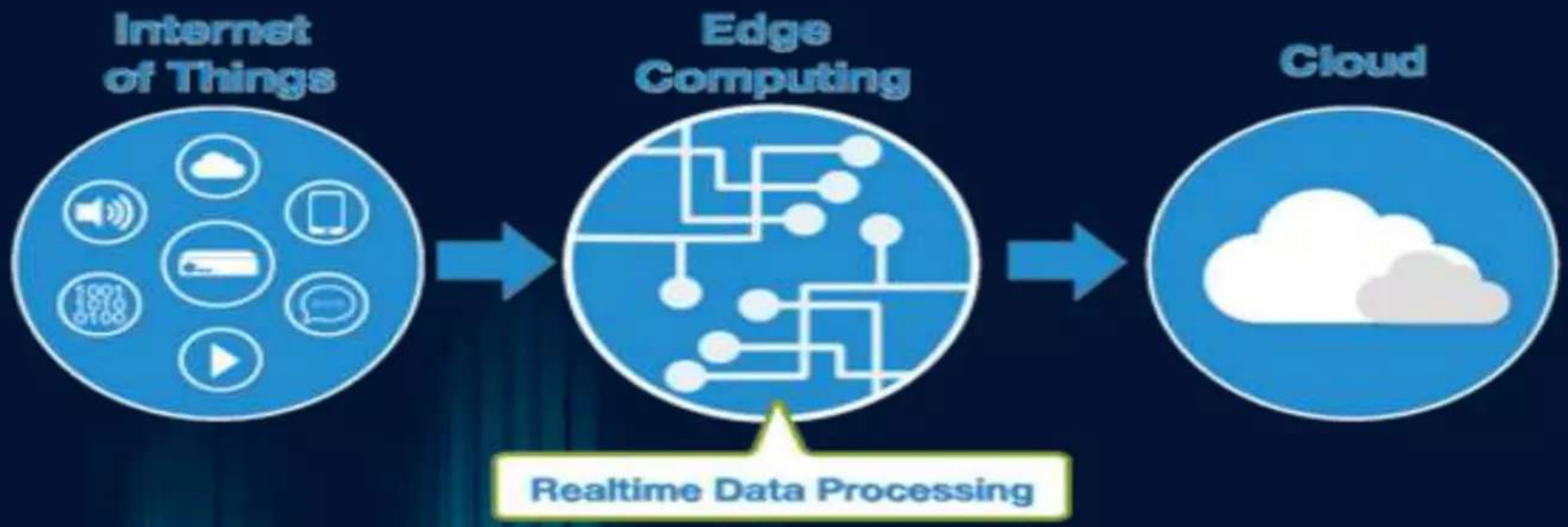
- An edge node is a computer that acts as an end user portal for communication with other nodes in cluster computing.
- Any device, server, or gateway that performs edge computing.

Cloud

A public or private cloud that acts as a repository for containerized workloads like applications and machine learning models. The cloud also hosts and runs apps that manage edge nodes

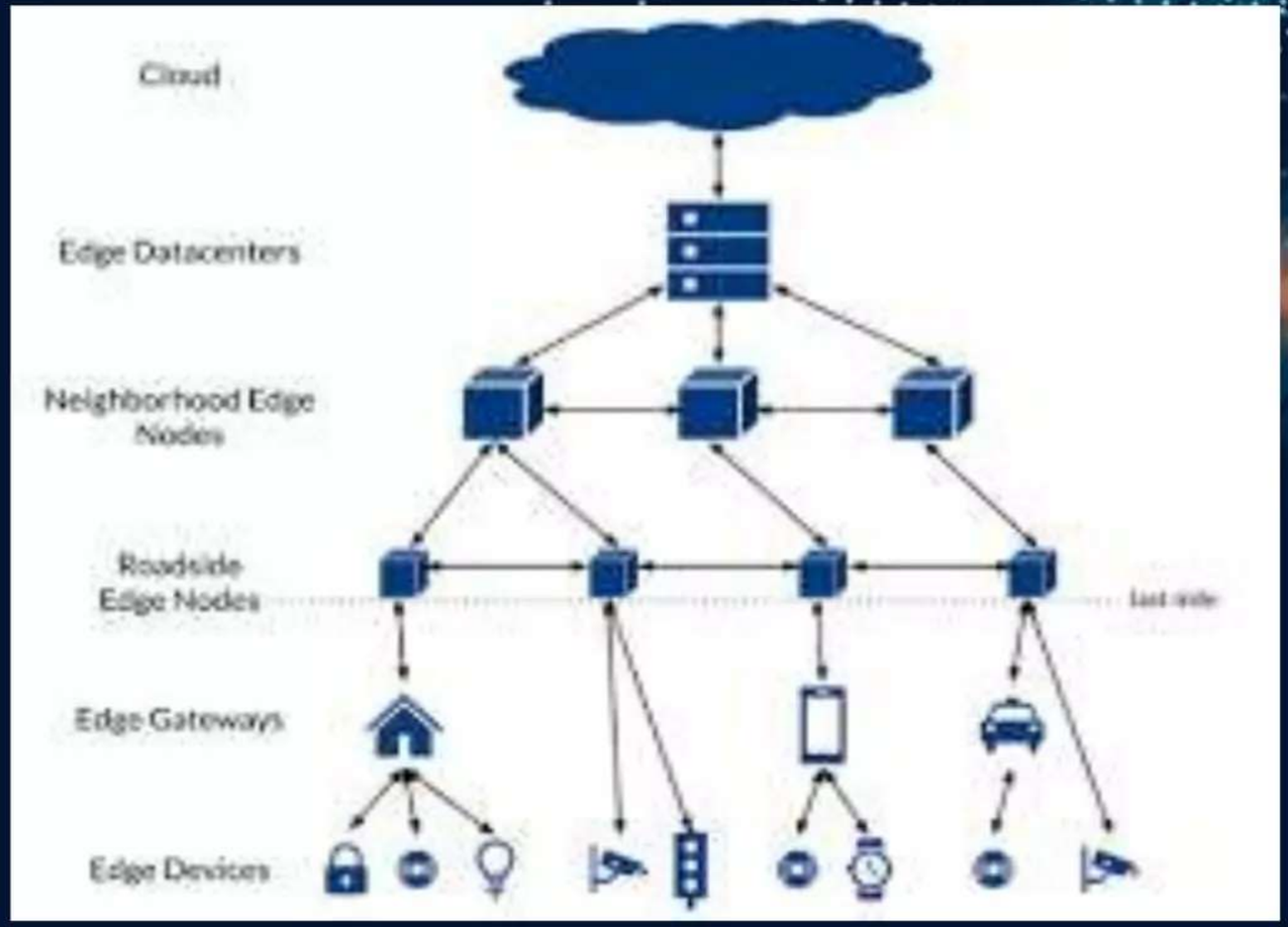
Internet of Things (IoT) and Edge Computing

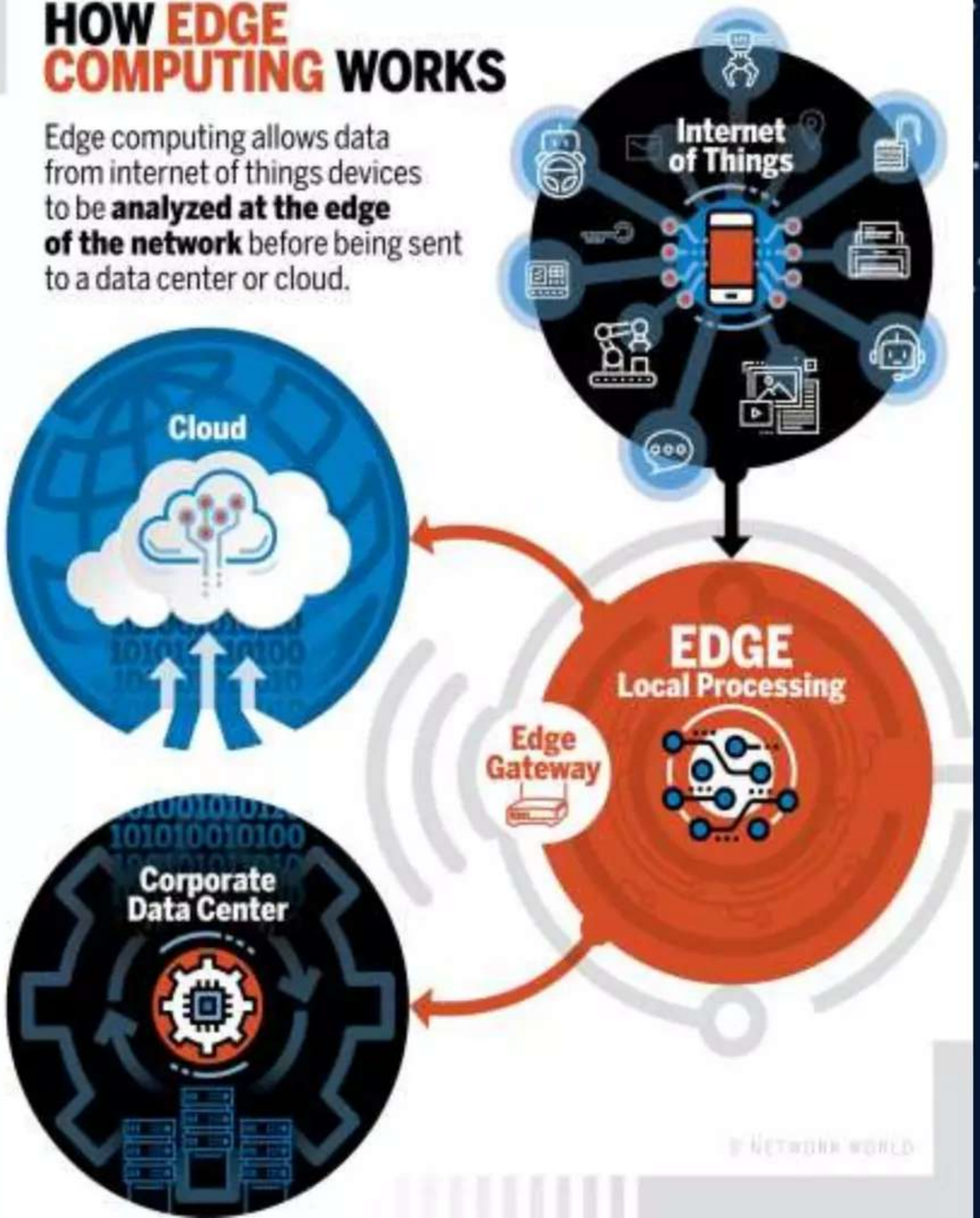
- The Internet of Things (IoT) refers to a system of interrelated, internet-connected objects that are able to collect and transfer data over a wireless network without human intervention.
- In IoT, with the help of edge computing, intelligence moves to the edge.
- There are various scenarios where speed and high-speed data are the main components for management, power issues, analytics, and real-time need, etc. helps to process data with edge computing in IoT.



Architecture of Edge Computing

Edge solutions are usually multi-layered distributed architectures encompassing and balancing the workload between the Edge layer, the Edge cloud or Edge network, and the enterprise layer. Furthermore, when we talk about the edge, there are the Edge devices and the local Edge servers.





More on Edge

- A network of micro data centres that store or process critical data locally and push received data to a centralized data centre or repository of cloud storage.
- Typically in IoT use cases, a massive chunk of data goes through the data center, but edge computing processes the data locally results in reduced traffic in the central repository.
- This is done by IoT devices, transferring the data to the local device, which includes storage, compute and network security.
- After that, data is processed at the edge while another portion is sent to storage repository or central processing in data centre.

Example: CCTV System

Consider a building secured with dozens of high-definition IoT video cameras. These are "dumb" cameras that simply output a raw video signal and continuously stream that signal to a cloud server.

Traditional Cloud Computing System

- On the cloud server, the video output from all the cameras is put through a motion-detection application to ensure that only clips featuring activity are saved to the server's database.
- This means there is a constant and significant strain on the building's Internet infrastructure, as significant bandwidth gets consumed by the high volume of video footage being transferred

Edge Computing System

- Now the motion sensor computation is moved to the network edge
- Each camera use its own internal computer to run the motion-detecting application and then sent footage to the cloud server as needed .
- This results in a significant reduction in bandwidth use, because much of the camera footage will never have to travel to the cloud server.

Advantages:

Speed

Edge computing has the capability to increase network speed by reducing latency. It greatly reduces the distance it should travel by processing data closer to the source of information.

Scalability

The edge can be used to scale your own IoT network without needing to worry about the storage requirements.

Reliability

Edge computing handles reliability part very well. Since most at times the edge computing does not depend on internet connection and servers it offers an uninterruptible service.

Security

The information present on the cloud has the tendency to get hacked easily. Since the edge computing only sends the relevant information to the cloud this can be prevented

Cost Effectiveness

Using edge computing for IoT allows users to reduce the bandwidth and data storage requirement and replace datacenters with device solutions. So, overall cost gets reduced.

Disadvantages

- **Security:** Due to the fact that data processing takes place at the outside edge of the network there are often risks of identity theft and cyber security breaches.
- **Incomplete data:** Edge computing only process and analyze partial sets of information. The rest of the data is just discarded.
- **More Storage Space**: Edge computing does take a considerably higher storage space on your device.
- **Investment Cost:** Implementing an edge infrastructure can be costly and complex. This is due to their complexity which needs additional equipment and resources.
- **Maintenance:** In edge Computing there are more various network combinations with several computing nodes. This requires higher maintenance cost than a centralized infrastructure.

Application: Use Cases

- **Manufacturing:** An industrial manufacturer deployed edge computing to monitor manufacturing, enabling real-time analytics and machine learning at the edge to find production errors and improve product manufacturing quality.

- **Farming:** Using sensors enables the business to track water use, nutrient density and determine optimal harvest. Data is collected and analyzed to find the effects of environmental factors and therefore produce good yield.

- **Improved healthcare:** The healthcare industry has dramatically expanded the amount of patient data collected from devices, sensors and other medical equipment. That enormous data volume requires edge computing to apply automation and machine learning to access the data

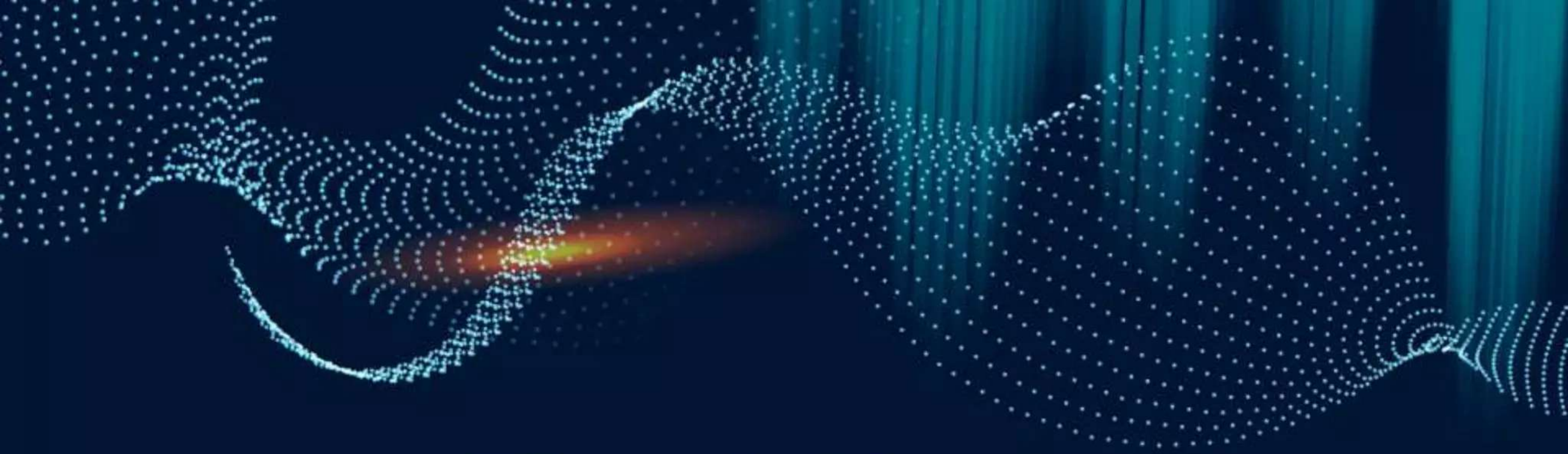
- **Traffic Management:** Edge computing can enable more effective city traffic management. Examples of this include optimizing bus frequency given fluctuations in demand, managing the opening and closing of extra lanes, and, in future, managing autonomous car flows.

- Smart Homes: Smart homes rely on IoT devices collecting and processing data from around the house. As an example, the time taken for voice-based assistant devices such as Amazon's Alexa to respond would be much faster.

Conclusion

- Edge Computing is very promising and has found many useful applications
- Bringing computation to the network's edge minimizes the amount of long-distance communication that has to happen between a client and server.

  However, there are still many challenges faced by the community, ranging from fundamental technologies to novel application scenarios and potential business models
- Edge computing gained notice with the rise of IoT and the sudden glut of data such devices produce. But with IoT technologies still in relative infancy, the evolution of IoT devices will also have an impact on the future development of edge computing.



Thank You!