Chapter

Perspective Chapter: A View – Cloud-Edge Computing Technology

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Abstract

In the computing era, the users of Internet grow tremendously. Each individual is using a number of devices that access data indefinitely. For any desired task, we will have three sorts of basic work in terms of storing, processing, and computation. In distributed world, many applications depending upon individual or enterprise rely on cloud computing. Edge computing has also evolved after cloud computing. Both the technologies have many common characteristics. The advantage of edge computing technology is service provisioning and it is done at the device level closer to the user rather than cloud. The application that needs faster response time or that holds sensitive data almost relied on edge technology for its computation.

Keywords: cloud, edge, latency, performance, cloud computing

1. Introduction

Cloud Edge technology is an innovative approach for managing and processing data in a distributed computing environment. It involves the integration of cloud computing with edge computing, which allows data to be processed and analyzed closer to the source of the data, reducing latency and improving response times.

At its core, cloud edge technology involves the deployment of edge devices or nodes that are connected to the cloud. These devices act as gateways that can process data in real time, and send only the relevant data to the cloud for further processing and analysis. This approach minimizes the amount of data that needs to be transmitted over the network, which in turn reduces network congestion and lowers the costs associated with data transmission.

The benefits of cloud edge technology are many. For one, it enables organizations to harness the power of cloud computing while still retaining the benefits of edge computing. This means that data can be processed and analyzed in real time, even when network connectivity is limited or unreliable.

Another benefit of cloud edge technology is its ability to support the deployment of new applications and services. By providing a distributed computing infrastructure, cloud edge technology enables organizations to deploy applications and services closer to their users, which improves performance and enhances the user experience.

Overall, cloud edge technology represents a significant advancement in the field of distributed computing. By combining the power of cloud computing with the benefits of edge computing, organizations can optimize their data processing and analysis capabilities, reduce latency, and enhance the overall user experience.

2. Background

Edge is the computing evolution after cloud computing but edge will not replace cloud in any means rather it will supplement cloud. On top level, always there will be cloud layer next to cloud layer bottom the edge layer will present, whenever applications is having data sensitive processing rather than cloud for faster processing. In research paper [1], all the basic scientific methods of cloud, edge, and fog computing have been discussed. Another research paper [2] compared this edge and cloud technology in performance parameters such as data filtering, processing, storage, and efficiency. Both the technological paradigms complement each other, n future industries such as manufacturing, mining, and transportation for detecting anomalies and sending alerts. In paper [3], comparison of fog nodes, edge nodes, and cloudlets is done on theoretical perspectives. The model reflects context awareness, access mechanisms, etc., and these have different set of characteristics that isolate them apart and it lacks standardization. The edge actually is acting as an interface, which connects all the edge devices to the cloud. Cloud will offer the services such as storing, processing, and analyzing the devices. By now in 2023 above 60% of the data is stored in network devices and managed in edge [4].

The major drawback cloud faces over edge is the amount of data processed per second, which is not passably supported by cloud. Next drawback is latency issues, and cloud also faces waste of resources as well. Also when data is piled and transferred to cloud it overloads the network so high bandwidth usage will occur. Edge computing [4] will not only helpful in minimizing data dependency over the app or service, and it will help in speeding up the process.

2.1 Why cloud computing?

Cloud computing offers many benefits that make it an attractive option for individuals and businesses alike. According to the research paper [5], there are some reasons why cloud computing is a popular choice:

Scalability: Cloud computing enables users to scale up or down their computing resources easily, depending on their needs. This means that users can adjust their computing resources as their requirements change, which can result in significant cost savings.

Cost-effectiveness: Cloud computing eliminates the need for organizations to invest in expensive hardware and software infrastructure. Instead, users pay for the computing resources they use on a pay-as-you-go basis, which can result in significant cost savings.

Accessibility: Cloud computing enables users to access their data and applications from anywhere with Internet connection. This means that users can work remotely, collaborate with others in real time, and access their data on any device.

Reliability: Cloud computing providers typically offer high levels of reliability and uptime, which ensures that users can access their data and applications when they need them.

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Security: Cloud computing providers typically employ robust security measures to protect their users' data and applications from cyber threats. These measures often exceed what most organizations can implement on their own.

Agility: Cloud computing enables organizations to quickly deploy new applications and services, which can result in faster time-to-market and increased competitive advantage.

Cloud computing offers numerous benefits that make it an attractive option for individuals and organizations. By enabling scalability, cost-effectiveness, accessibility, reliability, security, and agility, cloud computing has become an essential component of modern computing infrastructure.

2.2 Types of cloud

There are three main types of cloud computing: public cloud, private cloud, and hybrid cloud. Here is a brief overview of each type.

Public Cloud: A public cloud is a cloud computing environment that is hosted by a third-party cloud service provider and made available to the public. These providers offer computing resources such as servers, storage, and applications to multiple customers who share these resources. Public clouds are accessible to anyone with Internet connection and are typically priced on a pay-as-you-go basis.

Private Cloud: A private cloud is a cloud computing environment that is dedicated to a single organization. These clouds are hosted either on-premises or by a third-party service provider and are typically used by large organizations that require a high degree of control over their computing resources. Private clouds offer greater control and security than public clouds but require significant upfront investment.

Hybrid Cloud: A hybrid cloud is a combination of public and private clouds that work together to provide a single computing environment. This approach allows organizations to leverage the benefits of both public and private clouds while addressing their specific needs for security, control, and scalability. In a hybrid cloud, organizations can use a public cloud for non-sensitive data and applications while using a private cloud for sensitive data and applications.

In addition to these three main types, there are also other types of clouds, such as community clouds and multi-clouds. Community clouds are clouds that are shared by multiple organizations with similar requirements, such as government agencies or healthcare organizations. Multi-clouds are environments that incorporate multiple cloud providers, enabling organizations to leverage the strengths of different providers for different applications or workloads.

Benefits of cloud computing:

- Lower IT infrastructure and computer costs for users
- Improved performance
- Fewer maintenance issues
- Instant software updates
- Improved compatibility between operating systems
- Performance and scalability

- Increased storage capacity
- Increase data safety

Drawbacks of cloud computing:

- Downtime
- Security and privacy
- Vulnerability to attack
- Limited control and flexibility
- Vendor lock-in
- Cost concerns

2.3 Edge computing

Edge computing is a distributed computing paradigm that involves processing and analyzing data at or near the source of the data, rather than sending it to a centralized data center or cloud for processing. The term "edge" refers to the edge of a network, where data is generated, collected, and analyzed in real-time.

The main goal of edge computing is to reduce the latency and bandwidth requirements associated with transmitting data to a centralized location for processing. By processing data at the edge of the network, organizations can improve their response times, reduce network congestion, and improve the overall performance of their applications.

Edge computing involves deploying edge devices, such as sensors, gateways, and other types of computing devices, at the edge of the network. These devices are responsible for collecting data, processing it in real time, and sending only the relevant data to the cloud for further analysis or storage.

Edge computing is particularly useful in scenarios where low latency and high reliability are critical, such as in industrial automation, autonomous vehicles, and healthcare. It also enables organizations to process and analyze data in environments where network connectivity is limited or unreliable, such as in remote locations or on mobile devices. It is an important development in the field of distributed computing, as it enables organizations to improve the performance, reliability, and scalability of their applications by processing data at the edge of the network.

2.4 Working of edge computing

EDGE computing involves processing and analyzing data at or near the source of the data, rather than sending it to a centralized data center or cloud for processing. The following are the basic steps involved in the working of edge computing.

Data collection: Edge devices, such as sensors, gateways, and other types of computing devices, are deployed at the edge of the network to collect data from various sources. These devices may also preprocess the data to reduce the amount of data that needs to be transmitted to the cloud for further analysis or storage.

Data processing: Edge devices process the collected data in real time using local computing resources. This enables organizations to perform analysis and make decisions quickly, without the delays associated with transmitting data to a centralized location for processing.

Data storage: Edge devices may also store data locally for quick access and offline processing. This helps to reduce the latency associated with transmitting data to the cloud for storage.

Data transmission: Edge devices transmit only relevant data to the cloud for further analysis or storage. This reduces the amount of data that needs to be transmitted over the network, reducing network congestion and improving overall performance.

Cloud-based analysis: The cloud receives the relevant data from edge devices and performs further analysis or storage. Cloud-based analytics can provide insights into patterns, trends, and anomalies that can help organizations make better decisions and optimize their operations.

IT enables organizations to process data at the edge of the network, reducing the latency and bandwidth requirements associated with transmitting data to a centralized location for processing. By processing data at the edge, organizations can improve their response times, reduce network congestion, and improve the overall performance of their applications.

2.5 Types of edge computing

There are four main types of edge computing, each with their own specific characteristics and use cases. These are as follows:

Local edge: Local edge computing is the simplest form of edge computing, and involves processing data at the edge of the network on a device or gateway that is directly connected to the data source. Local edge computing is used to minimize latency and ensure high availability for applications that require real-time processing.

Regional edge: Regional edge computing involves processing data at a regional data center or a group of data centers that are geographically close to the edge devices. Regional edge computing is used to support applications that require higher computational power or storage capacity than what is available on the local edge.

Distributed edge: Distributed edge computing involves processing data at multiple edge locations simultaneously. This approach is used to ensure high availability and redundancy for applications that require real-time processing and are critical to business operations.

Cloud edge: Cloud edge computing involves processing data at the edge of the network using a combination of cloud and edge resources. This approach is used to support applications that require scalability, high availability, and high computational power. Cloud edge computing can also enable edge devices to offload data processing and analysis to the cloud when needed.

Benefits of edge computing:

Edge computing offers several benefits to organizations, including the following:

Reduced latency: Edge computing reduces the time it takes for data to travel from the source to the processing location, resulting in lower latency and faster processing times. This is especially important for applications that require real-time processing and response times.

Improved reliability: Edge computing can improve the reliability of applications by reducing the impact of network outages or disruptions. By processing data at the edge of the network, applications can continue to function even if the network connection is lost.

Lower bandwidth requirements: Edge computing reduces the amount of data that needs to be transmitted to a centralized location for processing, resulting in lower bandwidth requirements and reduced network congestion.

Enhanced security: Edge computing can enhance security by processing sensitive data locally, reducing the risk of data breaches and unauthorized access. Additionally, edge devices can be configured to encrypt data at rest and in transit, further enhancing security.

Improved scalability: Edge computing [6] can improve the scalability of applications by distributing processing and storage resources across multiple edge devices. This enables organizations to handle increasing volumes of data and user requests without impacting performance.

Cost savings: Edge computing can result in cost savings by reducing the need for expensive data center infrastructure and network bandwidth. Additionally, edge computing can reduce the cost of data transfer and storage by processing and storing data locally.

Drawbacks of edge computing:

Edge computing offers several benefits, and it also has some drawbacks that organizations should be aware of. These include the following:

Limited processing power: Edge devices typically have limited processing power compared to cloud servers or data centers. This means that complex applications or processing tasks may not be able to be handled at the edge, and may need to be offloaded to the cloud.

Limited storage capacity: Edge devices also typically have limited storage capacity, which can be a constraint for applications that require large amounts of storage.

Increased complexity: Edge computing can increase the complexity of IT infrastructure, as it involves managing and coordinating a large number of edge devices and data sources. This can be challenging for organizations that do not have the necessary expertise or resources.

Security risks: Edge devices are often deployed in remote or unsecured locations, making them more vulnerable to cyber-attacks. Additionally, managing security across many edge devices can be challenging, and can require additional resources and expertise.

Integration challenges: Integrating edge computing into existing IT infrastructure can be challenging, especially if legacy systems are involved. This can result in additional costs and complexity.

Maintenance and upgrades: Edge devices require regular maintenance and upgrades to ensure that they are functioning properly and are up to date with security patches and software updates. This can be challenging in remote or hard-to-reach locations.

3. Examples and use cases

Edge computing is being used in a variety of industries and use cases. Some examples include the following:

Manufacturing: In manufacturing, edge computing is used to optimize production processes, monitor equipment performance, and reduce downtime. For example, edge devices can be used to collect sensor data from production lines in real time, analyze the data at the edge, and provide insights into operators and engineers to improve production efficiency.

Healthcare: In healthcare, edge computing is used to monitor patients in real time, analyze data from medical devices, and provide alerts to healthcare providers when necessary. For example, edge devices can be used to monitor vital signs of patients in real time and provide early warning alerts when a patient's condition is deteriorating.

Smart cities: In smart cities, edge computing is used to manage traffic, monitor air quality, and provide real-time public safety alerts. For example, in Ref. [7] edge devices can be used to collect data from traffic cameras, analyze the data at the edge, and provide real-time traffic updates to commuters.

Retail: In retail, edge computing is used to personalize customer experiences, optimize inventory management, and improve supply chain efficiency. For example, edge devices can be used to collect data from in-store sensors, analyze the data at the edge, and provide personalized recommendations to customers based on their shopping behavior.

Oil and gas: In the oil and gas industry, edge computing is used to monitor and optimize production processes, reduce downtime, and improve worker safety. For example, edge devices can be used to collect data from oil rigs in real time, analyze the data at the edge, and provide insights into operators and engineers to improve production efficiency and reduce downtime.

4. Cloud-Edge technology

Cloud-edge technology is the integration of cloud computing resources with edge computing devices. Edge computing is a distributed computing paradigm that brings computation and data storage closer to the location where it is needed, to improve response times and save bandwidth. Cloud computing, on the other hand, is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale.

By combining the two technologies, organizations can take advantage of the scalability and flexibility of the cloud while also [2] enjoying the low latency and high performance of edge computing. This allows for real-time data processing and decision making, as well as the ability to offload data and processing to the cloud for storage, management, and advanced processing.

One of the main use cases of cloud-edge technology is in the Internet of Things (IoT) and Industry 4.0. IoT devices generate [8] large amounts of data that need to be processed and analyzed in real time. By using edge computing, this data can be processed locally, reducing the amount of data that needs to be sent to the cloud for processing. This can also reduce the cost of transmitting large amounts of data over long distances. In addition, edge devices can also make decisions based on the data they collect, without the need for a constant connection to the cloud.

Another use case of cloud-edge technology is in the field of autonomous vehicles. Autonomous vehicles generate huge amount of data from sensors that need to be processed in real time to make decisions. By using edge computing, the data can be processed locally, reducing the amount of data that needs to be sent to the cloud for processing. This can also reduce the cost of transmitting large amounts of data over long distances. Cloud-edge technology also plays a vital role in 5G networks, which helps to reduce the latency and increase the data rate for the end-users.

In conclusion, cloud-edge technology is an important trend in computing that allows organizations to take advantage of the scalability and flexibility of the cloud while also enjoying the low latency and high performance of edge computing. It has many use cases, including IoT, Industry 4.0, autonomous vehicles, and 5G networks.

5. Characteristics of cloud-Edge technology

The characteristics of cloud-edge technology can be summarized as follows:

1. **Distributed computing:** Cloud-edge technology is a distributed computing paradigm that brings computation and data storage closer to the location where it is needed, to improve response times and save bandwidth.

2. **Low Latency:** Edge computing can provide low latency as data does not need to be transmitted over long distances to a centralized location for processing.

3. **Real-time data processing:** Cloud-edge technology allows for real-time data processing and decision making, which is essential in some use cases such as IoT, Industry 4.0, autonomous vehicles, and 5G networks.

4. **Scalability:** Cloud computing offers scalability, as resources can be easily added or removed as needed. Edge computing, however, may have limitations in terms of scalability as resources are typically more constrained.

5. **Flexibility:** Cloud computing offers a high degree of flexibility as resources can be added or removed as needed. Edge computing, on the other hand, may have limitations in terms of flexibility as resources are typically more constrained.

6. **Security:** Edge computing devices are often located in remote or hard-to-reach locations, which can make them more vulnerable to security threats. Cloud computing, on the other hand, typically has more robust security measures in place to protect data.

7. **Cost:** Edge computing can be more cost-effective as it reduces the need for data transmission over long distances. However, the cost of deploying and maintaining edge devices can be higher than cloud computing.

8. **Integration:** Cloud-edge technology allows the integration of cloud resources for storage, management, and advanced processing, with edge devices for real-time data processing and decision making.

9. **Multi-cloud:** Cloud-edge technology can be used in a multi-cloud environment, where data can be processed on different cloud platforms depending on the use case.

10. **5G integration**: Cloud-edge technology plays a vital role in 5G networks, which helps to reduce the latency and increase the data rate for the end-users.

6. Why cloud-edge technology?

Overall, cloud-edge technology allows organizations to improve their operations and stay competitive by taking advantage of the scalability and flexibility of the cloud while also enjoying the low latency and high performance of edge computing.

6.1 Architectural concepts of cloud-edge technology

Cloud-edge technology refers to the integration of cloud computing and edge computing to create a hybrid computing environment. The main architectural concepts of cloud-edge technology include the following [9–19]:

1. ***Data processing:*** In a cloud-edge environment, data is processed both at the edge, near the source of the data, and in the cloud, allowing for real-time processing and analysis.

2. ***Distribution of resources:*** Cloud-edge technology allows for the distribution of resources such as storage, computation, and memory across the edge and the cloud. This enables efficient use of resources and reduces the need for large, centralized data centers.

3. ***Decentralization:*** Cloud-edge technology allows for a more decentralized computing environment, where data and applications can be distributed across a network of devices and locations.

4. ***Scalability:*** Cloud-edge technology allows for easy scaling of resources as needed, enabling efficient use of resources and cost savings.

5. ***Security:*** Cloud-edge technology can provide enhanced security by allowing sensitive data to be processed and stored at the edge, reducing the risk of data breaches.

6. ***Low Latency:*** Cloud-edge technology provides low-latency services by processing data on the edge devices, reducing the need for data transfer over the network.

6.2 Similarity of cloud-edge technology

A comparison of cloud and edge technology can be made based on several factors, including the following [9–19]:

Location of data processing: Edge computing involves processing data at or near the source of data collection, while cloud computing involves processing data in a centralized location such as a data center or the cloud.

Latency: Edge computing can provide lower latency as data does not need to be transmitted over long distances to a centralized location for processing. Cloud computing, on the other hand, may have higher latency due to the distance data needs to be transmitted.

Scalability: Cloud computing is known for its scalability, as resources can be easily added or removed as needed. Edge computing, however, may have limitations in terms of scalability as resources are typically more constrained.

Security: Edge computing devices are often located in remote or hard-to-reach locations, which can make them more vulnerable to security threats.

Cost: Edge computing can be more cost-effective as it reduces the need for data transmission over long distances. However, the cost of deploying and maintaining edge devices can be higher than cloud computing.

Flexibility: Cloud computing offers a high degree of flexibility as resources can be added or removed as needed. Edge computing, on the other hand, may have limitations in terms of flexibility as resources are typically more constrained.

By combining both cloud and edge technologies, organizations can take advantage of the scalability and flexibility of the cloud while also enjoying the low latency and high performance of edge computing. It also allows for real-time data processing and decision making, as well as the ability to offload data and processing to the cloud for storage, management, and advanced processing.

6.3 Dissimilarity of cloud-edge technology

The main difference between cloud and edge technology is the location of data processing and the way data is managed [9–19].

Cloud technology refers to the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale. Cloud computing is a centralized approach where data is stored and processed in data centers, which can be located anywhere in the world. It allows for scalability and flexibility as resources can be easily added or removed as needed.

Edge technology, on the other hand, is a distributed computing paradigm that brings computation and data storage closer to the location where it is needed, to improve response times and save bandwidth. Edge computing devices are located at the edge of the network, closer to the source of data collection. These devices process data locally, reducing the amount of data that needs to be sent to the cloud for processing. Edge computing can provide lower latency as data does not need to be transmitted over long distances to a centralized location for processing.

By combining both cloud and edge technologies, organizations can take advantage of the scalability and flexibility of the cloud while also enjoying the low latency and high performance of edge computing. It also allows for real-time data processing and decision making, as well as the ability to offload data and processing to the cloud for storage, management, and advanced processing.

6.4 Cloud-edge management

Cloud-Edge management refers to the processes and tools used to manage and maintain the hybrid cloud-edge computing environment. This includes managing the distribution and allocation of resources, monitoring performance, and ensuring security and compliance.

Some of the key elements of cloud-edge management include the following:

1. **Resource management:** Managing the distribution and allocation of resources such as storage, computation, and memory across the edge and the cloud. This includes monitoring resource utilization and ensuring that resources are used efficiently.

2. **Network management:** Managing the network infrastructure that connects the edge and the cloud. This includes monitoring network performance, troubleshooting issues, and ensuring secure communication between the edge and the cloud.

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3. **Security management:** Ensuring the security of the cloud-edge environment by implementing security measures such as encryption, firewalls, and access controls. This also includes monitoring for potential security threats and responding to security incidents.

4. **Compliance management:** Ensuring that the cloud-edge environment is compliant with relevant regulations and industry standards. This includes implementing policies and procedures to meet compliance requirements and monitoring compliance status.

5. **Monitoring and analytics:** Monitoring the performance of the cloud-edge environment, including the edge devices, the cloud, and the network. This includes collecting and analyzing data to detect issues and identify opportunities for improvement.

6. **Automation:** Automating the management tasks and processes such as scaling, updates, and monitoring.

7. Cloud:-edge integration complexity

Cloud-edge integration can be complex due to a number of factors, such as:

1. **Data management:** Integrating data from the edge devices with data stored in the cloud can be complex, as the data may be in different formats and may need to be transformed or cleaned before it can be analyzed. Additionally, there may be issues with data privacy and security when transmitting data from the edge to the cloud.

2. **Network connectivity**: Ensuring reliable and secure communication between the edge and the cloud can be complex, as it requires a robust network infrastructure and may involve integrating different types of networks and protocols.

3. **Resource allocation:** Managing the distribution and allocation of resources between the edge and the cloud can be complex, as it requires balancing the needs of different edge devices and applications with the available resources in the cloud.

4. **Security:** Ensuring the security of the cloud-edge environment can be complex, as it requires implementing security measures at both the edge and the cloud, and monitoring for potential security threats.

5. **Compliance:** Ensuring compliance with relevant regulations and industry standards can be complex, as it requires implementing policies and procedures to meet compliance requirements and monitoring compliance status.

6. **Scalability:** The scalability of the cloud-edge environment can be complex as the number of edge devices and the amount of data that needs to be processed increases.

7. **Latency:** The latency of the cloud-edge environment can be complex as the processing of data at the edge devices improves the latency, but it can also increase the complexity of the environment.

8. **Management:** The management of the cloud-edge environment can be complex as it involves multiple layers and multiple teams, which need to work together seamlessly.

Integrating cloud and edge technology can be a complex task, requiring coordination and collaboration among multiple teams and technologies. However, with the right approach and tools, the benefits of cloud-edge integration can be well worth the effort.

8. Real world examples of cloud-edge technology

There are many real-world examples of cloud-edge technology being used in various industries. Some examples include the following:

Internet of Things (IoT): Cloud-edge technology is often used in IoT to process and analyze large amounts of data generated by IoT devices in real-time. For example, a smart city might use edge computing to process data from sensors in real time to adjust traffic lights and reduce congestion. The data can then be sent to the cloud for long-term storage and analysis.

Autonomous vehicles: Autonomous vehicles generate huge amounts of data from sensors that need to be processed in real time to make decisions. By using edge computing, the data can be processed locally, reducing the amount of data that needs to be sent to the cloud for processing. This can also reduce the cost of transmitting large amounts of data over long distances.

Industry 4.0: Cloud-edge technology is often used in Industry 4.0 to process and analyze large amounts of data generated by industrial equipment and machines in real time. For example, a factory might use edge computing to process data from sensors on machines in real time to improve efficiency and reduce downtime.

5G networks: Cloud-edge technology plays a vital role in 5G networks, which helps to reduce the latency and increase the data rate for the end-users.

Healthcare: Cloud-edge technology is also used in healthcare, for example, in telemedicine, remote patient monitoring, and in clinical research. Edge computing can be used to process data from medical devices in real time, while the cloud can be used to store and analyze the data.

Retail: Retail companies are using cloud-edge technology to support the use of Internet of Things (IoT) devices such as RFID tags and sensors to keep track of inventory and customer behavior in real time.

These are just a few examples of how cloud-edge technology is being used in various industries. As technology continues to evolve, it is likely that more and more companies will begin to adopt cloud-edge technology to improve their operations and stay competitive.

8.1 Market providers of cloud-edge technology

There are several major market providers of cloud-edge technology, including the following:

1. **Amazon Web Services (AWS):** AWS offers a range of services for cloud-edge computing, including AWS Greengrass for edge computing and AWS IoT for Internet of Things applications.

2. **Microsoft Azure:** Microsoft Azure offers Azure Edge Zones for low-latency edge computing and Azure IoT Edge for Internet of Things applications.

3. **Google Cloud:** Google Cloud offers Cloud IoT Edge for Internet of Things applications and Cloud Edge for edge computing.

4. **IBM:** IBM offers IBM Edge Application Manager for edge computing and IBM Watson IoT Platform for Internet of Things applications.

5. **Alibaba Cloud:** Alibaba Cloud offers Apsara Stack for edge computing and IoT Platform for Internet of Things applications.

6. **Huawei:** Huawei offers FusionSphere for edge computing and IoT Platform for Internet of Things applications.

7. **Cisco:** Cisco offers Cisco Edge Intelligence for edge computing and Cisco IoT for Internet of Things applications.

These providers offer a range of services for cloud-edge computing, including software, platforms, and infrastructure for edge computing and Internet of Things applications. They also offer services for data storage, data analytics, and machine learning, to name a few. These providers are well-established, and many have a wide range of customers and partners, which can be a good indication of their experience, scalability, and reliability.

These are just a few examples of cloud-edge technology providers, but as the market is constantly evolving there are many more providers that are emerging and offering similar services. It is important to choose a provider that meets your specific requirements and that has a track record of success in your industry.

9. Conclusion

Edge computing technology with its advance features associated with IoT, smart mobile connected devices, etc., are bringing processing closer to the end devices. This enables low latency, mobility, low bandwidth, mobility, QoS, etc. This technology will act as a thin line between cloud and device tiers. Edge computing differs with cloud technology in terms of distributed architecture and mobility. Even though edge is having advantages, there are still flaws in cloud computing model that remains as the lead of data that continues to increase. The technology of edge computing further needs improvement, which will help to draw a line between cloud and edge.

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