VIEW POINT

EDGE COMPUTING

Abstract

With increasing number of "things" getting connected to the internet, there is an increased necessity of processing the data on the edge in realtime and without latency. With edge computing capabilities, systems can perform efficient data processing as large amount of data can be processed at or near the source thereby reducing internet bandwidth usage. Computing data on the edge also eliminates the need for the relaying of information on the public cloud infrastructure thus enabling additional security of sensitive information. In future we would see more companies, both OEMs as well as cloud service providers, joining the bandwagon of providing computing infrastructure on the edge.

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Introduction

Edge computing is a distributed open IT architecture that enables systems to compute data near or at the source of information rather than relaying the information to the cloud. Edge computing enables realtime data processing without latency. The convergence of the digital world with the people and things via a communication network is described as edge. With edge computing capabilities, systems can perform efficient data processing as large amount of data can be processed at or near the source thereby reducing internet bandwidth usage. Even though edge computing market is still nascent, the concept has existed for some time.

As per IDC, **"Edge computing is a mesh network of micro data centers that process or store critical data locally and push all received data to a central data center or cloud storage repository, in a footprint of less than 100 square feet"**[1]

Computing systems have oscillated between centralized and decentralized approaches. The initial era of IT systems saw a more centralized approach with mainframe terminals carrying out all the necessary processing and content storage. Late 1980s saw the emergence of PC which introduced a more decentralized approach to computing with the content delivery and processing were distributed to individual PCs. With the internet era, the IT systems again went back to a centralized approach where servers were deployed to undertake the computing processes. In late 2000s enterprises started implementing cloud computing with most of the processing taking place in centralized data centers. In the last couple years, IoT and connected things are in an upward trajectory which resulted in renewed focus on edge computing infrastructure complimenting the existing cloud computing systems.

Drivers of Growth

The major factors driving the growth of edge computing infrastructure are[2,3]:

- Amount of data being generated
- Shorter response time
- Heightened security risks
- Convergence of IT/OT

Amount of Data being Generated

With increasing number of IoT devices coming online, the volume and velocity of data being generated by these devices would increase many folds. By 2020, there would be 31 billion IoT devices connected across multitude of devices as per Statista[4] and a considerable number of these devices would be leveraging rich media types like video. For example, a level 5 autonomous vehicle could generate around 3 terabyte (TB) of data per hour which would be analyzed to make realtime decision. Transmitting and storing all these data in realtime in centralized data centers is often undesirable apart from being costly and difficult.

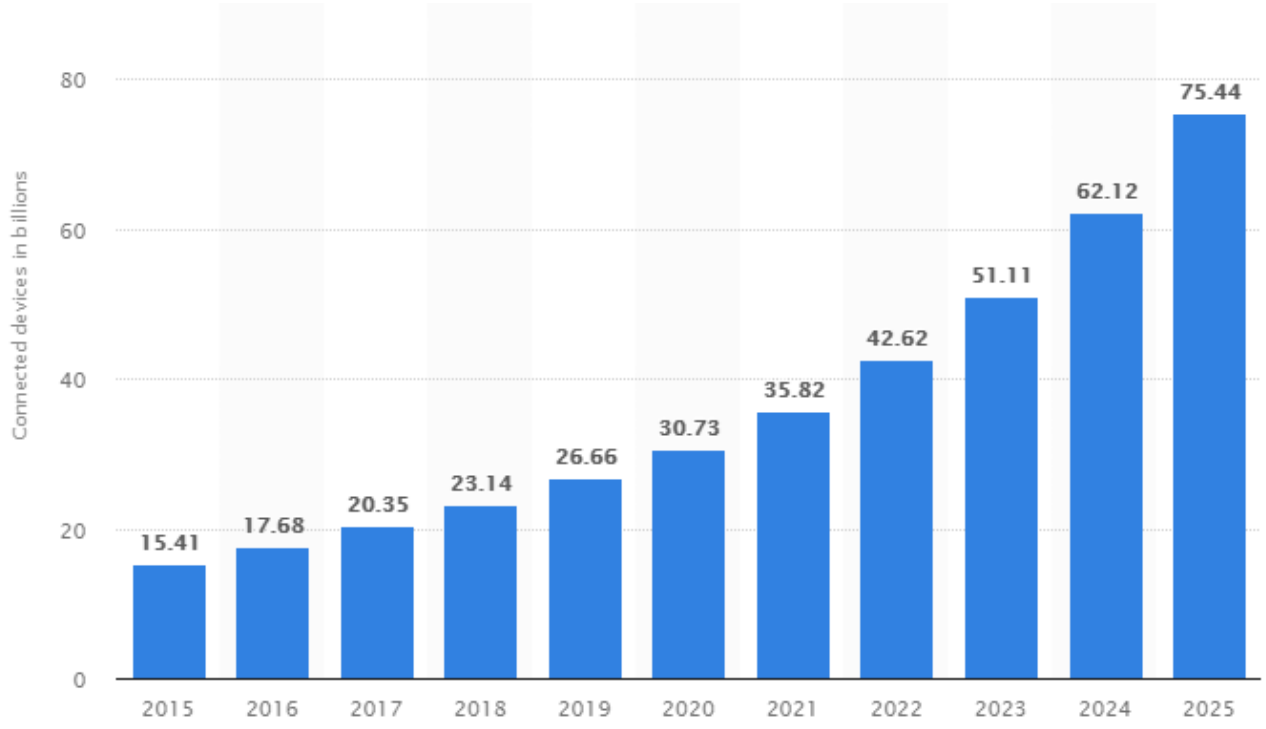
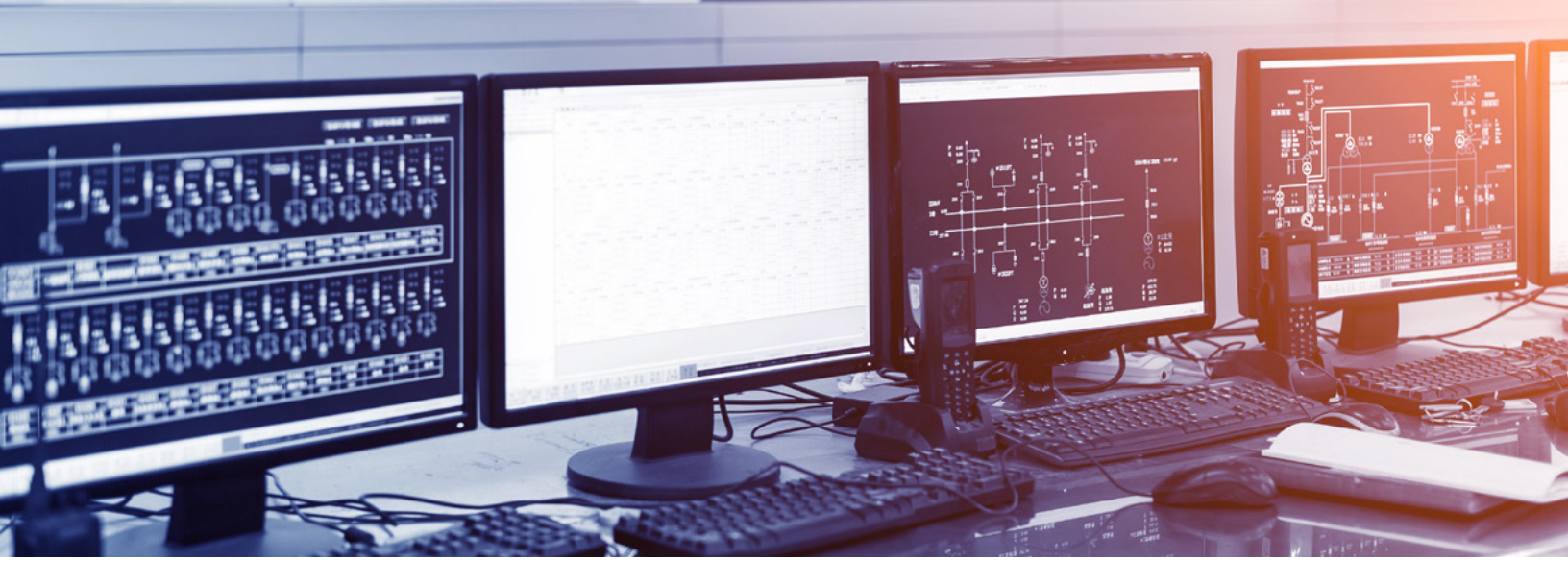


Figure 1: Growth of IoT connected devices from 2015 to 2025 (Source)



Shorter Response Time

The data being generated by the IoT devices need to be analyzed in realtime. But currently most of the processing of these data is done on cloud and thus suffers from the inherent speed of light latency. An autonomous vehicle has to respond immediately if it sees a pedestrian jumping onto the path of the vehicle. Its takes around 100 milliseconds for a large dataset to travel back and forth from a cloud and a lapse for a fraction of second might be the difference between colliding with the pedestrian or avoiding the collision. Even users consuming digital content on AR/VR devices expect faster response times and latency issues creates poor user experience apart from undermining the digital initiatives.

Heightened Security Risks

Relaying information collected from IoT devices to cloud creates security challenges. Each hop that the information makes is a potential security breach junction. Along with it, privacy compliances across geographies are becoming stricter, restricting the transmission of information across borders. For example, newer generations of mobile phones are embedded with AI functions at the device itself, eliminating the need to transmit the data and thus maintaining the integrity of data. Edge computing provides an efficient means to avoid these security risks by storing and processing the information at the source of generation.

Convergence of IT/OT

Traditionally information technologies (IT) have been more centralized while operational technologies (OT) which help in automating industrial machines resides at the edge. But recently there has been greater impetus at the convergence of IT and OT as it provides some strategic benefits to enterprises like:

- Automation outcomes driven by standard processes
- Analyzing or interpreting IoT data with relevant business data to augment decision making

Data Governance

While insufficient data governance might leave enterprises susceptible to business disruptions, an extreme governance policy might stifle innovation. Edge computing can help enterprises in overcoming the data governance challenge by reducing data clutter, contextualizing the data for better usability, lowering the data security breach and improving privacy.

Fog Computing and How It Is Different from Edge Computing

Fog computing or fogging is defined as a decentralized infrastructure for computing which outlines the most efficient and logical distribution of networking services, compute and storage between the data source and cloud computing. Fog computing was introduced by Cisco in 2014 wherein enterprises can create repeatable structures in accordance with edge computing concept, in order to have a better and scalable computing performance.[5]

While in an edge computing environment the computing occurs at the devices itself, in case of fog environment the computing takes place in a local area network. Data is transmitted from the devices to the gateway from where it gets transmitted to the computing system and returns back.[6]

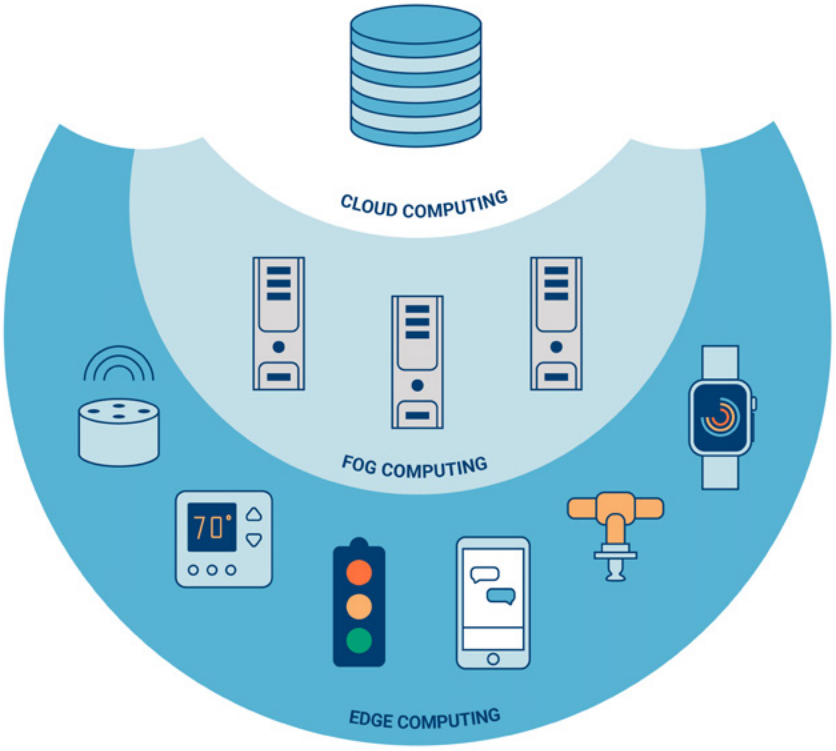


Figure 2: Cloud Computing Vs Fog Computing Vs Edge Computing (Source)

Components of Edge Computing Infrastructure

The two major components of an edge computing infrastructure are distributed computing infrastructure and data processing.[7]

Distributed computing Topology

By definition, edge computing necessitates consistent low power connectivity.

Currently, Bluetooth is the best low power connectivity option but lacks consistency while cellular connectivity provides the best consistency but is high power consuming. In future, 5G with NB-IoT standard would provide better connectivity option.

Data Processing

Edge computing comprises of compute, storage, data management, data analysis and networking among others. Depending on the complexity of analytics needed, the computing infrastructure might range from a simple MCU to a high end GPU.

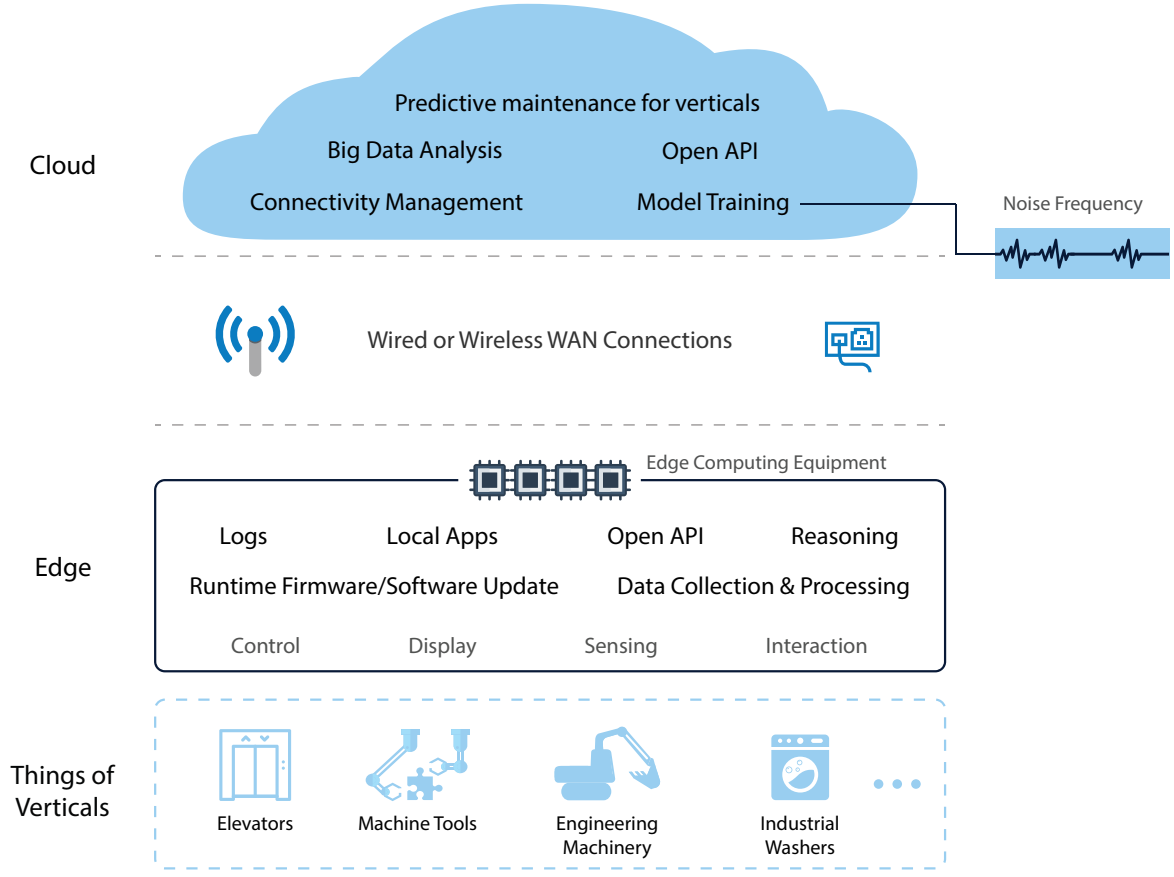


Figure 3: Architecture Diagram for Edge Computing (Source)

Market Activity

The edge computing market is evolving rapidly as more number of things are getting IoT enabled. As per market research firm Grand View Research, the edge computing market would reach $3.24 Billion by 2025.[8]

Some of the major cloud service providers are emerging as leaders in the edge computing space as well. AWS Greengrass from Amazon enables devices to act locally on the data and leverage cloud computing capabilities for deeper analytics and reliable data storage. Azure IoT solution from Microsoft enables edge devices to have cloud analytics capabilities even in offline mode. Similarly, Cloud IoT Edge from Google offers data processing and machine learning capabilities to edge devices. Hardware companies are also foraying into edge computing. HPE has planned to invest $4 billion over a period of 4 years and has already launched its edge computing device, Edgeline Converged Edge Systems. The device is capable of providing insights from connected things without the necessity of relaying the information to cloud. NVIDIA has also launched its computing platform Jetson TX2 in 2017 targeted specifically for edge devices.[9] Companies like Dell and Intel are also investing in smaller edge computing companies like FogHorn which provides edge intelligence solutions for commercial and industrial IoT.[10]

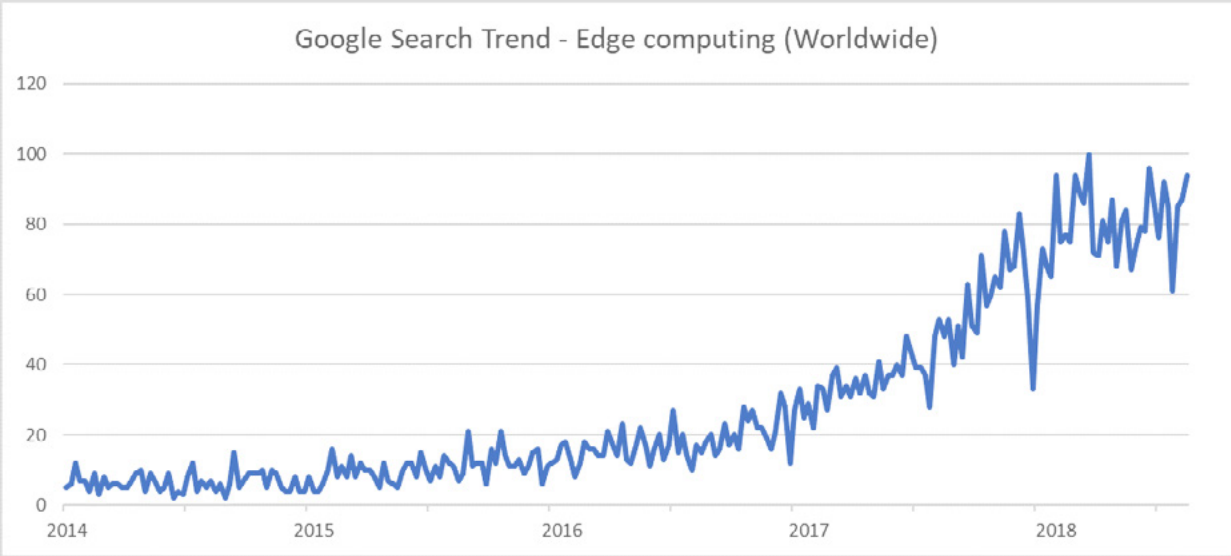


Figure 4: Edge Computing- Key Search Trend (Source)

Benefits of Edge Computing

Even though the industrial adoption of edge computing is still nascent, there are some apparent benefits of edge computing like:

- Data processing at the source: Data which are time sensitive can be directly processed at the source rather than transmitting it to cloud.
- Lower traffic congestion: With edge computing capabilities, systems can perform efficient data processing as large amount of data can be processed at or near the source thereby reducing internet bandwidth usage.
- Reducing network connectivity dependencies: Many enterprise assets are located at remote location where network connectivity is a serious challenge. With edge computing, systems can operate at remote location with intermittent internet and network connectivity.
- Improved data security: Eliminating the need of relaying all the information to public cloud enables an additional security of sensitive information.
- Lower latency: With data processing and analysis taking place at the edge, industrial applications would be able to perform at a faster speed and with better efficiency.

Infosys Play

Infosys in partnership with Huawei recently released the smart industrial robots solution based on the open edge computing IoT. The solution supports the interconnection of industrial robots from multiple vendors as well as helping manufacturers to anticipate faults and improve maintenance efficiency. The solution is able to reduce the industrial robots downtime by over 70% and defect rate by 40%. The solution is also able to schedule production rates based on resource utilization rates as well as optimize these production lines for maximum efficiency.

Infosys is also working on drone led inspection system having edge computing capabilities. The solution would enable the clients to optimally utilize drone fleets to inspect assets in remote location with intermittent internet connectivity without conceding on the effectiveness of the system. Leveraging enablers like control centers, multiple drones can be deployed to periodically monitor the assets. These drones are equipped with edge computing features which ensures precise positioning and deep rescanning of anomalies to gather the most suitable images and videos for further processing. The system is able to report on the type of risk and exact location of the anomaly in real-time. The below diagram highlights the key aspects of the drone led inspection system.

Planning	Inspection	Assessment	Remediation
The system seamlessly creates routing plan for various autonomous agents for maximum coverage with an high degree of agent coordination.	Edge computing capabilities enable the autonomous agents to perform rule based data acquisition for an efficient data capture process. This reduces excessive data storage issues as well as improve decision making.	Combination of video analytics, predictive analytics and AI trained learning model enable the system for effective anomaly identification and recommendation.	Decision making and workflow initiation enabled by various visualization tools improves the process turnaround time and reduces asset downtime.

Figure 5: Pillar of inspection management system

Conclusion

With increased adoption levels of IoT and reduction in prices, it opens up business opportunities for not only in the IoT space but also in the edge computing area. There would be newer business models evolving along the lines of providing edge intelligence platform services along with building computing networks closer to the source of data. Investments in these areas both in terms of money and human resources would enable organizations to stay ahead of the evolution and reap rewards.

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