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# A Survey of Edge Computing Market Analysis and Estimation

S.K. Saravanan[1] , M.Asan Nainar [2], Dr. G.N.K. Suresh Babu[3]

Assistant Professor, Dept. of G.E., SRM Valliammai Engineering College, Chennai, India[1, 2]

Associate Professor, Dept. of Computer Application, Acharya Institute of Technology, Bangalore, India[3]

**ABSTRACT:** Edge computing will reach for the stars in the next decade, aiming to achieve ubiquity, catch up to cloud services, and transform the internet and enterprise networks. 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. The move toward edge computing is driven by mobile computing, the decreasing cost of computer components and the sheer number of networked devices in the internet of things (IoT). Depending on the implementation, time-sensitive data in an edge computing architecture may be processed at the point of origin by an intelligent device or sent to an intermediary server located in close geographical proximity to the client. Data that is less time sensitive is sent to the cloud for historical analysis, big data analytics and long-term storage. Depending on the implementation, time-sensitive data in an edge computing architecture may be processed at the point of origin by an intelligent device or sent to an intermediary server located in close geographical proximity to the client. Data that is less time sensitive is sent to the cloud for historical analysis, big data analytics and long-term storage.

**KEYWORDS**: Distributed Information Technology Architecture (DIT), IoT, Time-Sensitive Data, Geographical Proximity, Big Data Analytics.

## I. INTRODUCTION

Edge computing can also benefit remote office/branch office (ROBO) environments and organizations that have a geographically dispersed user base. In such a scenario, intermediary micro data centers or high-performance servers can be installed at remote locations to replicate cloud services locally, improving performance and the ability for a device to act upon perishable data in fractions of a second. Depending upon the vendor and technical implementation, the intermediary may be referred to by one of several names including edge gateway, base station, hub, cloudlet or aggregator.

Transmitting massive amounts of raw data over a network puts tremendous load on network resources. In some cases, it is much more efficient to process data near its source and send only the data that has value over the network to a remote data center. Instead of continually broadcasting data about the oil level in a car's engine. For example, an automotive sensor might simply send summary data to a remote server on a periodic basis. Or a smart thermostat might only transmit data if the temperature rises or falls outside acceptable limits. Or an intelligent Wi-Fi security camera aimed at an elevator door might use edge analytics and only transmit data when a certain percentage of pixels significantly change between two consecutive images, indicating motion.

## II. EDGE COMPUTING MODEL

The name "edge" in edge computing is derived from network diagrams; typically, the edge in a network diagram signifies the point at which traffic enters or exits the network. The edge is also the point at which the underlying protocol for transporting data may change. For example, a smart sensor might use a low-latency protocol like MQTT to transmit data to a message broker located on the network edge, and the broker would use the hypertext transfer protocol (HTTP) to transmit valuable data from the sensor to a remote server over the Internet.

The Open Fog consortium uses the term fog computing to describe edge computing. The word "fog" is meant to convey the idea that the advantages of cloud computing should be brought closer to the data source. (In meteorology, fog is simply a cloud that is close to the ground.) Consortium members include Cisco, ARM, Microsoft, Dell, Intel and Princeton University.

Edge Computing will thrust the internet into a new era of its transformative history, following in the footsteps of cloud environments, according to Matt Trifiro, chief marketing officer of edge data center startup Vapor IO, Edge computing, which processes data closer to data sources for diminished latency and quick response times, was developed in response to demands for speed that continuous internet advancements -- such as rich media and video capabilities -- brought to the surface. The Fig.1 depicts the edge computing model.

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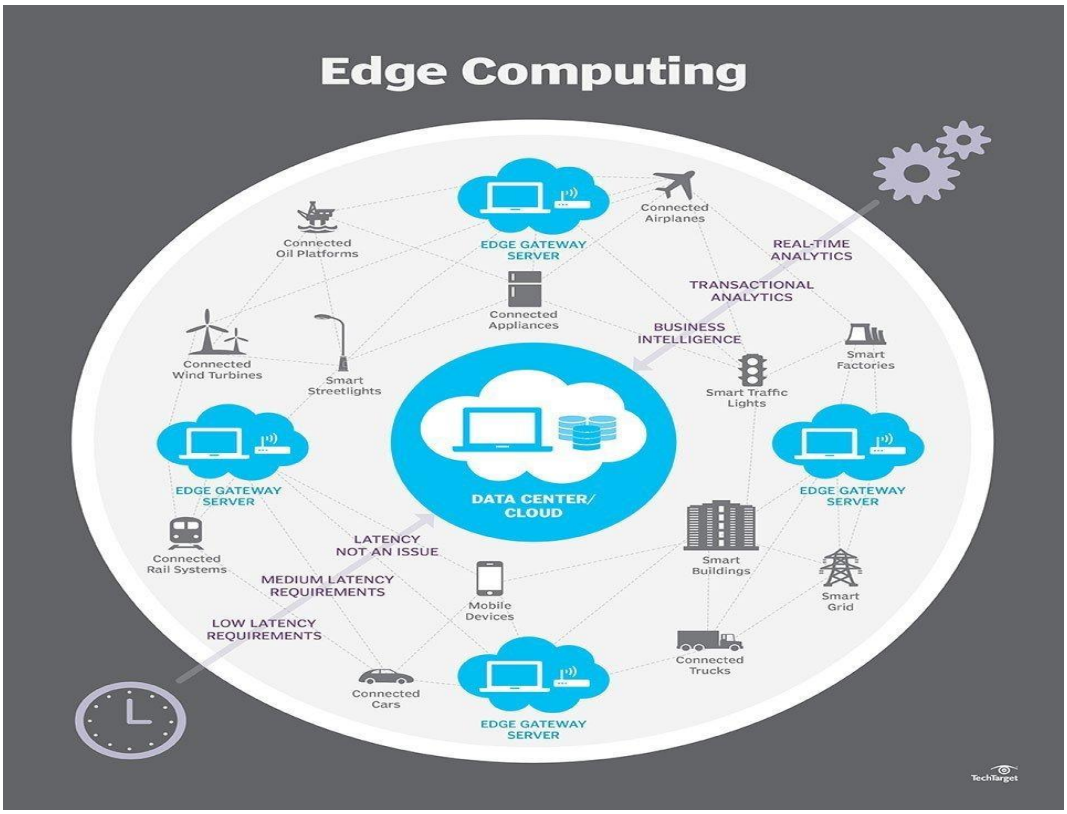


Fig1:Edge Computing Model

A major benefit of edge computing is that it improves time to action and reduces response time down to milliseconds, while also conserving network resources. The concept of edge computing is not expected to replace cloud computing, however. Despite its ability to reduce latency and network bottlenecks, edge computing can pose significant security, licensing and configuration challenges.

## III CHALLENGES OF EDGE COMPUTING

**1.Security challenges:**

Edge computing's distributed architecture increases the number of attack vectors. The more intelligence an edge client has, the more vulnerable it becomes to malware infections and security exploits.

**2.Licensing challenges:**

Smart clients can have hidden licensing costs. While the base version of an edge client might initially have a low ticket price, additional functionalities may be licensed separately and drive the price up.

**3.Configuration challenges:**

Unless device management is centralized and robust, administrators may inadvertently create security holes by failing to change the default password on each edge device or neglecting to update firmware in a consistent manner, causing configuration drift.

The "State of the Edge 2020" report -- from the vendor-agnostic edge computing trends and Awareness State of the Edge group -- delves into where edge computing currently stands and how the architecture will change the internet over the next decade. Edge computing is a natural extension of the internet and cloud environments and predicted worldwide edge computing availability around 2025. The report also explored edge computing trends in relation to wireless advancements, such as 5G, as well as how various edge computing use cases will lead to what it called an "edge-enabled internet."

**Enterprise edge computing trends for 2020s**

Enterprise IT will see various edge computing trends and growth throughout the 2020s, the report said. The key edge computing trend to benefit enterprise IT customers is edge computing's ability to streamline and simplify workload migrations. By 2028, 9.3% of enterprise IT workloads will be deployed at the edge. Edge computing will also affect other use cases, such as manufacturing, retail, health care, automotive and residential environments. However, as the

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need for speed and compute closer to data sources grows, these use cases may shift, and organizations that provide infrastructure services may glean the most benefits from edge computing.

"Worldwide, general availability of edge computing beyond these early use cases will become commonplace sometime between 2025 to 2028", Trifiro said. "Providing an edge computing environment for a factory floor might happen earlier." Use case deployment may depend on the existing devices and architecture of an organization's network. The internet was developed for humans, yet humans aren't the only things that now use the internet or require it to function. Communication among various machines, devices and applications requires faster architecture to function efficiently, and edge computing aims to answer this call.

The early stages of edge computing trends are what Trifiro called "solution-specific," meaning edge computing services focus on specific, individual situations rather than services that could benefit various use cases. Yet, over time, edge computing will focus on platforms and alleviate abstraction complexity, so developers can focus more on the edge applications themselves. This is still a few years off, though.

"2020 is what I would call a year of infrastructure building, and we might have a couple years of that," Trifiro said. To some extent, I imagine, by probably 2021, we'd actually stop talking about the edge because it'll just be absorbed into the entirety of the internet." Once edge computing is made accessible to all use cases -- not just specific ones -- these edge applications will expand and grow in popularity. Like the early days of cloud environments, Trifiro said, he believes these edge computing trends will be equally as transformative.

**Edge computing, 5G go hand in hand**

Edge computing may become an essential part of the internet, yet it also has close ties with the latest generation of cellular technology: 5G. Edge computing and 5G are tightly coupled, as the two can enable one another for virtualization and automation capabilities. Together, they can support workload migrations and benefit the cost and flexibility of wireless network operations.

The same is true for Wi-Fi 6, Trifiro said, as the new generation of Wi-Fi technology could act as an alternative to 5G in some use cases. However, for organizations eager to deploy edge computing services, Edge and cloud computing processes share similarities, so it may be safe to assume edge computing will be in a similar, ubiquitous place in the coming decade.

Edge Computing Market by Component (Hardware, Platform, and Services), Application (Smart Cities, IIoT, Content Delivery, Remote Monitoring, AR and VR), Organization Size (SMEs and Large Enterprises), Vertical, and Region - Global Forecast to 2024

Markets and Markets projects the global edge computing market to grow from USD 2.8 billion in 2019 to USD 9.0 billion by 2024, at a Compound Annual Growth Rate (CAGR) of 26.5% during the forecast period. Factors such as growing adoption of Internet of Things (IoT) across industries; rising demand for low-latency processing and real-time, automated decision-making solutions; and a need for surmounting exponentially increasing data volumes and network traffic. The Fig.2 & Fig.3 shows the edge computing market region and opportunities in the market.

Moreover, the emergence of autonomous vehicles and connected car infrastructure, and the need for lightweight frameworks and systems to enhance the efficiency of edge computing solutions are expected to create ample opportunities for edge computing vendors.

The edge computing market by component covers, hardware, platform, and services. The hardware component is estimated to hold the largest market size during the forecast period, owing to the large-scale deployment of hardware components for decentralizing storage and computing operations, enabling comprehensive edge infrastructure deployment, and reducing network traffic. Organizations offer advanced edge computing hardware that either acts as an initial point of data source (edge devices) or a facilitator of the entire network (gateways and servers); or serves as a storage and local processing unit (local data centres) in the overall edge computing process. The Table1shows the edge computing market report.

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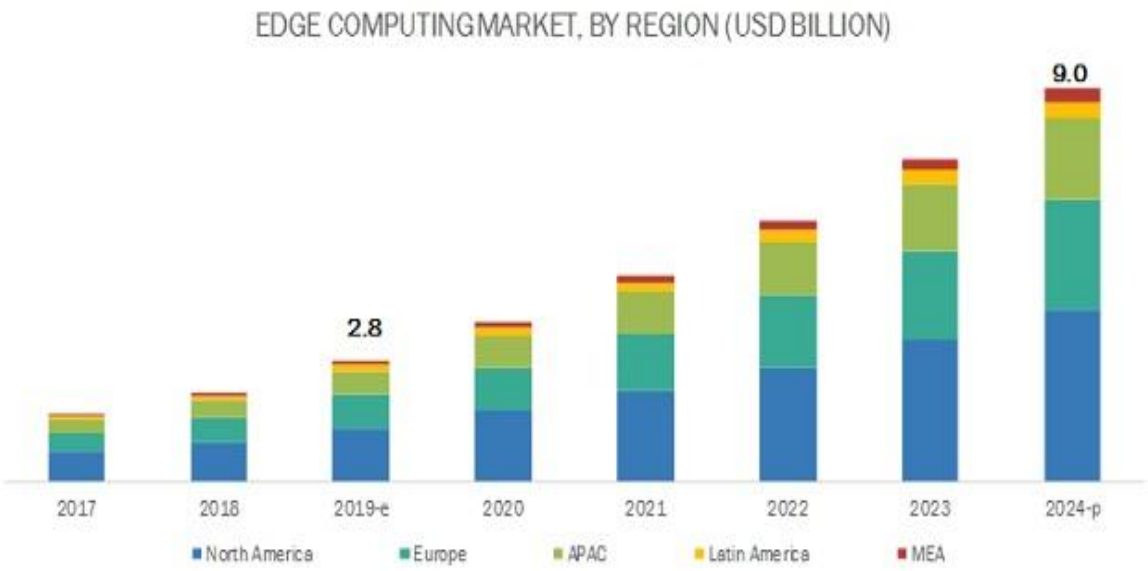


Fig 2: Edge Computing Market by Region

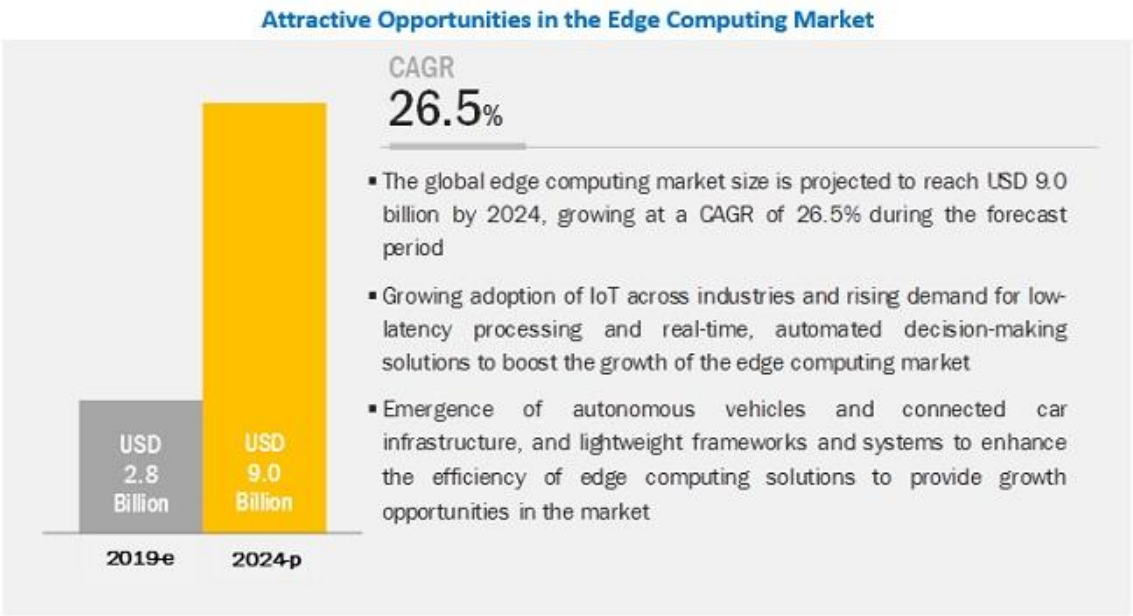


Fig 3: Edge Computing Market

## IV SCOPE OF THE EDGE COMPUTING MARKET REPORT

| Report Metric | Details |
|---|---|
| Market size available for years | 2017–2024 |
| Base year considered | 2018 |
| Forecast period | 2019–2024 |
| Forecast units | Million (USD) |
| Segments covered | Component, Application, Organization Size, Vertical, and Region |
| Geographies covered | North America, APAC, Europe, Latin America, and MEA |

| | |
|---|---|
| Companies covered | Cisco (US), HPE (US), Huawei (China), IBM (US), Dell Technologies (US), Nokia (Finland), Litmus Automation (US), FogHorn Systems (US), SixSq (Switzerland), MachineShop (US), Saguna Networks (Israel), Vapor IO (US), ADLINK (Taiwan), Altran (France), and Axellio (US) |

Table 1: Edge Computing Market Report

## V.KEY EDGE COMPUTING MARKET PLAYERS

Cisco (US), HPE (US), Huawei (China), IBM (US), DellTechnologies (US), Nokia (Finland), Litmus Automation (US), FogHorn Systems (US), SixSq (Switzerland), MachineShop (US), Saguna Networks (Israel), Vapor IO (US), ADLINK (Taiwan), Altran (France), and Axellio (US). HPE was founded in 2015 as a result of the split of Hewlett Packard into HP Inc. and HPE. It is a global pioneer in providing software, networking products, and solutions to its end users that range from small business startups to global leading enterprises. It has a wide range of solutions categorized into data storage, servers and systems, networking, and software solutions.

**Recent Developments**

•In June 2019, HPE entered into a partnership with AT&T, an American multinational conglomerate to create MEC systems. These MEC systems would help telecoms and their clients manage the data produced from connected systems and devices.

•In March 2019, HPE entered into a partnership with CTERA, an enterprise software company. CTERA with HPE, launched X series Hyper-Converged Infrastructure (HCI) for edge computing.

•In February 2019, HPE entered into a partnership with Samsung, a South Korean multinational conglomerateto provide a joint edge-to-core virtual RAN product, based on Samsung's radio network technologies and HPE's Edgeline EL8000 Converged Edge System.

## VI METHODOLOGY

The study involved 4 major activities in estimating the current market size for edge computing hardware, platform, and services. An exhaustive secondary research was done to collect information on the market, peer market, and parent market. The next step was to validate these findings, assumptions, and sizing with the industry experts across the value chain through primary research. Both top-down and bottom-up approaches were employed to estimate the complete market size. Thereafter, market breakup and data triangulation were used to estimate the Edge Computing Market size of segments and sub segments. The Fig.4 explains the markets and markets analysis.

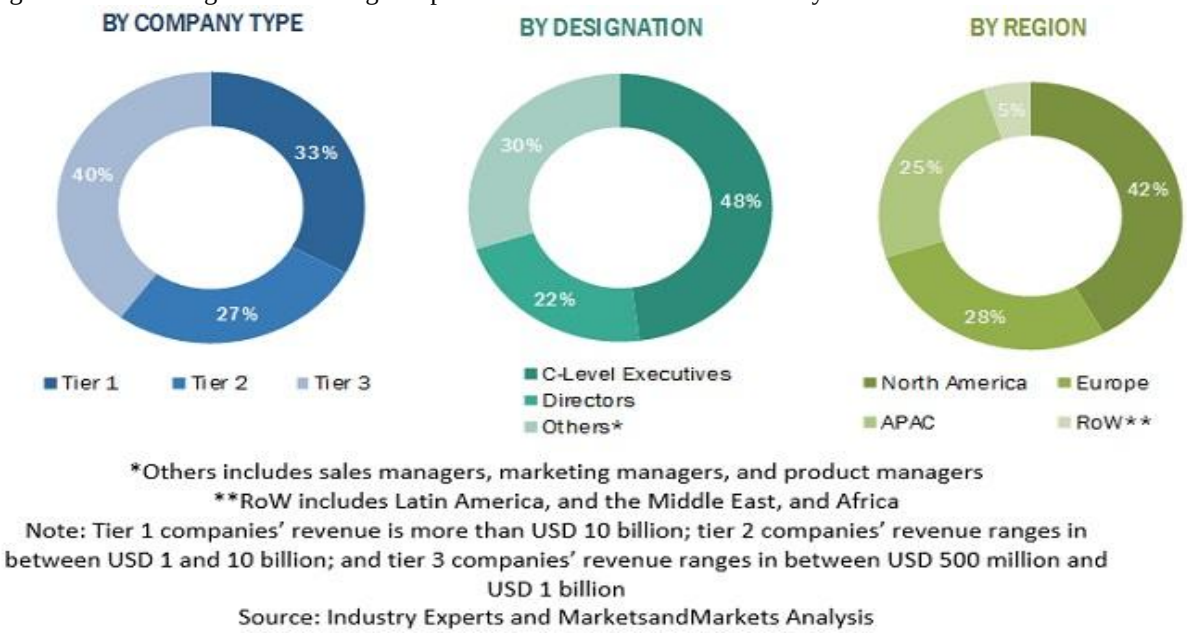


Fig 4: Markets and Markets Analysis

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**Secondary Research**

In the secondary research process, various secondary sources, such as Bloomberg and BusinessWeek have been referred for, to identify and collect information for this study. The secondary sources included annual reports, press releases, and investor presentations of companies; white papers; journals; and certified publications and articles from recognized authors, directories, and databases.

**Primary Research**

Various primary sources from both supply and demand sides were interviewed to obtain qualitative and quantitative information for this report. The primary sources from the supply side included industry experts, such as Chief Executive Officers (CEOs), Chief Marketing Officers (CMO), Chief Technology Officers (CTOs), Chief Operating Officers (COOs), Vice Presidents (VPs), Managing Directors (MDs), technology and innovation directors, and related key executives from various leading companies and organizations operating in the edge computing market along with the associated service providers, and system integrators operating in the targeted regions. All possible parameters that affect the market covered in this research study have been accounted for, viewed in extensive detail, verified through primary research, and analyzed to get the final quantitative and qualitative data. Following is the breakup of primary respondents.

## VII . CONCLUSION

Edge Computing define, describe, and forecast the edge computing market by component, application, organization size, vertical, and region. It provides detailed information about major factors (drivers, opportunities, restraints, and challenges) influencing the growth of the market. To analyze micromarkets with respect to individual growth trends, prospects, and contributions to the overall market and the opportunities in the market for stakeholders by identifying high-growth segments of the market. It forecasts the market size of the market segments with respect to 5 main regions, namely, North America, Europe, Asia Pacific (APAC), Middle East and Africa (MEA), and Latin America. This analyzes the profile key players of the market and comprehensively analyze their market size and core competencies in the market. To track and analyze the competitive developments, such as new product launches, product enhancements, acquisitions, partnerships, and collaborations in the global edge computing market.

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