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Research paper

Comparative Study of IoT Platforms and Support for Edge Computing

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Abstract.

The Internet of Things has power to make one's life comfortable and overcome challenges that people face even in their daily life. Today facilities like smart healthcare, smart homes, smart grid, remote monitoring of devices have become an indispensable part of our lives, the reason being Internet of things. To create smart devices, applications are rapidly moving to the cloud, because amount of data generated is increasing tremendously. But there are some applications that require real time processing, low latency, support for mobility, very large number of nodes, working in remote areas. These applications demand edge computing where data is stored and processed near the end device. IoT connects physical devices and facilitates them to communicate with each other and control them remotely. Now we are entering an era where the applications require data to be stored and processed at the periphery of the network. In this paper our focus is on study of Iot applications, core IoT services providing platforms based on cloud computing, their comparison, challenges and support for edge computing.

Keywords: Internet of Things, cloud computing, edge computing, AWS IoT Core, azure IoT edge, IBM Watson edge analytics.

1. Introduction

The Internet of things was introduced in 1999 by Kevin Ashton while working at Procter and Gamble on supply chain management. At the beginning, concept of IoT was mainly focused on enabling a computer to sense information by itself without any human intervention. With Internet of things gaining popularity around the world, a lot of data is being generated at the end of network. IoT is used in large number of fields such as healthcare, agriculture, natural disasters, security, manufacturing and industrial work. Everything around us is becoming smart day by day. It would be great if your car can find its own parking space and your smart watch can control the car. Also it can sense when you're about to exit the mall and drive up to you with air conditioner on and your favourite music playing. Earlier we used to click pictures using camera but today pictures can be clicked even with Google glasses. People use Nest (Nest learning Thermostat learns what temperature you like and builds a schedule around you) to control home temperature; make use of their smartphones to dim the light in their rooms. Through Internet of things everyday objects are now capable of talking to each other. Thus moving towards a world where things will communicate with each other reducing human dependence and making lives more comfortable.

There are undoubtedly enormous benefits of IoT like efficient resource utilisation, Security, minimizing human efforts, development of artificial intelligence, saves time. Internet of Things is formed by the networked connection among everyday objects. It involves wireless networks of sensors which create a sphere in which everything inside it sends information and important data to various objects and people as well. Together the internet and new advancements such as real time streaming, Wifi-direct and sensors calls for modification of everyday objects to interact with each other and the environment around them. There are certain components which can do a lot of work individually. It would be very great if these components can be collaborated with a system of various other components to build a very useful and better system than it would have been as an individual. Thus this is where Internet of Things is helping us. New initiatives like the Cisco's Planetary Skin, smart dust, HP's central nervous system for earth, will result in addition of billions of sensors to the Internet [1] .It provides a platform through which all these things are connected through the internet, hence internet has become a medium through which all these components about things to a platform. The physical world and information world is combined together through Internet of things. The near future is not going to be people talking to another people; it's also not going to be people retrieving information. It's going to be about using various machines to talk other machines on behalf of people [2]. Today the companies like Amazon, Google, Apple and many big giants are working on smart devices and have already launched Amazon alexa, Google home, siri, Microsoft Cortana[3] etc. Thus increasing our dependency on smart devices[4].

Internet of things is being used in wide variety of fields today, but still there is potential to be used in many more ways and to its fullest. Some broad applications of IoT include Healthcare, Smart cities, Smart Environment, Smart Water, Securities and Emergencies, Retail, Smart Home, Smart Agriculture[5]. There is scope of great improvements in healthcare with the help of IoT. It enables us to uniquely identify, collect data and establish communication with various healthcare components thus facilitating us to track and control devices remotely [6].

Table 1: Applications of Internet of Things

Area	Application	Description
Healthcare[7]	Remote monitoring	Easy monitoring of diseases with its remote monitoring and providing fast medical attention in case of accidents.
	Medical Fridges	To control the condition of vaccines, medicines and organic elements stored inside the freezer.
Smart Cities[8]	Smart Parking	To easily monitor available parking spaces in the city.
	Electromagnetic Field levels in city	To measure the radiated energy Wi-Fi routers other devices.
	Monitoring of traffic obstruction	To optimize driving and walking by monitoring movement.
Smart Environment	Air pollution	To control toxic and harmful gases such as CO and CO2 by factories and pollution generated by cars and other vehicles.
	Identification of fire in forest and residential areas.	Defining alert zones by monitoring of gases, fire and to create such devices which can do its early detection, and control with much destruction.
	Early Earthquake detection	To identify such places where natural disaster is more likely to occur and detect early about its occurrence.
Smart Water	Pollution Levels in seas	To monitor pollutions in seas and manage real-time releases and waste particulates in seas.
	Floods in Rivers	To monitor changes in the level of water in various rivers, ponds, dams and other water reservoirs.
	Recognition of leakage of various chemical substances rivers	To identify harmful waste releases of factories and urban industries in rivers and water bodies.
Securities and Emergencies	Access control	To identify various people residing in cramped areas and access control in unapproved areas.
	Detection of Liquid	To detect liquid in sensitive areas such as data centres, warehouses to prevent corrosion and their breakdown.
	Identification of harmful and volatile gases	Identification of levels of gases and releases from industries and from surroundings of chemical factories.
Retail	Supply chain Management	To monitor conditions of various warehouses and storages and to track product for the purpose of tracing them.
	Applications of Smart Shopping like e-commerce etc.	To get various recommendations in the seasons of sale according to habits of the customers, their choices.
	Intelligent Management of Product.	To control circulation of commodities and storage centres and warehouses to automate restocking process.
Smart Home	Remote control of the appliances.	From distant places automatically switching on and off whenever required to save electricity and also to avoid fatal accidents.
	Water and Energy Usage	To monitor Energy and water supply consumption to obtain advice on how to save cost and resources.
	Preservation of Artifacts and Goods	To Monitor conditions of museums, historical monuments, artifacts and goods warehouses.
Smart Agriculture	Compost	To control levels of temperature, humidity and to prevent fungus and micro-organisms.
	Green Houses	To Control climatic conditions to increase the production of fruits and vegetables and to also increase their quality with the green houses.
	Crops and Wine quality Enhancement.	To monitor quality of soil, balancing moisture and amount of fertilizers required to increase the quality of crops.

2. Literature Review

It is predicted by Cisco Systems that 50 billion devices will be attached to the internet by the year 2020. Various appliances and devices using sensors will give rise to massive volume of data. This can be done using various platforms like Amazon Web Services (AWS), Microsoft Azure, Google Cloud platform, IBM Watson, Kaa IoT platform and many more. These platforms provide IoT core services that can be used to store and analyse the data captured by the user applications. Thus we need the data which is captured by the end devices to be sent onto the cloud over the internet for analysis. The results of the analysis can be used as the basis for future decisions and predictions.

Table 2: Literature Review

Authors	Year	What?
M. Aazam et.al [9]	2018	Comparison of edge and cloud, performance of edge computing and directions for research on edge computing in future.
J. Guth et.al [10]	2017	Various IoT platforms are compared which helps in building better IoT products.
M. Conti et.al [11]	2018	Reliability , safety security and various other challenges in IoT.
Mahmoud Ammar , Giovanni Russello , Bruno Crispo [12]	2017	Various IoT platforms and their features, aws IoT platform.
Mauro A. A. da Cruz, Joel J. P. C. Rodrigues, Arun K. Sangaiahg [13]	2018	Evolution of IoT platforms, Kaa IoT platform.
W.Shi et.al [14]	2016	IoT and need of edge computing in IoT and edge computing addressing various concerns of IoT.
Felix Wortmann ,Kristina Fluchter [15]	2015	Technology stack of IoT, platforms of IoT, various challenges.
S.Chen et.al [16]	2014	Various challenges faced by IoT and its applications
A.Vahid Dastjerdi et.al [17]	2016	Edge computing, components, applications and challenges.
S.Yi et.al [18]	2016	Edge computing overview, challenges, components and applications.

3. Iot Core Service Providing Platforms

3.1 Platforms

i) AWS IoT

AWS IoT is the very comprehensive, popular and highly useful IoT platform in today's time. It has all built in building blocks needed to work with a smart device as well as work on the output of that smart device and built highly useful devices which would cover all the aforesaid applications. As part of the AWS IoT suite, there are many services offered.

ii) Azure IoT
It offers an end-to-end suite for working with the Internet of Things. It helps in remote monitoring, predictive maintenance etc. With Azure IoT, one can capture and analyse data to improve results of business. The key IoT services includes IoT hub, Stream analytics and notification hubs.

iii) Google Cloud IoT
Google Cloud Platform (GCP) is one of the most popular cloud platforms for building and hosting cloud based applications. GCP provides services which can be used by the users to store, compute and analyse the data. It also provides a service called as Cloud IoT Core service. It is a collection of organised and unsegregated services which facilitate users to safely link, send data and organize it. It also facilitates visualisation of data on the go at large scale. [19]

iii) IBM Watson IoT
IBM Watson IoT platform is another popular IoT services providing platform. With IBM Watson IoT Platform, user can establish connection, organise the data and secure the IoT applications. It is a totally-managed service hosted on cloud that can generate some value from the data collected from thousands and thousands of devices and from the data hence support decision making. IBM Watson offers advanced analytics which include Machine Learning, image and text analytics, NLP to reinforce IoT applications.

iv) Kaa IoT Platform
Kaa IoT Platform is an open source platform for rapid development of the IoT solutions, applications, and smart products for the users. The Key Capabilities of the Kaa IoT Platform include Connectivity, Integration, and Data Processing. Crafted by a very broad community of IoT experts and developers, Kaa is one of the world leading initiative for open and efficient IoT cloud based applications.

3.2 Characteristics of IoT Core Service Providing Platforms

The basic characteristics of IoT core service providing platforms are scalability, availability, security, plug and play, support for large number of devices, modularity and developer friendly. Five IoT platforms have been compared on the basis of these characteristics in table 3.

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Table 3: Characteristics of IoT Core service providing platforms

Characteristics	AWS IOT	AZURE IOT	GOOGLE CLOUD IOT	IBM WATSON IOT	KAA IOT
Scalability	Yes (can be enhanced by Amazon EC2 Auto Scaling) [20]	Yes (Azure Autoscale)	Yes (horizontal scaling is used for scaling immediately and limitless) [21]	Yes (Auto Scaling) [22]	Yes
Availability	Yes (storage and power of computing both)	Yes	Yes	Yes	Yes
Security provisioning [23]	security mechanisms to protect data which flows between AWS IoT and other devices [24].	secure IOT components solution viz. Device , Connection and Cloud security[25].	It provides security features [26].	operational security from bluemix and softlayer In addition to the standard security capabilities[27].	Yes
Plug and Play	Yes	Yes	Yes	Yes	Yes
Support for millions of devices	millions of devices as device management service makes device onboarding and managing very simple and easy to use.	Yes it supports millions of devices.	It connects lakhs of devices which uses horizontal scaling serverless on Google Cloud platform infrastructure	Using device management service millions of devices can be supported by this platform.	This open source platform supports millions of devices.
Real Time data	Automatically configuring a batch and on the go data-processing architecture on AWS.	Azure IoT Hub and Azure IoT Suite enables real-time analytics on data obtained from IoT devices.	Yes real time data processing occurs in google cloud IoT.	Yes	Yes
Modularity	Yes	Yes	Yes	Yes	Yes
Developer Friendly	Most developer friendly	Yes	Yes	Yes	Yes

3.3 Feature of IoT core Service Providing Platforms

Device Management
It includes Bulk operations on many devices at the same time, Rich device metadata and status information for the users, Diagnostic information, for both connectivity and for the devices as well, Device management actions, most importantly firmware update, and all of these things need to be made easily accessible for the users via APIs and dashboards.

Device SDK
Device SDK is used for connecting devices to the IoT platform. The SDK is typically used to develop an application that runs on the device and transmitting the data on the cloud.

Security
Smart devices need to be authenticated and authorized, and every packet that comes and goes between the cloud and the device needs to be monitored closely for data integrity as well as secured communication thus preventing unauthorised access. Not only does the communication between the device and the device management software need to be secure, but also we need to secure other entities that are interested in exchanging data with the IoT middleware.

Data protocols
Another very important feature that can enhance or break a platform is its ability to communicate using multiple data protocols. Today, there are large number of low power, reliable, and small footprint protocols that are ideal for IoT solutions. A platform's ability to support these protocols is essential to increase its usability.

Storage Support
The platform should provide the facility to store the data collected by sensors, as and when required almost instantly as required in today's world applications.

Load Balancing

Load balancing enhances the handling of workloads among various compute resources, group of computer, CPUs, or disk drives. Its aim is to make efficient use of resources, high throughput, least possible response time.

Dashboard

It is used by the user to monitor and manage various resources including resources for storage, clusters for computation, security related information, API's and services and various other configurations.

Big Data Support

The data collected from billions of devices demands for the need of big data support to enable the users to retrieve business or task relevant data by performing big data analytics and thus big data support is one of the key features of platforms.

Integration with machine learning tools on the platform

With Integration of machine learning tools and the platform you can use your own data that is collected by sensors to create, train, and deploy machine learning and deep learning models. Hence leverage an automated, collaborative workflow to grow intelligent business applications with more accuracy and confidence.

Pricing

It should be in such a way that the IoT services can be used with millions of devices involving connecting huge number of devices, sending and receiving messages to them and finally storing and managing the data.

Ease of Use

It plays a critical role as if the platform is not user friendly so it will be difficult for developers to use it and hence it will decrease its usage.

Third Party Integration support

It speeds up the operation as we can use the capabilities of various tools and services, thus making our work easier.

Supports edge computing (edge devices)

Edge computing can be achieved by the use of edge devices. An edge device has on-board storage and compute capabilities. Not all analytics needs to be done in the cloud. If you want a device to respond to emergencies as quickly as possible, you can perform computation on the device itself. Similarly, if you want to reduce bandwidth (network) costs and avoid transferring terabytes of raw data, you can perform data cleaning and aggregation locally, analyse the data and then send the insights to the cloud.

Managed Cloud

It's a service that allows businesses to use the power of cloud computing without having the burden of becoming an expert in everything. Companies that use managed cloud service can focus on their core business — on building great applications and other new products, and thus expanding their business.

Open Source

In case of open source IoT platform there is collaborative development from multiple independent sources, resulting in an increasingly more diverse scope of design perspective than any one company is capable of developing and sustaining in the long term.

Code complexity while implementing (Developer tools)

It makes the task of developers a bit simpler as it enables them to provide software solutions by keeping track of version of code, also it makes easier to build and test code.

BI Tool Support

It involves providing the historical, present and future (predicted) views to the customers. It involves complex tasks including data analytics, text mining, predictions, OLAP and many more.

Device SDK supported languages

IoT device SDKs contain code which enables building devices and applications that connect to and are managed by the platform. Hence a platform having wide range of Device SDK supported languages is of great use for the devOps.

Table 4: Feature of IoT core service providing platforms

Feature	AWS	Azure	Google Cloud	IBM Watson	Kaa
Device Management	Yes(AWS IoT Device Management)	Yes(Microsoft Intune device management)	Yes(device manager can be used through the Cloud Platform Console, gcloud commands, or the REST-style API)	Yes(Watson IoT Platform Device Management service using either the dashboard or the REST API)	Yes(through Endpoint provisioning and registration, Endpoint groups)
Device SDK	Yes-provided	Yes-Provided	Yes-Provided	Yes-provided	Yes-Provided
Data protocols	MQTT(s), HTTP(s)	MQTT(s)	MQTT(s)	MQTT(s), HTTP(s)	HTTP(s)
Storage support	Yes	Yes	Yes	Yes	Yes
Load Balancing	Yes(Elastic Load Balancing)	Yes(Azure Load Balancer)	Yes(Google Cloud Load Balancing)	Yes(IBM Cloud Load Balancer)	Yes(Active load balancing)
Has dashboard tools as part of the platform	Yes	Yes	Yes	Yes	No
Big data support	Yes	Yes	Yes	Yes	Yes
Integration with machine learning tools on the platform	Yes(Amazon SageMaker)[28]	Yes(Azure Machine Learning Studio, Data Science Virtual Machine)[29]	Yes(Google Cloud Machine Learning (ML) Engine)[30]	Yes(IBM Watson Machine Learning)[31]	Yes[32]
Scaling on demand	Yes(AWS Auto Scaling)	Yes(Azure Autoscale)	Yes(Autoscaling)	Yes(Auto Scaling)	Yes

Pricing (IoT core service)	Connectivity: Connection price per million minutes is: $0.080. Messaging: Per million messages: $1.00. Rules Engine: Rate of $0.15 for 1 million rules that are triggered and $0.15 for 1 million actions performed. Device Shadow & Registry Updates: $1.25 per million operations[33].	IoT Hub S1: $50 per unit with 4,00,000 messages with a maximum size of 4 KB.[34]	Monthly data volume of 250 MB to 250 GB billed at $0.0045 per MB. 250 GB to 5 TB Billed at $0.0020 per MB. 5 TB and above Billed at $0.00045. Number of devices-unlimited, within queries per second (QPS) maximums[35].	Standard Plan: Tier 1: 1 MB to 450GB, cost is $0.001 Tier 2:450GB to 7TB cost is $0.0007 Tier 3:It consists of 7TB and above. It costs $0.00014[36]	Depends on the infrastructure on which this stack is running.
Ease of use (in terms of interfaces, integration, and configuration)	Good	Good	Good	Good	Poor
Third-party integration support or interoperable standards	Yes (REST API and MQTT)	Yes (MQTT)	Yes (REST API and MQTT/Pub/Sub)	Yes (MQTT)	Yes (REST API and database dumping)
Supports edge computing (edge devices)	Yes(AWS Snowball)	Yes(Azure IoT Edge)	No	Yes(IBM Edge Analytics Agent)	Yes(IoT gateways)
Managed cloud	Yes	Yes	Yes	Yes	No(Users can store data in NoSQL data bases like Hadoop, Cassandra and MongoDB) [37]
Open source	No	No	No	No	Yes
Code complexity while implementing	Low(AWS Developer Tools support)	Low(Open source SDK, preferred language support, focus only on your need)	Low(Developer tools and libraries support)	Low(IBM's partner Mendix provide low code environment)	Low(Open source and transparent)
BI tool's supported	Tableau, Microstrategy, Looker, SAP	Datameer, AtScale Intelligence, Informatica, Power BI	Anodot, Arimo, AtScale, bime, Chartio, CoolaData, Yellowfin, Tableau, SAP, Mode, Metabase, Looker, Dundas BI	SPSS, Cognos Analytics, Watson Analytics, Watson Explorer	-
Device SDK supported languages	Embedded C, JavaScript, Arduino Yun, Java, Python, iOS, Android, and C++ SDK	C, Python, Node.js, Java, and .NET	Can use any MQTT client in any language	Python, Node.js, Java, Android, Node Red, Embedded C, iOS, C#, and Arduino	Java, Android, C++, C, and Objective C

3.4 Challenges in core IoT services

Although the platforms providing the IoT core services are working on making the services more efficient and better for the users but there are some challenges which still requires improvements. The challenges are as follows:

Latency
The large gap between the end device and the cloud is a big challenge itself. This gap becomes trouble for the applications which requires real time analytics in few seconds, for example a drone which continuously collects data through sensor and depends on real time analytics for deciding next step to be taken (it could be direction, or any other action). Hence a solution is required to tackle this problem of latency because in today's world there are some applications which demand decisions to be taken in real time and thus sending data to cloud, then performing analytics and again sending back response to end device is not suitable for such applications.

Geographic Distribution
There are various services and applications that inherently demand widely distributed environment. In such cases the centralised cloud does not meet the requirements of these applications. Hence there arise a need for solution to this problem. Examples of such applications include Smart Cities, Smart Grid, Connected Vehicles etc which are naturally geographically distributed.

Large Scale Sensor Networks
IoT includes the use of a billions or even more sensors to collect data which can be used in many ways like controllers, in decision making and many more. So these sensors could be deployed in remote areas for applications like weather prediction, earthquake prediction or on national boundaries for security purpose. Hence it may not be possible for remote sensors to send data to cloud due to extremely low network bandwidth or lack of internet connectivity and thus this is a challenge which needs to be tackled.

Support for mobility
It is extremely important for many applications to communicate straight away with devices which are mobile and thus it is challenge for platform to provide mobility support techniques and thereby supporting such mobile applications. An example of this kind of application is moving vehicles. Here there is need for cars to cars connectivity, cars to access point connectivity, sending real time alerts about accidents, also there is need for streaming high quality streaming to moving vehicles and hence we need distributed environment to provide these services.

Bandwidth Costs and network limitations

The traditional cloud platforms require the data providers (sensors) to send data via the network or rather the internet to cloud where data is processed and then the actions are send back via the network again. Hence this leads to high bandwidth costs, also as the data produced by the end devices is increasing at very high rates so the network will not be able to cope up with these rates. It is predicted by Cisco Global Cloud Index that, things (devices and people) will lead to generation of approximately 500 zettabytes by the year 2019, but that global network traffic capacity will be approximately only 10.4 zettabytes[38].

3.5 Edge Devices

An edge device is a device which is present between the end devices (sensors) and cloud and having its own storage and computation power. Hence it is located at the edge of the network and can provide local storage and real time analytics because it has its own computing power. The use of edge devices is a solution to the above mentioned challenges and can be seen as follows:

One of the major challenges is latency. With the use of edge device we can overcome this challenge to a great extent. Instead of the end device collecting the data then sending it to the cloud through the internet, then analytics is performed on the cloud and then finally the response is sent back to end device. But this is not suitable for applications that require real time analytics. So in case of edge device, it is located near the end device and so it locally stores the data collected by end device and locally perform data analytics thus suitable for real time applications such as in case of aircrafts where data collected by sensors is used to assist the pilot for flying the aircraft.

Next challenge is geographic distribution. So this challenge can again be solved by the use of edge devices. The applications like smart grid, connected vehicles are only few examples. Now considering the connected vehicles example, Here there is need for cars to cars connectivity, cars to access point connectivity, sending real time alerts about accidents or high quality streaming. So it is possible with the help of edge devices which support the distributed demand of such applications as the edge devices are present in distributed way at the edge of the network. Hence here another challenge of mobility is solved as mentioned above. Next challenge of large scale sensor networks can also be solved by edge device. In remote areas where there is no internet connectivity, the edge devices are of great use because they can work in offline mode and can be used to store as well as perform real time analytics locally. Last challenge of bandwidth cost and network limitations is automatically solved by edge devices as data is stored and processed at the edge of network hence reducing the network bandwidth cost and load on the network. As the number of applications that calls for edge computing in combination with the current cloud based services is increasing so now many platforms are working in this direction.

AWS Snowball edge
Amazon web services (AWS) supports edge computing by providing the service of AWS Snowball edge device. AWS Snowball Edge is a device with on-board capabilities to store and process data. It facilitates the operations in remote areas where there is no or poor internet connectivity by storing data locally and processing it there itself. Later data can be transferred to cloud by shipping it.
AWS Snowball Edge advantages are Movement of data is easier, simple to Use, Process Data Locally, Stand Alone Storage and Secure. Oregon State University is the example of snowball, it sends ships to collect oceanographic data for research. Now they use Amazon snowball edge to provide storage and compute capabilities on the ship itself thus increasing efficiency. Second is Aircrafts that are installed with Snowball Edge to gather data during flight, store and process it thus providing results on the go.

Azure IoT Edge
Azure IoT edge brings the capabilities of artificial intelligence, cloud, and edge computing together. Combine cloud workloads such as Azure Cognitive Services, Machine Learning, Stream Analytics and run them locally using Azure IoT Edge. Examples of applications using Azure IoT Edge
1 Tetra Pak: In milk industry the processing of milk needs to be done in real time otherwise any problem in processing of milk can lead to great loss. Thus the giant Tetra Pak makes use of Iot to predict the problem in machinery beforehand to prevent such losses.
2 Schneider Electric uses Internet of Things for sustainable farming. Farmers use the industrial Internet of Things (IoT) solution, to monitor and manage the water usage. Thus the remote monitoring increases the efficiency in agriculture as well and also it reduces price because of efficient use of resources like electricity, water.

IBM Watson Edge Analytics
Edge Analytics is an approach to data collection and analysis in which an automated analytical computations are performed on data close to its source instead of waiting for the data to be sent back to a centralized location i.e. cloud. Here in Watson Edge analytics, computations are done near source of data in place of waiting for the data to be sent back to cloud. Hence it reduces latency, also there is increase in scalability as we remove low value data by sending only that data which matters the most.
A wide variety of fields can benefit from edge analytics. Work done on remote sites like in mines, wind and solar farms, power stations and many more. Manufacturing plants can also make use of edge analytics in which taking real time decisions is key. Hence we can analyse data to take future steps and send high value data to cloud.

Kaa Edge analytics
Kaa edge analytics allows implementing the edge analytics into IoT gateways, which means data processing and data aggregating performed by an IoT gateway reducing the load on network, reducing server equipment and network bandwidth costs.

4. Conclusion

Iot the help of Iot one can live smart life. Here we identified some real life applications of Iot. Comparison of Iot core Service providing platforms and their challenges. Edge computing came as the new solution of Iot challenges.

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