Design of a Smart Gateway Solution Based on the Exploration of Specific Challenges in IoT

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***Abstract*— The Internet of Things environment is rising at a staggering rate. Every day, we are observing the appearance of new devices, cameras, smartphones and sensors that are connected to the internet. It is visualized IoT will discover, integrate and make use of such devices and their data in the progress of new services and products that can alter and positively blow our lives. In this survey, the technologies, key concepts and recent developments in IoT are systematically reviewed. Firstly, the concept and various applications of IoT are discussed; then the technologies of IoT are compared with its diverse selected characteristics followed by the discussion on communication features of IoT; subsequently technological challenges in IoT are explored which lead to the thought of discussion on recent perspectives in IoT. Among these perspectives, nowadays, IoT needs a service oriented approach to improve the functionality of device and to provide successful application integration using middleware architecture. Finally, the critical disputes that require addressing by research community are investigated and a solution for these issues is taken in hand by using IoT gateway and a proposal has been made to make the data handling in IoT more efficient.**

Keywords*— *Internet of Things (IoT), Service Oriented IoT, Service Oriented Architecture (SOA),Middleware, IoT gateway

I. INTRODUCTION

Internet of Things (IoT) is defined as a network connecting the things through sensors wirelessly enabling conversation without human intrusion (Pretz 2013).Many applications in IoT are initially developed in various fields like automotive industries, healthcare, electricity and transportation. Presently, technologies in IoT are at initial stages of growth; while the modern advancements in integrating the objects in cloud based internet with sensors are being developed. The development of architecture design of Internet of Things needs to face many challenges like interfaces, communication standards, interoperability of devices, protocols, scalability and infrastructure. We are provoked in reviewing the evolution of IoT realized up to now by research community in applications, technologies, communication features, and in discovering important research issues and upcoming research perspectives of IoT.

The composition of the article is structured in the following manner as: Segment I & II summarizes general idea on concepts of IoT. In Segment III, various application domains in IoT are discussed. Facilitating technologies and the communication features required for IoT applications are examined in Segment IV & V. Then the exploration on technological challenges in IoT is done in Segment VI. The former segment directed the survey to view through recent perspectives and research proposal in IoT gateway has been made to provide efficient data handling in IoT in Segment VII and in Segment VIII respectively. Finally, the article ends up with the conclusion in Segment IX.

II. THE CONCEPTS OF IOT

In 1999 at Auto-ID Center the term Internet of Things (IoT) has been originated and proposed by Kevin Ashton. But till 2010 the term IoT does not reach its hike and it reached it sudden popularity in 2014. The sub segment of IoT is the industrial internet or M2M. To attain smart identification and management the RFID systems connect the interoperable devices and the particulars are passed on to the internet through radio frequency (F.Wang et al; 2015). Iot provides consumer a greater peace in monitoring and controlling the devices remotely.

As per [2-4], an internet report was published by the International Telecommunication Union. The report contains the detailed information about IOT. The IoT is stated in the report as generation of cluster of active network is made when multiple connections are established. This development enroutes a hopeful IoT notion that is in rising ground of study.

In [5], Internet of Things (IoT) is pointed out as a new prototype and is the quickly growing field in the circumstances of present wireless telecommunications. The concept behind IoT is also mentioned which involves the existence of diverse objects like RFID tags, sensors, mobile phones, etc., to interact and cooperate with neighbors containing specific addressing methods to attain certain goals.

In [6], a common definition of IoT is mentioned that paves an extensive range of applications in past decades like agriculture, transport etc. IoT is fundamentally considered as group of devices that are connected and are exclusively identified by near field communication (NFC) techniques. As the technologies evolve, the definition of things may change but still the nature of computer to sense the information lacking human involvement remains unchanged.

In [7], it has been said that enhancement of internet into network of connected things directs to provide exclusive services such as transfer of information , analytics and communication including collection of information and interaction from the environment using accessible internet standards. This enhancement of internet to integrated internet also holds and supports the wireless technologies such as Bluetooth, RFID, telephonic data services and Wi-Fi to observe the happening of devices.

In [8], they convey that objects will acquire their smartness by making choices linked to context and things by themselves will communicate the information and are easily identifiable.

From above discussion it can be inferred that connection of the things using network at all the instance is the main objective of IoT and definition varies accordingly relying on the implementation technology required for corresponding applications in IoT. IoT is considered necessary to track, locate & monitor the things by building physical and IT infrastructure all together to handle network roles.

III. APPLICATIONS OF INTERNET OF THINGS

The IoT further more recognized as the internet of everything is concepts which in future will most likely need to be classified into different categories as the basic fashion it describes becomes more and more a part of everyday reality. In various ground the technology of IoT is being evolved and few among those prominent fields are addressed underneath.

The Internet of Things describes broadly, the circumstances in which huge numbers of organisms or objects are embedded with individually specialized computing devices connected to the internet, facilitating them to share, store, collect and analyze data and the objects are remotely controlled by the use of other internet-connected devices.

A. M2M (Or Machine-To-Machine) Communication

Natasaet. al[9], Gengwu et. al[28], conveyed that the communications infrastructure of the IoT is M2M (or machine-to-machine) communication. It has been referred to as communication technologies which allow embedded computing devices to distribute data with each other by the use of wired or wireless connections without the requirement of triggering the communication or human interaction.

B. Smart Agriculture

From [10],[27],[40], the concepts of IoT in agriculture domain have been observed. It is observed that M2M technology and the IoT are used to enlarge productivity and yield of food creation and make sure it is environmentally sustainable. The technology uses sensors that can be fixed in the soil, in agricultural equipment or in livestock (Nikesh et. al, 2016). These sensors will supervise specific parameters such as fertilizer levels or moisture, and agricultural equipment which embed computing devices examine the data to optimize processes of decision-making, by making use of machine-learning software which can examine data and optimize processes in real time.

C. Smart Home

The overall concept of smart home analyzed from Borgia [27] and Thomas et. al [36] is that the technology is used to provide the residents of a building with internet-connected checking and controlling of devices that can remotely control and in parallel the building's key functions such as lighting ,heating, multimedia , security or cooking are made efficient.

D. Smart City

Smart city has been analyzed from Andrea et. al[12] and Michael batty et. al [44] as a integrating digital technology, including but not narrowed to IoT technology, overall all the key functionality of the city, from energy management and traffic, healthcare, public transport, water and waste to culture, public services and governance, with the cause of greater resource effectiveness and sustainability, enhanced livability and increased public service.

E. Smart Transportation

The concept of smart transportation is discussed by Sherly et.al [13], Borgia[27], Christopher et.al[43] as a technology that involves the digital sensor and communication in the road, rail, air transportation or waterway. Here the vehicles and infrastructure are set with digital communication and sensory computing devices, enabling both infrastructure-toward-vehicle and vehicle-toward-infrastructure as well as vehicle-to-vehicle data communication and data collection for use of resource efficiency, traffic flow optimization, surveillance, safety and infrastructure maintenance or law enforcement.

F. Smart Grid

In [14],[31],[33] smart grid is addressed by Ali et.aland Ramyar et.al as a network that uses electricity to intelligently integrate and optimize the events of all the elements contained within the network, from the supply of power generation and transport to consumption, by way of internet-linked monitoring and communication computing devices.

G. E-Health

According to [15], E-health is a term relating the use of communication technology and digital information all through the healthcare industry. Some of the basic forms of E-health delivered by Reid Berryman et.al[35] and Maalelet. al [34] are:

1) Telemedicine: It is one of the basic forms of healthcare that provisions diagnostic service and treatment service remotely via video conferencing or internet-connected devices.

2) Healthcare companies-Digitization, is the form of increasing the use of classy computational models and genome ordering in the pharmaceuticals industry (bio-informatics).

3) Mobile health is the utilization of remote patient or self-monitoring wearable devices, supervises for health information and vital signs, ingestible smart pills or smart contact lens.

4) Pharmaceutical distribution digitization all through online pharmaceutical sales and e-prescriptions.

5) Gathering of medical data such as allergies, diseases and prescriptions on smart chips or cards to give information for regular treatment and emergency.

These are the various domains that are gaining importance at present scenario and the development of these applications need the help of technology for its full-fledged implementation.

IV. TECHNOLOGIES USED IN IOT

From [16], it has been analyzed that information about a tagged object can be identified by looking through the entry in database or internet address by using technologies like RFID or Near Field Communication. RFID community members are the foremost to encourage the concept of Internet of Things and so RFID is considered to be the ground and networking center of the design of IoT.

It has also been studied that by using various tagging technologies similar to RFID like NFC and 2D barcode that recognizes the object over internet, allows the users of IoT to carry the object to the fake world.

From the evaluation made from [4],[5],[9],Table 1 has been designed describing and comparing different characteristics of some main technologies that are used to collect data from IoT.

TABLE 1. COMPARISON OF CHARACTERISTICS OF TECHNOLOGIES IN IOT

Characteristics	Technologies				
	RFID	***NFC***	***Sensor***	***Bluetooth***	***Zigbee***
Peak distance	3-10m	≤10 cm	10-100 m	10-100m	100m
Data rate	Up to 640 Kbps	106-424 Kbps	250 Kbps	< 1 Mbps	250 Kbps
Capability	Identifying Storing, Interacting	Interacting	Processing Sensing Storing	Sharing, Identifying	Secure sharing of data
Used in	Logistics, Transportation, Retail, Payment	Smart phones, access control, contactless payment	Healthcare Agriculture Surveillance	Retail, Healthcare Transport-ation	Industrial controls, Digital Agriculture

Table 1 conveys that Bluetooth and RFID technology can be used to gain high data rate for identification of and communication with smart things. But still the RFID technology covers only shorter distance when compared to NFC covering greater distance and all other technologies. Each of this technology is used accordingly to the need of specific application. When reviewing, the capability needed to be offered by all the technology mainly involves the interaction and sharing which implies the importance of communication factor.

V. COMMUNICATION MODELS AND FEATURES OF IOT

From [17], the various methods of how IoT devices bond and communicate has been explained in terms of their communication models. A structure of four Communication models (Device-to-Device, Device-to-Cloud, Device-to-Gateway Communication Model, Back-End Data-Sharing Models) for networking of smart objects have been sketched out by IAB (Internet Architecture Board) through providing Guiding architectural document in March 2015.

E.Borgia in his article described the general communication features of IoT. It has been said that newer inventive applications can be crafted by IoT. These applications may belong to particular domain and they may exhibit the feature of that particular domain or may exhibit the feature cross-cutting multiple domains.

As referred in [27] some of the main communication features of IoT is listed and described as follows,

- Bulk transmission: This feature covers the process of handling simultaneous transmission of large amount of data from devices.
- Low power consumption: Few of the application will have some process or methodology to reduce consumption of energy.
- Securing & monitoring: It is involved in any type of communication to check integrity, identity and timestamps and to detect intruder behavior.
- High reliability: This feature describes about reliable transmission of data or connectivity by using some sort of protocols and coding schemes as solutions.
- Access Priority: Preemption mechanisms are used for this communication feature to manage communication and priority stage of services.

To wrap up we provide a sample of plotting the above mentioned communication feature with the applications discussed in former sections.

A. Communication Features of IoT

In table 2 it can be noted that some of the communication features are fitted to many numerous service applications but the rest fitting to only few. To briefly explain about the table, the characteristics of bulk transmission are used by multiple applications like e- health, logistics and surveillance. Besides, there are situations where certain applications require multiple features at the same time like in e-health, where bulk transmission of device should have less latency when transferring medical information and should have to be highly reliable when transferring data.

On the other hand, the characteristic of low power is the choice of logistic system and, the surveillance system takes the feature of priority access where alarm notifications have a higher precedence relating to rest of the dynamic streams.

Thus till this segment present scenarios in IoT are discussed with respect to all criteria’s including enabling technology, communication features and most prominent applications. However it seems that IoT is still in immature stage and some measure has to be taken to make it as a ripen technology. To make the development, IoT initially needs to face and overcome certain challenges that are explored in next section.

TABLE 2 COMMUNICATION FEATURES OF VARIOUS APPLICATIONS

Applications	Communication Parameters							
	Bulk transmission	Low power	Security & Monitoring	Low mobility	Extremely low latency	Small data burst	Priority access	High reliability
Smart meter [28]	-	-	-	Yes	-	Yes	-	-
e-health [29]	Yes	-	-	-	Yes	-	-	Yes
Smart retail [27]	-	-	Yes	Yes	-	-	-	Yes
Smart logistics [30]	Yes	Yes	-	-	-	-	-	-
Smart surveillance [27]	Yes	-	-	-	-	-	Yes	-

VI. TECHNOLOGICAL CHALLENGES IN IOT

From [7] it has been observed that in development, the cause of Internet of things can be seen in all technical fields. It aids in smart communication between objects but there are several challenges are to be addressed before the worldwide execution of IoT.

IoT should support scalability equally in all environments and should automatically set up connection to work with the particular environment. The main two challenges faced by IoT as analyzed are interoperability and heterogeneity.

In [7] interoperability issue was portrayed by the way that as the things are widely varying in IoT world, each variety of smart things will have their own processing and communication abilities. For example the factors like bandwidth and energy availability differs with different smart applications. So general standards and practices are needed to make possible cooperation and communication. When talking about requirement of IoT, discovery of things and its services are very much important. For this, semantic based approach is used to correlate their functionality and search engines can be used to provide status of objects and to find things.

Management of bulk data is the most prominent focus in logistics and large scale applications because they require data of enormous capacity on servers. Security and Privacy are also the main features need to be built in any smart application which prevents unauthorized access of services and communication. Refinement in the structure of IoT in a robust way is needed to adapt and adjust to immediate transforming condition to make things fault tolerant.

Each application in IoT has certain requirements that are need to be met. In table 3 it has been analyzed and mapped the requirements that are mandatory for each application. It is inferred from the table that three main requirements such as data accuracy, security and reliable transmission are mostly acquired by all applications. Bandwidth plays a major role in communication with devices but their range may vary according to certain need. Other than these, the next precedence is given to the features of resiliency, interoperability and energy optimization.

Interoperability of heterogeneous devices which includes heterogeneous data representations and API's remains a great challenge in internet of things. The problem of Heterogeneity is addressed in [18] as, Constructed data do not build any logic for IoT applications without the context information in IoT. The SOA undertakes the duty of diverse data incorporation and offers semantic data fusion services for numerous purposes. If suppose location information is included, this will not be helpful without including the context information, ontology's from the web and related sensor data other than multimedia sensor data in the data. Above said information's are diverse and processing and incorporation of those data's frequently is hard.

These above discussed disputes need to be conquered and the expansion of technology must be made. To make this happen few perspectives in IoT are required that are investigated on next segment.

VII. RECENT PERSPECTIVES IN IOT

Feng Wang et.al, describes three key perspectives of IoT that are mostly failed to be noticed in current works. The perceptions in IoT are service- oriented, cloud-centric and information fusion. By semantic and and mathematical methods information fusion in IoT is analyzed. The next perception is service-oriented IoT that led to the development of middleware structure based on semantics. Another viewpoint of IoT is cloud-centric, where the three interrelated technologies such as network, device and platform virtualization is compared and directed.

The most important requirement that need to be fulfilled by IoT is interconnection of things in the network. So that these things will communicate with other things in real time. To make this communication dynamic and unambiguous, the architecture of IoT should be made adaptive, scalable, extensible and interoperable. Of the three perspectives the service oriented approach ensures interoperability between things. Also a complex system is considered by SOA as set of subsystems or simple objects of well-defined way. So that the upgrade and reuse of IoT's hardware and software

TABLE.3 REQUIREMENTS OF VARIOUS IOT APPLICATIONS

Applications	**Requirements**						
	Bandwidth	**Interoperability**	**Resiliency**	**Energy Optimization**	**Security**	**Data accuracy**	**Reliable data transmission**
Smart meter [27],[31],[33]	Low	*	*		*	*	*
Smart lighting [27],[32]	Low						*
e-health [27],[34],[35]	Differs	*	*	*	*	*	*
Home automation [27],[36],[37]	Low				*	*	*
Smart Camera [27],[38],[39]	Medium		*		*	*	*
Smart agriculture [27],[40],[41]	Low	*	*	*	*	*	*
Smart media [27],[42]	High					*	*
Smart transportation [27],[42],[43]	High	*	*	*	*	*	*

Due to these benefits provided by SOA, it has been extensively practiced to be a conventional structural design for wireless sensors networks.

A. Significance of Service Oriented IOT

With the increasing number of devices, sensors, embedded chips and cell phones in every feasible appliance and machine, there is been the rise of the Internet of things, where they all interact , discover and swap messages with each another. Physical devices running services in the real world will be provided structural design methodology by SOA. The functionality of systems of devices can be raised by service orientation.

SOA nowadays is becoming more important for communication and processing of real-time embedded devices. Here the on-demand provisioning of missing functionality and discovery of services will be an important dispute.

Guinard and company recommend that SOA offers an architectural methodology that enables the placement and administration of services that are in real-world running on devices. The process of incorporating devices to current information system can be achieved by using Web-oriented patterns (REST) and Web service standards. To dynamically register the services provided by the device, web services can be used.

There are many regions this could apply. Applying SOA values to several smart components of logistics systems that trust on many independent components – pallets, containers, and vehicles could support coordinate operations. Embedded sensors with equipment can be at a production floor that talks to each other.

Guinard and company afford some approaches that can make service orientation occur, with the use of inquiries to examine service metadata. They also exposed that recognization of increased number of services can be done without overfilling description information into devices. To have an in-depth knowledge of service orientation the concepts are reviewed.

B. Service Oriented Architecture

Outcomes for service consumers as they prefer can be attained by using SOA that connect business and computational resources. These outcomes may be services or end users. According to [19], SOA in practice is a model to establish and use abilities that are distributed across different fields.

DCOM, CORBA, J2EE are those who lead to the advancement of Service Oriented Architecture. These are not exactly the web services but serves as a replacement in SOA execution to provide features of SOA to architecture.

The Benefits of SOA

From [20], the significance of SOA has been realized such that to provide simple use of services and easy scalability of internet and to decrease price in association, SOA based architectures serves development of large scale enterprise system in a controllable way as the key drivers. Large group of networks that need to realize interoperability as essential factor in each component can be created by SOA by offering a simple pattern which is scalable. Certainly, about the network SOA makes the least probable conventions and so SOA is accessible. Also in smaller scale systems there are regularly made trust assumptions which can be reduced by SOA.

Details of SOA

Prior to collect the particulars of SOA, it is essential to study about software architecture that comprises of coarse-grained structures of the software. Components of the system which are not distributed objects and the way they communicate with them at high level are defined by software architecture. Components are software of intellectual modules that are installed with further components onto a server as a unit. As shown in figure 1 the connectors define the communication among the components.

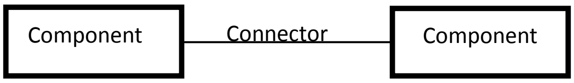

Fig.1.Software architecture describes a system's components and connectors.

SOA may be a new term but since 1990 software service is in existence and was utilized to portray services and processes in services in Tuxedo.SOA is mentioned in [21] has a software architecture having many numerous exclusive characteristics.

Web services are technology that can be executed effectively. Splitting the service's accomplishment from interface is the key part of SOA. Services supporting certain contract or request format are just observed as an endpoint by service consumers. They only focus on the result instead of worrying about how they execute their requests. Interoperability, discoverability, loose coupled and composable, self-contained and modularity are the characteristic features owned by SOA.

Service-orientation is a design model that comprises of service-orientation design values. When applied to part of solution logic, these values create services with different design characteristics that support the overall vision and goals of service-oriented computing.

Services:

Services are as physically self-sufficient software programs with exact design characteristics that support for the accomplishment of the intentional goals related to service-oriented computing.

Each service is allocated with its own distinct functional background and is composed of a set of capabilities associated to this information background. Those capabilities appropriate for invocation by exterior consumer programs are usually expressed by means of an available service contract. [22]

Service-Oriented Computing

To maintain low cost, a pattern which uses service as its basic element is used for rapid growth of the applications that are distributed in heterogeneous environments. Such computing pattern is named to be Service-Oriented Computing (SOC).

To make dynamic business processes by collaborating loosely coupled services and to make flexible agile applications are the abilities of SOC.

With the aim of assembling and creating multiple service inventories, a new invention of computing platform is described by SOC covering the service orientation model and architecture.

For the integration and management of environment containing heterogeneous smart items, a service oriented middleware is needed.

C. Service Oriented Middleware Architecture

The rising usage of smart embedded devices – the Internet of Things – needs middleware that is capable of handling integration among the software and the device which is trying to make use of it.

Service discovery and on-demand provisioning of the huge number of resource-limited and networked devices require the correct infrastructure to handle the out coming network traffic. A SOA-based approach facilitates standards based realization using loosely coupled interfaces and services.

In [22], the middleware concepts were described which allows communication among business applications and smart items networks. This network includes RFID systems, embedded systems and wireless sensor networks.

Since different devices have their own programming interfaces and protocols, challenging factor lies in the integration of those types of devices into business applications. Present middleware fails to simplify back-end systems integration but succeeds in improvement of software that race on smart items.

Business applications are integrated comfortably by abstracting the middleware thought on service oriented level from the smart items network.

Improvement of capability of business applications to organize, query and to run the services without any basic idea on network of smart items was permitted by the middleware.

The middleware architecture in Figure.2 is separated as a platform dependent layer and independent layers as in [22]. The former contains Service Lifecycle Managers and Message Handlers. The latter contains key components such as the Service Mapper, the Request Processor, and the Service Repository.

In [23], a middleware platform has been designed for integration of multisource heterogeneous information based on Service-Oriented Architecture. Then the SOA data processing middleware is used to make an environmental monitoring system for validation verification.

The SOA data processing middleware has laid a concrete base for interaction and data integration among diverse networking systems, simplifying the difficulty of the system integration process and developing the reuse of components in the future.

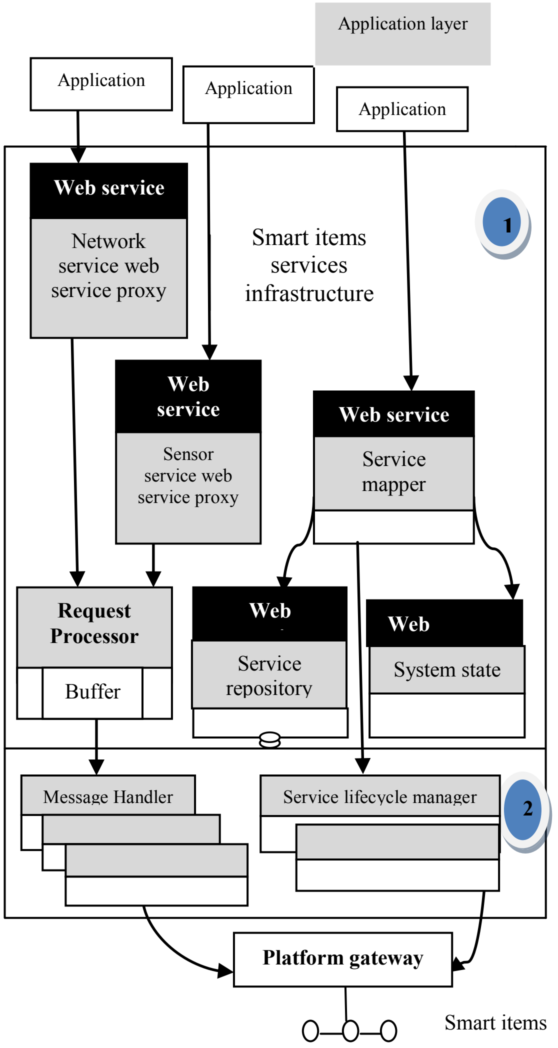

Fig.2.Architectural Overview

1. Platform independent layer

2. Platform dependent layer

The architecture is shown in figure.3. These Service Oriented Middleware necessities involve the hold up for Service composition and standardization, Service registry and publishing Service discovery and integration, Heterogeneity, Integration transparency to client applications, Adaptation and Autonomicity, Scalability and efficiency, Reliability and security and QoS requirements. [24]

In [25], Service oriented information integration architecture underlying SOA and different integration approach has been proposed for credit scoring system. This architecture provides a high level of reusability and provides high performance by solving the issues through virtualization.

SOM is commonly intended to handle the publication and discovery of web services, communication, and reliable and efficient event management between diverse services. Also taking into account, distributed application functionality and efficient heterogeneous resource handling must need to be maintained by SOM. To maintain continuous information flow, it is most vital to have a reliable, efficient and scalable system because of sharing of enormous quantity of data. Satisfactory levels of control, reliability, and security should also be maintained by SOM. For reuse and effective integration, adaptive and dynamic SOM architectures must be used to improve the approach.

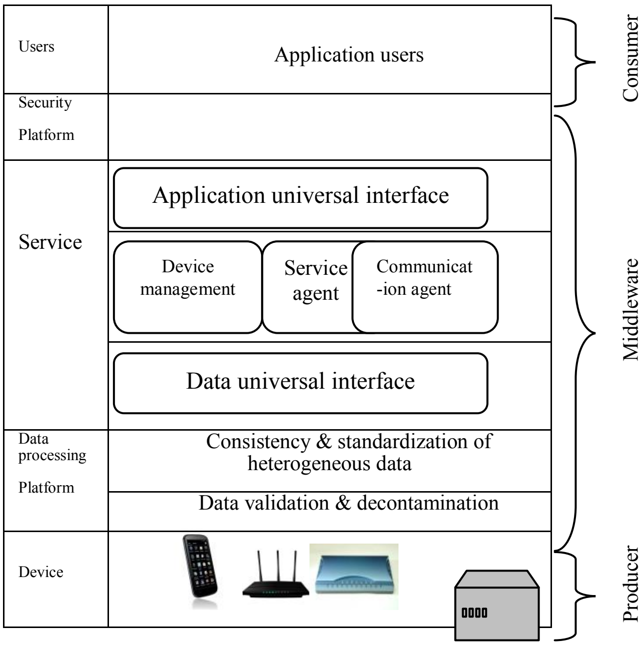

Fig.3.IoT middleware architecture based on SOA

D. Semantic- Based SO-IoT

The process of connecting diverse services of the application by using the contracts as well as the interfaces is defined to be SOA. The interface is a connecting point of interacting with something in an unbiased way and it must be self ruling of hardware platform, execution services, programming languages and operating systems.SOA considers service as its root, so that depending on interface with software agents and systems, the services can be related effectively and frankly. Learning's with respect to Service Oriented Architectures related to heterogeneous networks are under development.

Recent Review

In [18], it has been analyzed that storage based and computer-based valuable supplies are restricted in every sensor nodes of IoT and it is guessed that there will be hike in physical valuable supplies in every nodes in next generation devices, where resource limitation of individual sensor nodes will be lessened. There is wide range of IoT applications that forms the core of smart infrastructure. Some of the applications are smart home and grid, intelligent medical, agriculture, industry, transportation and security. On the other hand, these various applications from IoT contain different requirements and different services are provided to them by the concept of service-oriented IoT. In [18], service oriented IoT has been proposed that is semantic oriented where its application's order for a bunch of needed services, so that the application could obtain more integrated functions only because of supportive work of services. Realizing the integration of heterogeneous data will be addressed by future SOA for different applications by offering semantic mash up services.

There are sensor data that do not build any logic. If suppose location information has been included, this will not be helpful without including the context information, ontology's from the web and related sensor data other than multimedia sensor data in the data. Above cited information's are diverse, and processing and incorporation of those data's frequently is hard.

Though, researchers have covered the mode to store, unfold and present those data by means of the Web Ontology Language (OWL) which is a Semantic Web language intended to signify prosperous and complex facts on the subject of things, otherwise by using the Resource Description Framework (RDF) which is a model that merges different schemas. Heterogeneous data can be defined and mapped with semantic explanations like in OWL and RDF, and an actual solution for this structure can found by using RDF triples [18]. This kind of approach also needs improvement in future research and a proposal to handle such heterogeneous data is made in next section.

VIII. PROPOSAL

Since in the IoT, each day, new machines, sensors, and devices come online and feed information into data systems, those swelling volumes of data need to be managed and it is a great challenge to handle such diverse, complex and vast moving data constantly streaming from untold numbers of sources. The discussed semantic approach does not fulfill the requirements to manage data. These data level management is done in IoT by using a intelligent network component "IoT Gateway" which has been discussed in next section.

There is a lot of apprehension about interoperability in the Internet of Things. For the IoT to attain its full potential, devices require being able to work jointly in various ways, a lot of which are not obvious at the time of the design. Interoperability between devices is required for this revelation to be realized, and IOT gateways propose one possible solution.

A. IoT Gateway

For designing IoT, Gateways serves as a component of the hub-and-spoke model. In hub-and- spoke model, devices at the endpoint converse with a gateway or central hub that passes on the information to and from the Internet, to a certain extent than devices at the end conversing directly with the Internet. This formation of using a gateway in IoT design offers a number of rewards [26].

These benefits include connectivity at longer distance, forwarding the data after undergoing preprocessing and gateways also provide the capability of holding different internet protocols and additional security features are also included in gateways. The general infrastructure of IoT gateways is depicted in figure 4.

Of that, a possibly most important benefit is that the gateway can bring together a heterogeneous set of end devices into a functional group. It is not an issue what protocols or connectivity options a specified device utilizes [48] [49]. A device can work as a group only if the gateway exists to coordinate them. In this way, devices at the endpoint need not to be designed to interact and interoperate.

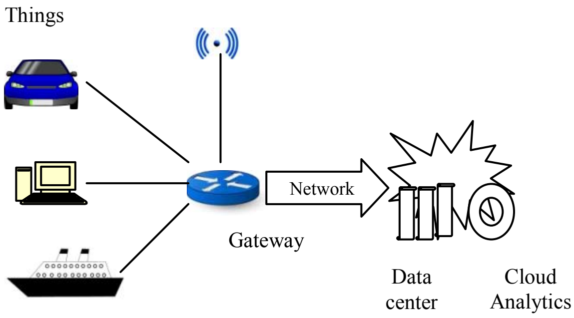

Fig.4. General Infrastructure of IoT using Gateway

Organizing intelligence is offered by the gateways in addition with required message relays and translations. But still, there exists the problem in IoT gateway because today's gateways conflate in network processing, data processing, user interface functions and network connectivity. [50]

The data lifecycle in IoT consists of following elements such as data querying, production, collection, aggregation, delivery , preprocessing. These processes are needed to be handled by IoT gateway efficiently.

B. Data Handling in IoT

IoT is not considered to be scientific invention or an industry advertises but as an alternative it is supported on realization of ideas of network ubiquity and solid technological advances. It is in the premature phases of improvement, so in future it is estimated that scalable and durable network will be developed efficiently.

The feature of producing data endlessly in IoT should be handled by a network component "IoT gateway". From the investigation made it has been noted that there is no comprehensive gateway designed to take care of the data level operations in IoT. So in our upcoming research, a adaptive gateway is to be designed to provide a efficient data handling in IoT. For creating adaptiveness in IoT gateway, Bio-inspired approach is to be used.

IX. CONCLUSION

IoT has been urbanized quickly in the earlier period and huge proposal of technologies and applications are made. Drift to subsequent internet is considered to be the Internet of Things. This article converses the state-of-the-art various technologies, key concepts and latest expansions in the IoT. The incentive of this article supplies the main perception of service-oriented IoT.

In fussy, the responsibility of SOA in IoT and different existing middleware architectures that allows making the communication between smart items network and business applications are discussed. Besides this, there still exists heterogeneity issue in IoT which need to be dealt. Mainly huge diverse number of data flooding from different sources creates this heterogeneity issue more serious and it is handled by IoT gateway and it has been found that it is in premature stage. Finally, a proposal in IoT gateway have been pioneered as a solution to solve interoperability and data level issues in IoT.

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