Usability of Wireless Sensor Network Data in a Cloud Environment

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Abstract— **In this paper we have an approach to develop an application which will enable us to integrate wireless sensor network data with the cloud environment. So therefore we give a perspective framework of building a cloud primarily which will be used for sharing sensor network data collected from an existing clusters of wireless sensor networks with the help of an Application for collecting data packets within it. Here we will simulate a Wireless Sensor Network and fetch the data primarily required to be used as raw data to be fed in the cloud environment. As a highly sensitive application the whole cloud would be covered with multiple security cordon with respect to data feeding, integration and sharing. We would experience a new application development which would have wider implementation practically and especially in defense sector**

Index Terms— **Cloud Computing, Wireless Sensors.**

I. INTRODUCTION

Wireless sensor network (WSN) consists of a large number of sensor nodes that are interconnected to form a wide communication network.
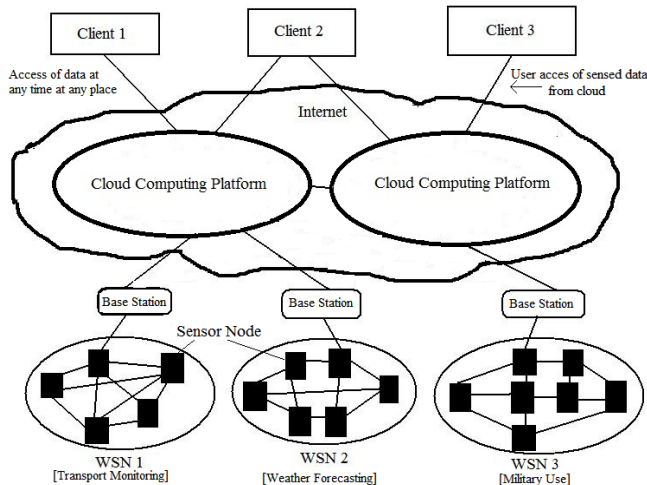

Fig. 1 WSN- Cloud Computing Platform

Usually, it can achieve small size, low cost, low power consumption, fewer network components and other features easily. In recent years, it has been readily implemented in agriculture, industry, environmental protection and other fields. With the development of hardware limitations, and in pursuit of a better performance and enhancing greater computing capability, people turn to find other techniques to achieve these goals. Therefore, the concept of "Cloud" was born. In fact, as early as the Internet appeared, the "Cloud" has already existed silently providing for us some services. In recent years, the "Cloud" concept has become more and more popular, especially on the business sector, but now it can be further enhanced , secured and can be implemented in the

Defence Sector. The thesis of our project will deal with such aspects in a varied form. The work will start with creating clusters with a cluster head and nodes, which will act as sensors. The sensor nodes will have a sink node. The communication will be prevailed in such a way that the sensor nodes will communicate with each other and pass the data to the sink head. Each sink node will then send the data to the cluster head. Each clusters will have their own cluster heads, and these Cluster Heads will communicate with each other by sending data packets. The data packets generated by the wireless sensors will be captured by a plugin tool which would be exclusively developed indigenously for capturing the raw data and will be used to convert it to a cloud under stable format. Then a separate cloud will be developed where this data's will be fed and they will be used to share among the clouds and their users. This cloud will be secured at multiple levels so that only authenticated user would be getting access to it. Moreover it should be suitable for the defence use.

II. SURVEY

1. CLOUD: OVERVIEW

Cloud computing is a term used to describe both a platform and type of application. A cloud computing platform dynamically provisions, configures, reconfigures servers as needed. Servers in the cloud can be physical machines or virtual machines. It is an alternative to having local servers handle applications. The end users of a cloud computing network usually have no idea where the servers are physically located—they just spin up their application and start working. Advanced clouds typically include other computing resources such as storage area networks (SANs), network equipment, firewall and other security devices. Cloud computing also describes applications that are extended to be accessible through the Internet. These cloud applications use large data centers and powerful servers that host Web applications and Web services. Anyone with a suitable Internet connection and a standard browser can access a cloud application.

Many formal definitions have been proposed in both academia and industry, the one provided by U.S. NIST (National Institute of Standards and Technology) appears to include key common elements widely used in the Cloud Computing community:

Cloud computing is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [2].

A. Features
The following are the essential features of cloud computing:

1) Service on demand: The request of the clients to avail resources can be fulfilled automatically without human interaction.

2) Elasticity of demand: There is no formal agreement or contract on the time period for using the resources. Clients can use the resources whenever they want and can release when they finish.

3) Abstraction: Resources are hidden to clients. Clients can only use the resources without having knowledge regarding location of the resource from where data will be retrieved and where data will be stored.

4) Network access: The client application can perform in various platform with the help of mobile phone, laptop and PDA using a secure internet connection.

5) Service measurement: Although computing resources are pooled and shared by multiple clients (i.e. multi-tenancy), the Cloud infrastructure can measure the usage of resources for each individual consumer through its metering capabilities.

6) Resource pooling: The resources are dynamically assigned as per clients' demand from a pool of resources .

B. Services
The cloud provides following three services:

1) SaaS (Software as a Service): This model provides services to clients on demand basis. A single instance of the service runs on the cloud can serve multiple end user. No investment is required on the client side for servers and software licenses. Google is one of the service providers of SaaS.

2) PaaS (Platform as a Service): This model provides software or development environment, which is encapsulated & offered as a service and other higher level applications can work upon it. The client has the freedom to create his own applications, which run on the provider's infrastructure. PaaS providers offer a predefined combination of OS and application servers. Google's App Engine is a popular PaaS example.

3) IaaS (Infrastructure as a Service): This model provides basic storage and computing capabilities as standardized services over the network. Servers, storage systems, networking equipment, data centre space etc. are pooled and made available to handle workloads. The customer would typically deploy his own software on the infrastructure. The common example of IaaS is Amazon.

C. Cloud Computing Models
The following models are presented by considering the deployment scenario:

1) Private Cloud: This cloud infrastructure is operated within a single organization, and managed by the organization or a third party irrespective of its location. The objective of setting up a private cloud in an organization is to maximize and optimize the utilization of existing in-house resources, providing security and privacy to data and lower data transfer cost [3] from local IT infrastructure to a Public Cloud.

2) Public Cloud: Public clouds are owned and operated by third parties. All customers share the same infrastructure pool with limited configuration, security protections, and availability variances. These are managed and supported by the cloud provider.

3) Community Cloud: This cloud infrastructure is constructed by number of organization jointly by making a common policy for sharing resources. The cloud infrastructure can be hosted by a third-party vendor or within one of the organizations in the community.

4) Hybrid Cloud: The combination of public and private cloud is known as hybrid cloud. In this model, service providers can utilize 3rd party Cloud Providers in a full or partial manner so that the flexibility for using the resources are increased.

2. SENSOR NETWORK: OVERVIEW

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance. They are now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control .Each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, usually a battery. The size of sensor node may vary from shoebox down to a grain of dust. The cost of sensor nodes is also varies from hundreds of dollars to a few pennies, depending on the size of the sensor network and the complexity required of individual sensor nodes . Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and bandwidth.

A sensor network is a computer network Composed of a large number of sensor nodes. The sensor nodes are densely deployed inside the phenomenon, they deploy random and have cooperative capabilities. Usually these devices are small and inexpensive, so that they can be produced and deployed in large numbers, and so their resources in terms of energy, memory, computational speed and bandwidth are severely constrained. There are different Sensors such as pressure, accelerometer, camera, thermal, microphone, etc. They monitor conditions at different locations, such as temperature, humidity, vehicular movement, lightning condition, pressure, soil makeup, noise levels, the presence or absence of certain kinds of objects, mechanical stress levels on attached objects, the current characteristics such as speed, direction and size of an object. Normally these Sensor nodes consist there components: sensing, processing and communicating .The development of sensor networks requires technologies from three different research areas: sensing, communication, and computing (including hardware, software, and algorithms). Thus, combined and separate advancements in each of these areas have driven research in sensor networks. Examples of early sensor networks include the radar networks used in air traffic control. The national power grid, with its many sensors, can be viewed as one large sensor network. These systems were developed with specialized computers and communication capabilities, and before the term ─sensor networks‖ came into vogue.

A. Terminology

Following are the important terms which are used widely in sensor network:

1) *Sensor:* A transducer that converts a physical phenomenon such as heat, light, sound or motion into electrical or other signal that may be further manipulated by other apparatus.

2) *Sensor node:* A basic unit in a sensor network, with processor, memory, wireless modem and power supply.

3) *Network Topology:* A connectivity graph where nodes are sensor nodes and edges are communication links.

4) *Routing:* The process of determining a network path from a source node to its destination.

5) *Resource:* Resource includes sensors, communication links, processors and memory and node energy.

6) *Data Storage:* The run-time system support for sensor network application. Storage may be local to the node where the data is generated, load balanced across a network, or anchored at a few points.

B. Routing Protocols in WSNs

Routing protocols in WSNs are broadly divided into two categories: Network Structure based and Protocol Operation based. Network Structure based routing protocols are again divided into flat-based routing, hierarchical-based routing, and location-based routing. Protocol Operation based are again divided into Multipath based, Query based, QoS based, Coherent based and Negotiation based.

In flat-based routing, all nodes are typically assigned equal roles or functionality sensor nodes collaborate together to perform the sensing task. Due to the large number of such nodes, it is not feasible to assign a global identifier to each node. The examples of flat-based routing protocols are –SPIN , Directed Diffusion, Rumor Routing , MCFA , GBR, IDSQ & CADR , COUGAR , ACQUIRE , Energy Aware Routing etc. In hierarchical-based or cluster based routing, nodes will play different roles in the network. In a hierarchical architecture, higher energy nodes can be used to process and send the information while low energy nodes can be used to perform the sensing in the proximity of the target. This means that creation of clusters and assigning special tasks to cluster heads can greatly contribute to overall system scalability, lifetime, and energy efficiency. Hierarchical routing is an efficient way to lower energy consumption within a cluster and by performing data aggregation and fusion in order to decrease the number of transmitted messages to the BS. Hierarchical routing is mainly two-layer routing where one layer is used to select cluster heads and the other layer is used for routing. The examples of hierarchical-based routing protocols are – LEACH, PEGASIS, TEEN, APTEEN , MECN, SMECN, SOP, Sensor Aggregate routing , VGA, HPAR , TTDD etc.

In location-based routing, sensor nodes' positions are exploited to route data in the network. In this kind of routing, sensor nodes are addressed by means of their locations. The distance between neighbouring nodes can be estimated on the basis of incoming signal strengths. Relative coordinates of neighbouring nodes can be obtained by exchanging such information between neighbours .Alternatively, the location of nodes may be available directly by communicating with a satellite, using GPS (Global Positioning System), if nodes are equipped with a small low power GPS receiver . The examples of location-based routing protocols are – GAF , GEAR , GPSR ,MFR, DIR, GEDIR , GOAFR, SPAN etc.

In multipath routing, communication among nodes uses multiple paths to enhance the network performance instead of single path. In Query based routing, the destination nodes propagate a query for data from a node through the network and a node having this data sends the data which matches the query back to the node, which initiates the query. Usually these queries are described in natural language, or in high-level query languages. In QoS-based routing protocols, the network has to balance between energy consumption and data quality. The network has to satisfy certain QoS metrics, e.g., delay, energy, bandwidth, etc for delivering data to the BS. In coherent routing, the data is forwarded to aggregators after minimum processing. The minimum processing typically includes tasks like time stamping, duplicate suppression, etc. In Negotiation based routing, protocols use high level data descriptors in order to eliminate redundant data transmissions through negotiation. Communication decisions are also taken based on the resources that are available to them.

III. LITERATURE SURVEY

Rajesh et. al. [1] presents Secured Wireless Sensor Network-integrated Cloud Computing architecture. The real-time sensor data must be processed and the action must be taken regularly. The integration controller module of the proposed architecture integrates the sensor network and Internet using Cloud Technology which offers the benefit of reliability, availability and extensibility. Peter et. al. [5] discusses the idea of combining wireless sensor networks and cloud computing from the existing approach. The paper proposes wireless sensor network by virtual sensor in the cloud. The idea is to store the data on both the real sensor and virtual sensor. The paper proposes an architecture to realize distributed shared memory in WSNs with the help of a middleware called tiny DMS. Tongrang Fan et. al. [8] proposes sensor data storage solutions based on the Hadoop cloud computing framework. Due to the rapid growth of sensor data storage and processing, traditional storage systems are not able to meet the data access requirements. By contrast to the private cloud system storage and traditional storage model, the characteristics and advantages of private cloud system storage are analysed. The designed storage solutions were performed by MapReduce programming model, and the experimental results indicated that the new cloud storage solution had higher data access performance. Geoffrey et. al. [10] discusses the characteristics of distributed cloud computing infrastructure for collaboration sensor-centric applications on the Future Grid. The paper mainly focuses on the performance, scalability and reliability at the network level using standard network performance tools. Sajjade t. al. [11] proposes a new framework for Wireless Sensor Network integration with Cloud Computing model with a possibility of an existing Wireless Sensor Network getting connected to the proposed framework. The integration controller unit of the proposed framework integrates the sensor network and cloud computing technology which offers reliability, availability and extensibility. Peng Zhang et. al. [12] discusses some of the

Wireless Sensor Network challenges like the limited resources of a sensor, limited battery life, limited bandwidth and limited processing power. The paper proposes a novel architecture based on cloud computing for wireless sensor network, which can improve the performance of wireless sensor network. Based on this architecture, a cloud acts as a virtual sink with many sink points that collect sensing data from sensors. Each sink point is responsible for collecting data from the sensors within a zone. Sensing data are stored and processed in distributed manner in cloud. Junya Terazono et. al. [13] describes the construction of a sensor network using a messaging network. A messaging network is an overlay network with a set of content-aware message handling capabilities. The use of a messaging network can reduce the complexity and maintenance burden of integrated sensor information systems. Message mediation (a function of the messaging network) enables interoperation of various applications and integration of diverse sensor data. Subscription (another concept in the messaging network) enables proper information delivery of the sensor data to each user. Khandakar et. al. [18] discusses novel and attractive solutions for information gathering across transportation, business, health-care, industrial automation, and environmental monitoring. The next generation of WSN will benefit when sensor data is added to blogs, virtual communities, and social network applications. The proposed architecture is based on cloud computing for wireless sensor network, which can improve the performance of wireless sensor network. Based on this architecture, a cloud acts as a virtual sink with many sink points that collect sensing data from sensors. Each sink point is responsible for collecting data from the sensors within a zone. Sensing data are stored and processed in distributed manner in cloud. Cloud computing provides huge computing, storage, and software services in a scalable and virtualized manner at low cost. This paper proposes an architecture for integrating Wireless Sensor Networks with the Cloud. REST based Web service is used to monitoring e-health care service and smart environment. Data can be accessed from anywhere due to using of IP in REST based Web service. Srimathi et. al. [6] proposes the idea of combining underwater sensor network and cloud computing. The underwater sensor network with static sensor nodes is used for monitor environment. The underwater sensor cloud architecture provides a way for underwater sensor nodes to collect, store and retrieve environmental data. A Hadoop framework is proposed which serves as a middleware for underwater sensor cloud. The proposed sensor cloud architecture consists of three layers namely Underwater sensor network layer (This layer is the collection of underwater sensor nodes for environmental data analysis), Underwater sensor web layer (This layer consists of a sensor cloud middleware, a meta-modelling tool) and Underwater data computing layer (comprises of collection of data cloud nodes and a cloud interface service to perform sensor data computations).John Tooker et. al. [7] discusses a system which has a novel underground communication system and an online underground sensor network test bed. The system includes an underground antenna and underground sensor network test bed. The underground sensor network test bed consists of a network of underground communication systems with soil moisture sensors and a mobile data unit equipped with cellular communication. Wen Qiang Wang et. al. [23] proposes Smart Traffic Cloud, a

software infrastructure to enable traffic data, manage, analyse and present the results in a flexible, scalable and secure manner using a Cloud platform. The infrastructure is used to handle distributed and parallel data management and analysis using ontology database and the popular Map-Reduce framework. The paper presents a prototype infrastructure in a commercial Cloud platform and a real-time traffic condition map is developed using data collected from commuter's mobile phones. Traffic related application such as real time map and on demand travel route is proposed. Both archived and real-time data involved in these applications could be very big, depending on the number of deployed sensors. The cloud infrastructure is used to handle big data and enough computing and storage area.

IV. PROPOSED WORK

1. Objective

The main objective of the project is to integrate WSN data with that of a cloud environment and successfully build a cloud that would accept these data into the cloud framework. Another objective is to secure the cloud as it would be used for very sensitive purpose and no user should be able to access it without authorisation.

2. Scope of Work

The work will fill the existing gap which prevails between the problems of integration with WSN and Cloud. As a future strategy to thrive in technological arena , it would be necessary that a proper medium is followed while integrating these two arenas.

3. Envisaged Research

➤ The proposed research will deal with creating Clusters comprising of Wireless Sensor Nodes. The nodes will ensure having a sink node along with it , where data packets will be transferred and a communication channel will be established. Each Clusters will comprise of a Cluster head which will be connected with the sink node.

➤ Each cluster will communicate with each other with the help of the Cluster head. This whole setup of establishing Wireless Sensor Network will be done in simulation tool known as Ptolemy.

➤ A packet capturing application will be developed using JAVA which will b by default embedded within the simulation tool to capture packets generated by the internode communication of these sensor networks. These can then be used to convert the RAW data to User Under stable format.

➤ A private cloud is being set up, which would get these user under stable data format and then it would share among other authorised user with in the cloud and also to other cloud.

➤ Major Authentication and security protocol will be implemented to secure the cloud and get make it computable and safe.

V. DEVELOPMENT

1. WIRELESS SENSOR NETWORK

Here we setup three network for the nodes and clusters which would be identified as a simulation source for the packet transfer. Here the networks are simulated through the OMNET++ Simulation Tool. The resultant packet transmission between the nodes and clusters and with the clusters with the base station are being collected.

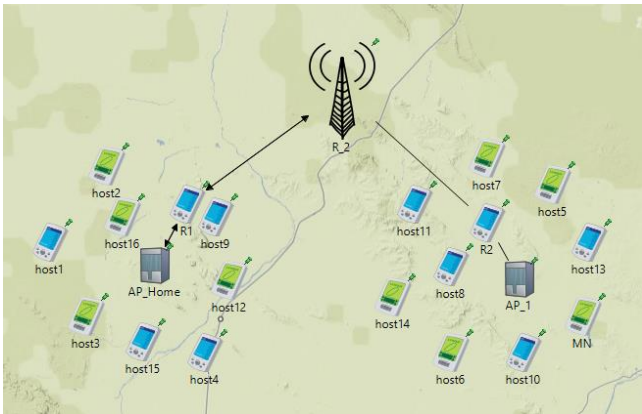The following image shows the result of the simulation for a hybrid cluster configuration

Fig 2. Hybrid Cluster Formation

On the other hand we accumulate these clusters and build a another network which will primarily create the clusters and also will account for these sensors connectivity with the base station.
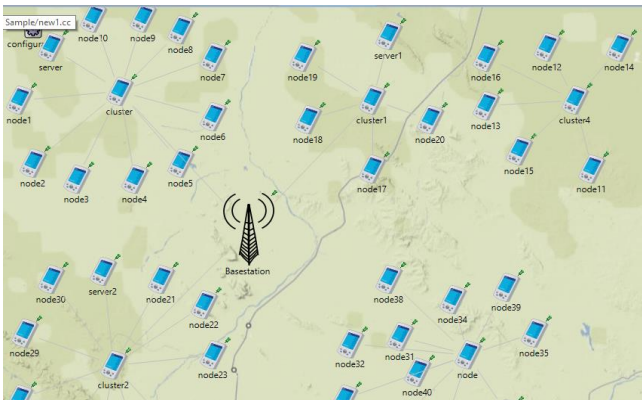

Fig 3. Multiple cluster formation.

On the other hand another simulation is performed which results in the creation of multiple nodes being attached with the clusters.
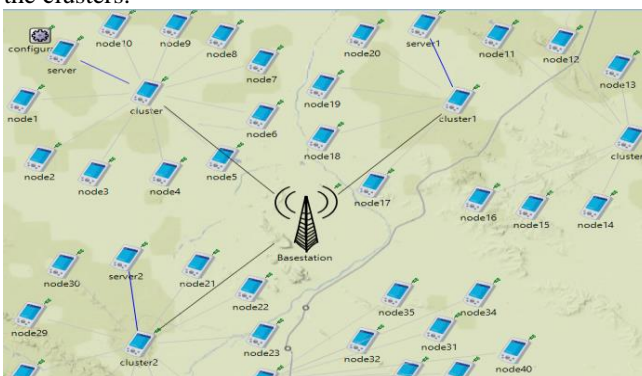

Fig 4. Wireless Sensor Network

After the creation of the Wireless Sensor transmission of packets is done. While transmission these packets are being captured. The captured packets are the collected to a resultant folder. These will in near future will be used in feeding data in the cloud.

VI. FUTURE WORKS

In the near future the cloud application will be developed and this will lend another way to creating a cloud.Where each sensors will be allotted with separate containers and this will enable to crate instances for each cloud container.Once the container in the cloud is being created,It will convert the data into human understable format.

VII. CONCLUSION

There were numerous constraints which has been undertaken during this timeframe. The connection between the systems are being established and then Packet Transfer is being executed.

The main hurdles faced are being taken care of and will be looked forward for the project to get executed.

In near future we will come across Capturing of Data Packets and then subsequently it will be thrown into the Sensing Node As a Service framework. This in turn will be taken care of with the Data packets being converted into that Human Under stable format inside the cloud.

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