A Survey on the Interfacing the Wireless Sensor Networks with the Cloud

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ABSTRACT
Informative, complex and a lot of data from different situations are sensed by different sensors in wireless sensor network and are being uploaded into cloud for getting good storage and transfer the well processed data to the physical world in an efficient manner. Hence, there is a need for interfacing Wireless sensor Network with the cloud, by choosing different communication protocols and appropriate wireless technology, to cover wide area and to provide services for the diverse requirements. In this paper, surveyed several approaches used to upload sensed data from sensor in wireless sensor network into the cloud in an efficient manner by using communication protocols and wireless technologies by assessing their key technical concepts and different parameters.

Keywords
Cloud, Wireless Sensor Network, Wireless Technologies, Communication protocols

1. INTRODUCTION
Collection of extraordinary sensors with an inter-communication framework establishes to a Wireless Sensor Network, for sensing and observing situation at varied regions. Sensors which produce electrical signals depending on sensed physical parameters and circumstances observed. [1] Generally monitored parameters are pressure, speed, humidity, temperature, wind direction, power line, voltage, chemical concentrations pollutants levels, emission counts of radiation, vital body functions, intensity of sound, vibration and illumination. However, the sensing nodes in a network are deployed densely and prone to failures. They have higher orders of magnitude and use broadcast communication paradigm. They may not have global identification (ID) due to large amount of overhead and limited in power, computational capacities and memory. Topologies of a sensor network changes very frequently because of large number of sensors.

Wireless sensor networks are needed because, [2]

- There is no need of any fixed infrastructure for setting up the network.
- It is suitable for non-reachable areas like deep forests, mountains, rural areas, sea and radiation leakage area.
- It is very much flexible in extending the workstation when it is needed.
- Reduce cost of implementation.
- It avoids risk involved in wiring
- New devices can be included in the network whenever it is needed.
- Partitions can be done with ease.
- Centralized system can access the information by the network.

Wireless Sensor Network has come up with magnificent tool for different areas of application. Sensors are classified into Environmental sensors, Gas sensors, Physical sensors, Optical and Biometric sensors. Environmental sensors are used in the area of agriculture for finding quality of water, temperature, soil humidity, wind speed and wind direction. Gas sensors are used to find Organic gas Carbon evolved from the living system. Physical sensors are used for finding movement of any object in living system. Optical sensors are used to find human presence through the IR spectrum and to find total amount of energy and light absorbed by plant by finding absorption of sun light, radiation and ultraviolet rays. By identifying radiation leakage in the area, it avoids human life from dangerous causes. Biometric sensors like accelerometer avoid probable attacks or the fall of person who are suffering from heart problems by observing the pulse and activities of heart and alert the related persons by SMS alarms that uses the GSM/GPRS module.

Along with these WSN applications are found in Natural environment protection, Area monitoring, Supplies control in manufacturing, Radiation prevention, Disaster relief operations, Earth quake detections, Biodiversity mapping, Intelligent buildings or bridges, Industrial automation, Machine surveillance and preventive maintenance, Tanks and oil level control, Medicine and health care, Traffic monitoring, Electric consumption, Precision agriculture, Irrigation, consumption of water, detection of leakages in pipe lines, Liquid storage management and Animal grazing, etc.

In spite of this, WSNs have to face many problems with regards to the range of short communication, security and privacy, reliability, mobility, consideration of power, capacity of storage, capabilities of processing and availability of bandwidth. At the side, wireless sensor network contains its components and specific constraints in design, depending on the area under monitor. Whatever it may be, by the availability of wireless technologies and communication protocols all these problems can be overcome by integrating the objects instead of people, to create a smart environment to upload the sensed data from WSNs to cloud.

In this paper, overview of wireless sensor network and its application is illustrated. The remaining part of the paper is organized into different sections: Section II presents existing literature survey, Section III presents survey of various wireless technologies for interfacing WSNs with cloud and Section IV concludes the paper by summarizing the overall study.

2. EXISTING LITERATURE

Rajeev Piyaree and Seong Ro Lee [3] proposed the architecture for integrating wireless sensor Networks with the cloud for sharing sensor data. To get an inter-operable application layer, this is directly integrated into other application domains for remote monitoring such as health care services, smart homes, and vehicular area network. For that, they have used representational state transfer based web services and implemented different decision levels for different architectural layers.

There is a need of better web services, wireless standards, modules and mechanism to build a low power, deployment of nodes in a simple manner, reliable data transmission-self healing wireless sensor network, to decrease energy consumption and to increase the life time of network devices.

Gathri. K and v. Ananthanarayan [4] presented a frame work for integration of WSNs with cloud. Data from all the deployed sensors is aggregated in to single message and sent to the cloud for storing. There is a lack in minimizing the path to send the data to the base station. New concept of algorithm is needed for that.

Khandakar Entenam Unayes Ahamed and Mark A Gregory [5] proposed an infrastructure to integrate the cloud computing model with WSN. This framework gives approaches for managing user, access control, and storage of data. Sensed data form sensor in WSN goes to data repository and data processing unit through gateway. Unnecessary data will be processed for trimming. The formatted data is sent to the data repository for storage. Data along with index stored in publish/subscribe broker. Subscription will be created by Request Subscriber. Whenever the data is requested Event Matcher will find map between subscription requests and published data. Then mapping is over. Publish/subscribe broker will fetch data from data repository and allow the data to user through cloud's user interface.

However there is need of development of methodology for data processing, storage and retrieval of data.

Peng Zhang et al., [6] proposed an architecture by integrating WSNs with cloud. Here, a cloud acts as a virtual sink and collects sensing data from different points and for processing collected data, processing software is used in the cloud. WSNs are divided into zones. Size of sensors is reasonable, then sink will send by the commands to sensor nodes. Master/slave architecture is used in data processing system, in which master is responsible for storing data. Band width cost is reduced by comprising data with the help of compression mechanism called Hadop. Master node is connected to the internet and is the access point.

Chunsheng Zhu et al., [7] focused on integrating WSNs and mobile cloud computing. Here, sensors in WSN collect the data and give it to cloud. From the cloud mobile user will use the data. For the cloud, source is WSN and the data requester to cloud is mobile user. Here TPSS Scheme is used for integrating WSN with mobile cloud. It includes Time and Priority-based Selective Data Transmission for Wireless sensor networks gateway to transmit selected sensed information to cloud and priority -based sleep scheduling algorithm for Wireless sensor network to minimize the energy utilization so that it can collect and transmit.

Javier Barbaran and Manuel Diaz Bartoome Rubio [8] presented a frame work for integrating wireless sensor in the cloud. The basic idea of the framework is the concept of virtual channels which define communication between physical and virtual sensors. Those channels exchange messages between the virtual sensors and the cloud with less complexity, less computing and less battery utilization.

Sajid Hussian Shah et al., [9] proposed architecture that integrates a wireless sensor network to the internet using cloud. Long range destination is communicated by using short range communications protocol.

There is need of more security in integration of wireless sensor network to the internet using cloud which is very much essential for focus on critical issues.

Samer samarah [10] proposed a prediction model for integrating wireless sensor networks and cloud. The purpose of data prediction model is to send fine detailed summarized data to data centric center's by minimizing extra load on the sensors nodes for improving the performance of WSNs through reducing the lot of data to be sent to the cloud system.

However still there is need of several predication models to improve the performance of the WSNs when integrating with cloud.

Sanjit Kumar Dash et al., [11] surveyed applications of WSNs and cloud computing and discussed some issues of cloud computing and sensors network, to get single virtual wireless sensor network through cloud computing by combing WSNs of different applications under one roof.

Sanjit Kumar et al., [12] investigated the design and challenges for sensor clouds and proposed a framework for integration of sensor cloud. The idea in their frame work is WSNs of different applications are combined together as single through cloud considering it has distinct virtual WSN.

However, the success of the sensor cloud mainly depends on the capability of the sensor network and cloud, increasing the compatibility in the techniques and algorithm.

Nathalie Milton et al., [13] presented an architecture using which sensed data of different environment can be accessed by the different users for their requirements. Design of pervasive infrastructure contains Hypervisor, Autonomic Enforcer and Volunteer Cloud manager components. Hypervisor duty is to broadcast command, retrieve the data from the standalone sensors or from WSNs, abstraction of devices which are connected and virtualization of abstracted resources. Sensing devices are communicated with the help of adapter. Communication between nodes and cloud is by the Autonomic Enforcer. Volunteer Cloud manager centralized the sensors in a cloud Environment.

There is a need of high level of abstraction of sensing technologies and addressing the volatility of mobiles through volunteer based techniques.

Manuel et al., [14] surveyed different components for integration of different levels, analyzed different existing proposals, identified some challenges and research issues. They also presented survey on platforms and infrastructures needed for cloud, middleware for internet of things, and data analytics techniques for integration of internet of things with cloud computing.

Zhengguo Sheng et al., [15] proposed an approach for Management of Wireless sensor networks and COAP based management protocol to connect sensor devices through cloud for construction of prototype system.

There is need of efficient design of gateway to get better service and middleware design to transfer information when a sensed data is out of threshold.

3. SURVEY OF VARIOUS WIRELESS TECHNOLOGIES FOR INTERFACING WIRELESS SENSOR NETWORKS WITH CLOUD COMPUTING

In real world environment, to get more services from wireless technology to the users for different applications, single technology cannot possess properties like fast range of operation, maximum data rate, vast area of coverage, high level of security, safety, scalability and reliability. Users are also expecting systems like cheap and consume less power from wireless technologies devices. Hence they are classified by different parameters such as number of channels, frequency bands and access and modulation techniques,[16] etc. Some application in environment needs significant improvement in identification and monitoring by covering wider area. The use of better technology in combination with WSN and cloud gives the promising future for sensing data from sensors in WSN by identifying the situation properly and upload the data for cloud in efficient manner.

Table 1 Shows power consumption of short, medium and long range wireless technologies. Fig 1 shows the pictorial representation of power consumption of short, medium and long range wireless technologies. Table 2 Provide data rate comparisons among different range of wireless technologies and Fig 2 shows pictorial representation of Data rate of short, medium and long range wireless technologies Table 3: shows Survey of various Wireless Technologies for interfacing Wireless sensor networks with cloud computing and also Shows appropriate wireless technology cover wide area and to provide various services services for the diverse requirements.

By observing the figure.1 power consumed by long range wireless technology is high and figure.2 shows the data rate comparison of short, medium and long range wireless technologies. It is observed that, for the application of internet access WIFI is suitable because it gives high data rate. However, for monitoring and controlling, ZigBee and Bluetooth are better technologies. RFID is an effective identification technology and cellular technologies such as GSM, GPRS and UMLTS provides low data rates. WiMAX provides high data rate for long range communication. Hence, for interfacing Wireless sensor with cloud for uploading sensed data in reliable, secure, seamless communication manner, there is a need of selecting suitable wireless technology.

4. CONCLUSION

In this paper we have reviewed several papers which have integrated Wireless sensor network with cloud for uploading the sensed data from the sensors in a network in an efficient way to the cloud by using different technologies. Many of the existing works from different authors are widely reviewed which makes it possible for many of the users to have a direct conclusion about the technology that can be used for the specified application. Here selection of technology depends on different parameters based on limited consumption of power, desire range, well architecture, network span, security, suitable band width and number of channels. Hence it allows the user to select better technology. Different communication protocols and appropriate wireless technology cover wide area and to provide services for the diverse requirements. By the availability of wireless technologies and communication protocols all communication problems can be overcome by integrating the objects instead of people, to create a smart environment to upload the sensed data from WSNs to cloud.

5. REFERENCES

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6. APPENDIX

Table 1. Power consumption of short, medium and long range wireless technologies

Standard	Bluetooth	Zigbee	WIFI	RFID	WiMAX	GSM	GPRS	UMLTS
Nominal power	1 to 10	1 to 63.1	31.6 to 100	1 to 10	100 to 1000	500 to 20	500 to 200	500 to 600

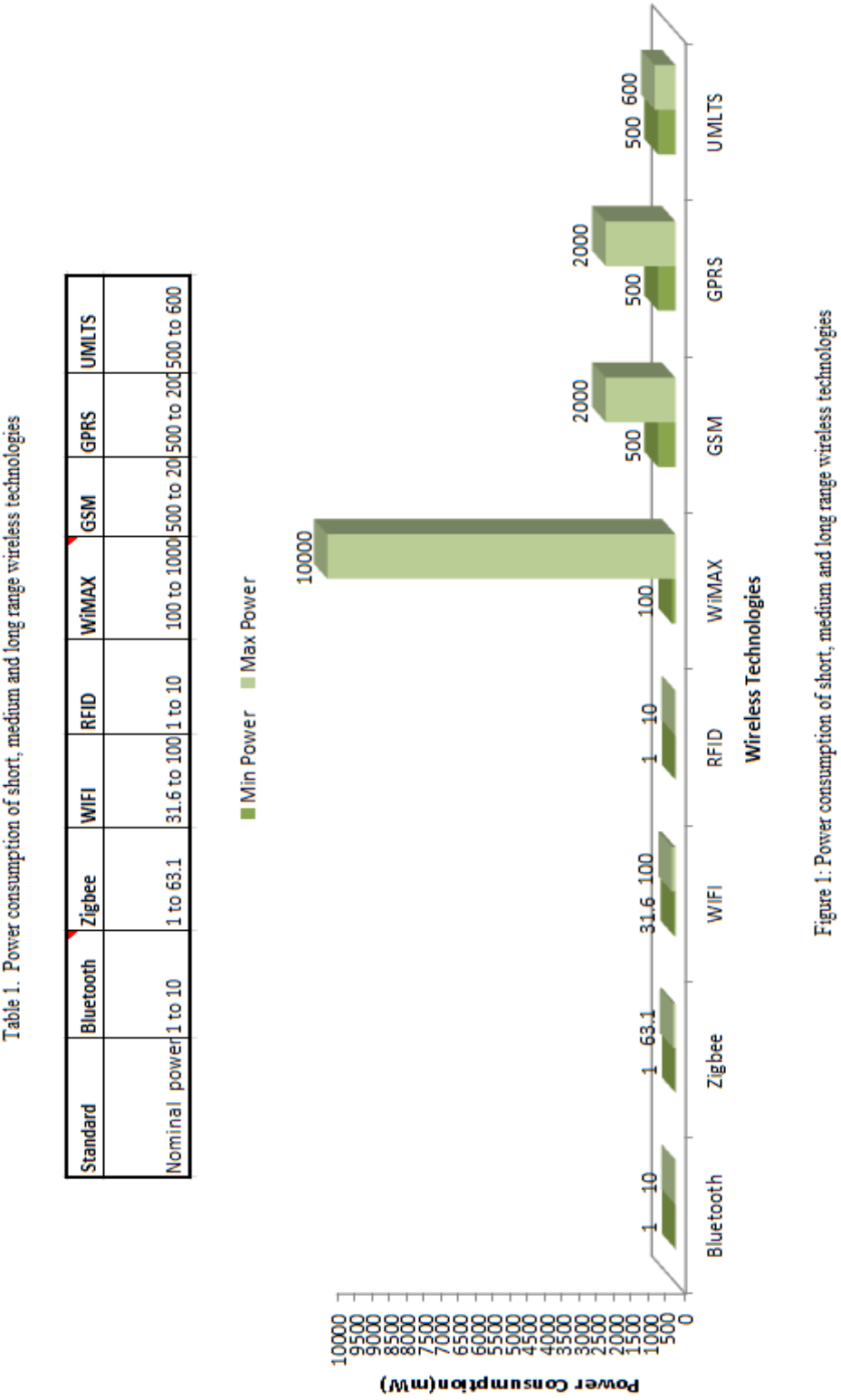

Figure 1: Power consumption of short, medium and long range wireless technologies

Table 2. Date rate of short, medium and long range wireless technologies

Standard	Bluetooth	Zigbee	WIFI	RFID	WiMAX	GSM	GPRS	UMLTS
Min. Bit	0.72	0.02	11	o.o4	30	0.0096	86.4	0.384
Max. Bit	1	0.25	54	0.04	50	0.0096	0.115	2

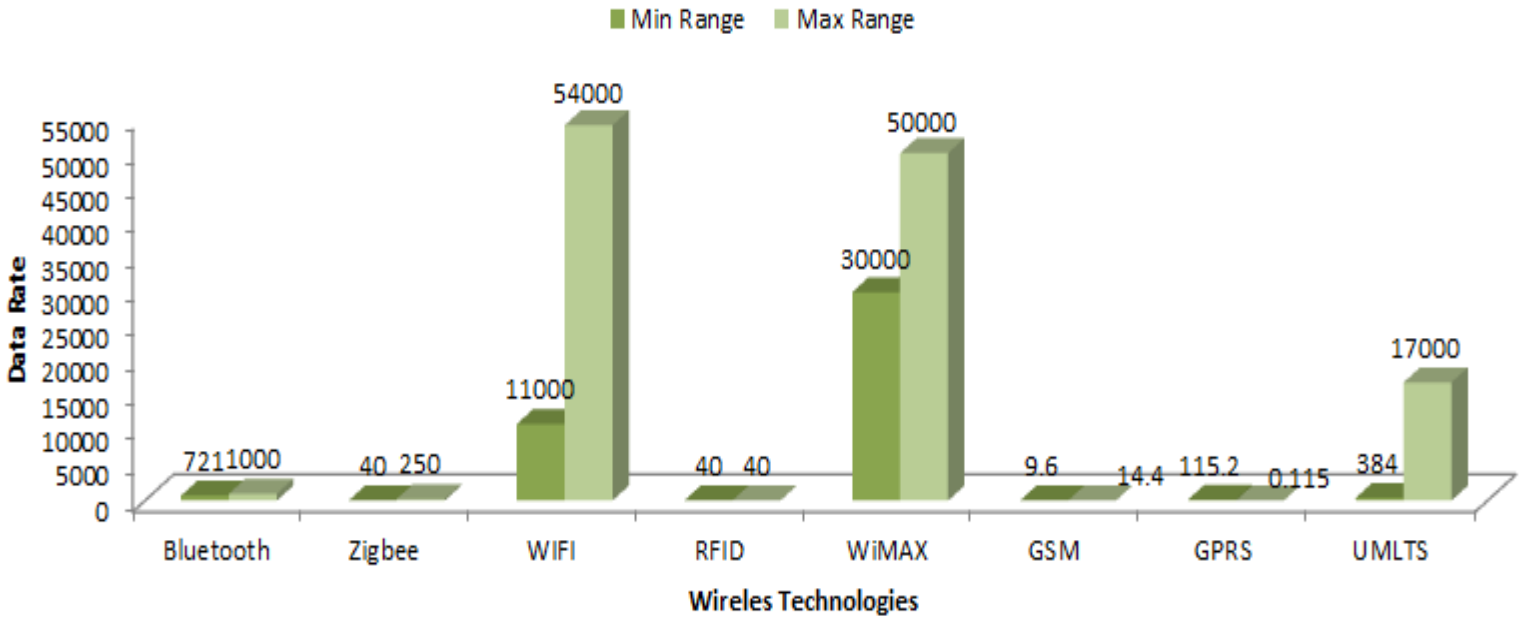

Figure 2: Data rate of short, medium and long range wireless technologies

Table 3. Survey on technologies need for interfacing WSNs with cloud

Standard	WiMax	ZigBee	Bluetooth	WiFi	RFID	GSM	GPRS	UMTS
Technology	Broadband MAN	LR-WPAN	WPAN	WLAN	LAN	2nd Generation	2.5 Generation	3rd Generation
Data Rate	30 Mb/s To 50Mb/s	250 kb/s	1 Mb/s	54 Mb/s	40 kb/s	9.6 Kb/s to 14.4kb/s	115.2 Kb/s	0.384 Mb/s to 02 Mb/s
Nominal Range	10-50 KM 1-5 m	10-100 m	10-100m	100m	1 to 10 m	0.5-35 km	0.5-35 km	0.1-10km
Channel Bandwidth	1.25-20 MHz	0.3/0.6 MHz 2 MHz	1MHz	22 MHz	200KHz	200KHz	200KHz	5MHz
Data Protection	AES CMAc MD-5 HMAC	16 bit CRC	16-bit CRC	32 -bit CRC	256	3-bit CRC with 1/2 convolution	3-bit CRC with 1/2 convolution	ANSI-41,SS7
Nodes	1	More than 65000	8	32	3 or more	7 cells/cluster 9,12,13	7 cells/cluster 9,12,13	1-7 cells
Acquisition Time of Node	100 ms	30 ms	3s	2s	Depends on Radio signal	Depends on GOS	Depends on GOS	Depends on GOS
Wake up time Node	100ms	15 ms	3s	1s	NA	NA	NA	NA
Topology	Point to Multipoint, Multipoint to Multipoint	Star, Mesh, Cluster-tree	Star, Piconet, Scatter-net	Star Topology	Multipoint to Multipoint	Multipoint to Multipoint	Multipoint to Multipoint	Multipoint to Multipoint
Category of Power	High	Low	Low	Low	low	High	High	High
Consumption of Power	100mW-10W 20-40 dBm	3.16 µW-1 mW -25 to 0 dBm	1-10m W 0-10dBm	31.6-100mW 15-20dBm	0.5-2 w 27-33dBm	0.5-2W 27-33dBm	0.5-2W 27-33dBm	600mW 27.78dBm
Range	Long	Short	Short	Middle	Middle	Long	Long	Long
Frequency Band	10-66GHz 2-11GHz	868/915 MHz 2.4 GHz	2.4 GHz	2.4 GHz; 5 GHz	860 to 960 MHz	900-1800 MHz	900-1800 MHz	1.92-1.98 GHz 2.11-2.17GHz
Encryption	128-bit AES 3-DES,EAP	40 bit RC4 block cipher	128- bit AES block cipher	128 bit RC4 Stream cipher (WEP)	AES Read/ Write protection, anti-cloning, and no encryption	A5 and A8 Algorithm	Token based, WAP, IPsec	Token based Security
Cost	Low	Low	Low	High	High	High	High	High
Security	Moderate	Moderate	Moderate	High	Moderate	High	High	High
Application	Interface with internet ,IOT server communicatio -n	Interface with internet IOT server , sensor networks building automation	Wireless connectivity between devices like phones, and sets, Sensor node, IOT application	Interface with internet IOT server communicate -on, IP camera, Gateway device	Inventory access, Tracking. of asset and item.	Sensor interface, smart city automation	Navigation, traffic condition, Location finder	Interface with internet IOT server communication