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A Review On: Protocols and Standards in Different Application Areas of IOT

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Abstract: Emerging Smart phones and smart systems are to give a whole new dimension to the way we shop, bank, and go about many of our everyday activities. The Internet of Things (IoT) shall be able to incorporate transparently and seamlessly a large number of different and heterogeneous end systems, while providing open access to selected subsets of data for the development of digital services. Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system. Today, application architects need to use a messaging broker to speed and scale their applications, in the particular cloud. Once we select our messaging middleware application, then application developers need to select the protocol. Finally, we provide our conclusions for the IoT communications based protocols and we have conducted their study in different application area.

Keywords: open access, link layer technologies, and heterogeneous end systems.

I. INTRODUCTION

The **Internet of Things** (**IoT**), also called Internet of Everything or Network of Everything, is the network of physical objects or "things" embedded with electronics, software, sensors, and connectivity to enable objects to exchange data with the production, operator and/or other connected devices based on the infrastructure of International Telecommunication Union's Global Standards Initiative. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure.

The Internet of Things (IoT) is a recent communication prototype that visualizes a near future, in which the object of everyday life will be equipped with microcontrollers, transceivers for digital communication that will make them able to communicate with one another and with the users, becoming an integral part of the Internet [1]. The IoT concept, hence, aims at making the Internet even more immersive and pervasive. Furthermore, by enabling easy access and interaction with a wide variety of devices such as, home appliances, surveillance cameras, monitoring sensors, actuators, displays, vehicles, and so on, the IoT will foster the development of a number of applications that make use of the potentially enormous amount and variety of data generated by such objects to provide new services to citizens, companies, and public administrations. This prototype finds application in many different domains, such as home automation, industrial automation, medical aids, mobile healthcare, elderly assistance, intelligent energy management and smart grids, automotive, traffic management, and many others [2].

II. RESEARCH MOTIVATION

The IoT is a term used for a huge wave of innovation originated in industries, but currently heading to urban centers, in-home environments, and individuals. Our main motivation was to create an IoT test-bed where to test communications protocols and also innovative applications that could be applied to a various scenarios. While searching for the appropriate application protocols to use, we found out that while comparisons can be found between two protocols, there is no paper over viewing all the possible alternatives with pros and cons. The main motivation of this paper is to fill this gap and provide a brief yet accurate description of the key protocols that are being used today to implement the IoT. The discussion is mainly on the protocols and standards being used alternatively or jointly to solve different needs of the communication between machines.

III. LITERATURE SURVEY

In this section, review of the selected literature on Internet Of Things (IOT) in different standards, protocols and their usage in different area using different application is mentioned.

Luigi Atzori a, Antonio Iera [1] paper addresses the Internet of Things. Main enabling factor of this promising prototype is the integration of several technologies and communications solutions. Identification and tracking technologies, wired and wireless sensor and actuator networks, enhanced communication protocols shared with the Next Generation Internet, and distributed intelligence for smart objects are just the most relevant. As one can easily imagine, any serious contribution to the advance of the Internet of Things must necessarily be the result of cooperating activities conducted in different fields of knowledge, such as telecommunications, informatics, electronics and social science. In such a complex scenario, this survey is directed to those who want to approach this

complex discipline and contribute to its development. Different visions of this Internet of Things are reported and enabling technologies reviewed. Here the highlighted point is assigning an IPv6 address to each IoT element so as to make it possible to reach them from any other node of the network, looks more suitable for the traditional Internet paradigm. Therefore, it is possible that the Internet evolution will require a change in the above trend. In this paper, authors have surveyed the most important aspects of the IoT with emphasis on what is being done and what are the issues that require further research. Current technologies make the IoT concept feasible but do not fit well with the scalability and efficiency requirements. The interest shown by industries in the IoT applications, in the next years addressing such issues will be a powerful driving factor for networking and communication research in both industrial and academic laboratories.

P.Bellavista [2] this paper uses smart environments, equipped with low-cost and easy-deployable wireless sensor networks (WSNs) and widespread mobile ad hoc networks (MANETs). These are opening brand new opportunities in wide-scale urban monitoring. MANET and WSN covers the way for the development of brand new Internet of Things (IoT) communication platforms with a high potential for a wide range of applications in different domains. Urban data collection, i.e., the harvesting of monitoring data sensed by a large number of collaborating sensors, is a challenging task because of many open technical issues, from typical WSN limitations (bandwidth, energy, delivery time, etc.) to the lack of widespread WSN data collection standards, needed for practical deployment in existing and upcoming IoT scenarios. Effective collection is important for classes of smart city services that require a timely delivery of urgent data such as environmental monitoring, homeland security, and city surveillance. After surveying the existing WSN interoperability efforts for urban sensing, this paper proposes an original solution to integrate and MANET overlays and collaboratively formed over WSNs, to boost urban data harvesting in IoT. Overlays are used to dynamically differentiate and fasten the delivery of urgent sensed data over low-latency MANET paths by integrating with latest standards/specifications for WSN data collection. The results show the feasibility and effectiveness (e.g., limited coordination overhead) of the proposed solution.

Andrea Zanella, Lorenzo Vangelista [3] paper focuses on urban IOT system. Urban IoTs, are designed to support the Smart City vision, this paper hence provides survey of the enabling technologies, protocols, and architecture for an urban IoT. It also presents the technical solutions and best-practice guidelines adopted in the Padova Smart City project, a proof-of-concept deployment of an IoT island in the city of Padova, Italy, performed in collaboration with the city municipality. The goal of Padova Smart City is to promote the early adoption of open data and ICT solutions in the public administration. The application consists of a system for collecting environmental data and monitoring the public street lighting by means of wireless nodes, equipped with different kinds of sensors, placed on street light poles and connected to the Internet through a gateway unit. This system shall make it possible to collect interesting environmental parameters, such as CO level, air temperature and humidity, vibrations, noise, and so on, while providing a simple but accurate mechanism to check the correct operation of the public lighting system by measuring the light intensity at each post. The monitoring of the correct operation of the bulbs is performed through photometer sensors that directly measure the intensity of the light emitted by the lamps. The wireless IoT nodes are also equipped with temperature and humidity sensors, which provide data concerning weather conditions, and one node is also equipped with a benzene (C_6H_6) sensor, which monitors air quality. This system involves a number of different devices and link layer technologies, thus being representative of most of the critical issues that need to be taken care of when designing an urban IoT.

Kary Fr¨amling, Sylvain Kubler [6] with Internet of Things (IoT), it should be possible to create *ad hoc* and loosely coupled information flows between any kinds of products, devices, computers, users, and information systems in general when and as needed. The paper presents necessary requirements for such interfaces, as well as proposed interface standards that fulfill those requirements. The paper describes the design principles and provides a high-level description of the proposed standards, followed by real-life implementations that illustrate why such standards are needed and how they are applied. Creating numerous IoT implementations in different domains, there is true need for sufficiently generic and generally applicable application-level IoT messaging standards. In this paper, set of requirements identified for such IoT messaging standards. The QLM-DF and QLM-MI specifications presented here are candidates for becoming that standard. A major purpose of this paper is to promote QLM standards. QLM-MI allows setting up *ad hoc* and flexible communication links that fulfill the requirements of most IoT-like applications; it should be a “safe choice” even for the early adopters. QLM-MI and QLM-DF can be applied to virtually any kind of information, i.e., not only physical products but also to documents.

Kary Främling, Ville Hinkka, Sagar Parmar [8] with increasing globalization and loosely-coupled business relations between different companies, the importance of information exchange standards is increasing. GS1’s Electronic Product Code Information Services (EPCIS) is currently one of the main standards proposed for interorganizational data exchange for trace and track purposes in the supply chain. However, some parts of the EPCIS framework are yet to be defined and the standard has to overcome some obstacles to be used as a global standard for trace and track applications. This paper tries to address the main question whether EPCIS has the potential to ‘take off’ as a globally accepted data-exchange standard.
But EPCIS is not used more universally

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- Companies may not be ready or willing to share information with other organizations. Most RFID success stories are mainly intra-organizational applications, where the use of EPCIS does not provide enough value for the cost that it causes.
- EPCIS is too tightly coupled with RFID and SCM focused, which makes it hard to extend for use in other parts of business, thereby limiting the potential profits that could be achieved.
- EPCIS is too complex or costly to implement compared to the benefits. Even though validated EPCIS implementations are provided by many software providers, the required implementation and systems integration may still be perceived as being too high.

Yi-Bing Lin, Yun-Wei Lin [9] *Internet of Things* (IoT) technologies have been used in applications for money flow, logistics flow, people flow, interactive art design and so on. To manage these devices and connectivity options, ETSI has specified end-to-end M2M system architecture for IoT applications. Based on this architecture an IoT EasyConnect system has been developed to manage IoT devices. a network application handles individual device features independently, then we can write a software module for each device feature, and the network application. In EasyConnect, the functions are used to develop device feature modules, which are easily created through Python script language, and can be executed immediately without compilation. attach IoT devices to EasyConnect, and how these attached devices can be easily linked to perform interesting interactions through a friendly GUI executed in a smart phone, a tablet, a notebook or a desktop. EasyConnect is especially powerful in creating interactive artworks and designs. We showed how home automation applications and artworks can be implemented through EasyConnect. As compared with the previously proposed approaches, the advantages of this approach are (1) the IoT functions are more easily modularized and re-useable, and (2) multiple input features can be flexibly and conveniently combined to affect the output device features. This paper provided appropriate IoT security managements for interactive design. According to the ETSI M2Mspecifications, keys can be derived hierarchically from the root key to a connection key then to an application key to ensure a maximum level of security.

A. P. Castellani, M. Dissegna [10] We know that the Internet has become a participative medium, which allows users to interact with one another and with the services from anywhere and at any time. Phenomena such as social networks and cloud computing are just two of the many innovative solutions that have been born from the Web 2.0. At the same time, a new class of users is establishing itself in the Internet landscape: with the Internet of Things (IoT), smart objects are becoming the new, and possibly the biggest, Internet community. In this paper, author has propose WebIoT, a novel web application framework, based on Google Web Toolkit, aimed at enhancing the interaction among things and between humans and things. Here the focus is on the following principles: thing-centric design, modularity and web service communications. The main components of the framework are described here, their interactions and how simple it is to develop any custom IoT application integrating any number and type of smart things. It is shown how different things can be integrated in the framework, how they interact and how users can exploit these interactions to develop any complex functionality. A typical HealthCare application for the IoT realized using WebIoT is described here.

P. Huss, N. Wigertz [11] This paper presents an flexible architecture for Internet of things utilizing a local manager to solve many issues. The component design and the communication between them are introduced here com. The Local Manager architecture consists of a gateway, Message Broker, Message Relay Bridge and several small applications (Apps) with different purposes. The Local Manager can be used as a platform for integration of things into cloud services via the Internet. Among various type of MBs RabbitMQ was the suitable candidate used for this purpose because of its maturity and open source availability. It has built-in support for many protocols and is designed for managing large number of connections. RabbitMQ utilizes a message protocol named Advanced Message Queuing Protocol (AMQP) which is a standard for message exchange between different systems. AMQP has a well-defined structure which focuses on - Security, Reliability, Interoperability, Open standard. AMQP is a binary, application layer protocol, message centric protocol.

Shifeng Fang, Li Da Xu [12] This paper introduces a novel IIS (Integrated Information System) for regional environmental monitoring and management based on IoT for improving the efficiency of complex tasks, the proposed IIS combines IoT, Cloud Computing, Geoinformatics (RS, GIS, and GPS), and e-Science for environmental monitoring and management with a case study of regional climate change and its ecological responses, which is one of the most hot topics in the scientific world. The results showed that it is greatly benefited from such an IIS, not only in data collection supported by IoT but also in Web services and applications based on cloud computing and e-Science platforms, and the effectiveness of monitoring processes and decision-making can be improved obviously. The integrative system introduced in this work is valuable for the perception, transformation, processing, management, and sharing of multisource information in environmental monitoring and management especially in the era of big data and IoT. A number of challenges limit the implementation of fully fledged IISs, such as the complexity of the IIS , the standardized processing and management of multisource data from multi-sensors, security and privacy challenges , efficient heterogeneous sensing , people centric sensing platforms, quality of service in cloud computing, new protocols and APPs, In conclusion, this paper provides a prototype IIS for environmental monitoring and management with a case study on regional climate change and its ecological responses in Xinjiang, China, and the results showed that

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water resource availability is the decisive factor with regard to the primary production of the terrestrial ecosystem in the area.

Runliang Dou and Guofang Nan [13] the paper shows, Representational State Transfer (REST) is not a protocol but an architectural style. REST uses the HTTP methods GET, POST, PUT, and DELETE to provide a resource oriented messaging system. Here all actions are performed by using the synchronous request/response HTTP commands. The content type can be XML or JSON (JavaScript Object Notation) and depends on the HTTP server and its configuration. It can be implemented in smart phone and tablet applications easily because it only requires an HTTP library which is available for all the Operative Systems (OS) distributions. RESTful services use the secure and reliable HTTP which is the proven worldwide Internet language. It can make use of TLS/SSL for security. Now a day's most commercial M2M platforms do not support HTTPS requests. Instead, they provide unique authentication keys that need to be in the header of each request to achieve some level of security. Even though REST is already used widely in commercial M2M platforms, it is unlikely that it will become a dominant protocol due to not being easily implementable. It uses HTTP which means no compatibility with constrained-communication devices. The current tendency for applications running on smart phones, tablets and pads, the additional overhead associated to request/response protocols affect battery usage, as it also does the continuous polling or long polling for values especially when there are no new updates and the overhead becomes useless. These issues can be avoided if a publish/subscribe protocol is used such as MQTT

Jamie M, Robinson [14] in this paper, by combining automatic environment sensing and experimental data collection with broker based messaging middleware; a system has been produced for the real-time monitoring of experiments. Changes in the laboratory environment are encapsulated as simple messages, which are published using an MQTT compliant broker. Clients subscribe to the MQTT stream, and perform a data transform on the messages; this may be to produce a user display or to change the format of the message for republishing. An MQTT client written for the Java MIDP platform can be run on a smart-phone with a GPRS Internet connection, freeing from the constraints of the network. Here it shows an overview of the technologies used, and how these are helping chemists make the best use of their time. The use of a message broker based approach gives best monitoring solution. The MQTT message broker provides message transmission reliability, the ability to distribute messages to a range of clients, and the ability to filter the message stream based on client requests. The availability of standard libraries eases the implementation of MQTT clients. By collecting and distributing data automatically, additional metadata can be provided to the experimental report.

IV. CRITICAL EVALUATION

TABLE I: SUMMARY OF VARIOUS APPLICATION AREAS OF IOT

Title	Techniques/algorithm/ Protocol used	Application area	Benefits/ conclusion
L. Atzori[1] (2010)- The internet of things: A survey	• Concept of data centric network, • Assigning Ipv6 address to each IOT element • Paradigm used is web squared evolution of web 2.0	Overall survey of Internet of things	Survey of what has done(protocol, algorithm solution) in IOT, and what is remaining
P.Bellavista[2] (2013)- Convergence of MANET and WSN in IoT urban scenario	Wireless Sensor Network (WSN) Wide Spread Mobile Ad Hoc Network (MANETS)	Urban monitoring, homeland security, city surveillances	It gives brand new IOT communication platform in different domains
A. Zanella[3] (2014) Internet of Things for Smart Cities	Used CoAP protocol and 6LoWPAN Wireless node equipped with photometer, benzene(C_6H_6) sensor Temperature & humidity sensor through gateway unit	Urban IOT Monitoring temperature, Humidity, light, benzene	Environmental data & public streetlight monitoring for smart city vision
K. Framling [6] (2014)- Universal Messaging Standards for the IoT From a Lifecycle Management Perspective	QLM standard QLM-DF and QLM-MI are its candidates	Setting ad hoc & flexible communication link for IOT application	• Creates ad hoc network between any kind of products devices, users & interface. • Can be applied to not only products but also documents
K. Framling [8] (2012)- Standards for inter-organizational tracking information exchange in the supply chain information control problems in manufacturing	Information exchange standard EPCIS-GSI's electronic product code information service	For trace and track purpose in supply chain	Global standard for trace and track application & successfully used for interorganizational data exchange

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Yi-Bing Lin[9] (2015) EasyConnect: A Management System for IoT Devices and Its Applications for Interactive Design and Art	End to end M2M architecture	Home automation application & artwork easy connect	IOT functions are more easily modularized & reusable Multiple input features can be flexibly and conveniently combined.
A. P. Castellani[10] (2012) – WebIoT: A web application framework for the internet of things	Web IOT based on Google web toolkit	Health care application to web IOT, Thing centric design and modularity web service communication	Integration of thing in framework which can interact with one another from any where any time
P. Huss,N. Wigertz [11] (2014) Flexible Architecture for Internet of Things Utilizing an Local Manager	AMQP protocol WSN Message Relay Bridge	Local manager implementation Remote control test heater	Local manager works as well as provides flexible solution for IoT Implementation of AMQP adds overhead to each massage
Shifeng Fang [12] (2014) An Integrated System for Regional Environmental Monitoring and Management Based on Internet of Things	IIS(Integrate Information System) with cloud computing, geoinformation(RS,GIS,GPS) & escience platform	Regional environment monitoring and management	• Case study for regional climate change & ecological respect • Benefits in large data collections& web service application
Vasileios Karagiannis [13] (2015) A Survey on Application Layer Protocols for the Internet of Things	HTTP used by REST	In request response application area	• Handles application running on smart phones, tab ,pads • Also does continuous polling and non polling
Jamie M, Robinson [14] Sensor Networks and Grid Middleware for Laboratory Monitoring	MQTT Protocol	In laboratory for monitoring environmental changes	• Provides message transmission reliability • Ability to distribute and filter message • Automatically collect & distribution of data and provide experiment of report

V. CONCLUSION

We studied that Internet of things (IOT) is a wide network having various application area for making city smart. Each application of IOT can be implemented using different standards and different protocols. We have gone through various standards and protocols and way they are used for specific application, but each one has some drawback for its technological differences. MQTT is a publish/subscribe, extremely simple and lightweight messaging protocol, designed for constrained devices and low-bandwidth, high-latency or unreliable networks. The design principles also minimize network bandwidth. It is an asynchronous publish/subscribe protocol on top of the TCP stack. Publish/subscribe protocols meet better the IoT requirements than request/response since clients do not have to request updates thus, the network bandwidth is decreases and the need for using computational resources is dropping. Each client can be a publisher that sends information to the broker at a specific topic or/and a subscriber that receives automatic messages every time there is a new update in a topic he is subscribed. Hence the paper comes to a conclusion that MQTT can be a reliable and most suitable protocol for IOT application areas that can publish real time message directly on the cloud.

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