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An Extensive Survey on IOT: Communication Protocols and its Applications

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ABSTRACT: IoT is an interconnected network of heterogeneous devices where these devices communicate with each other. This paper provides an overview of Internet of Things (IoT) with a communication protocols and application. At scratch, it provides an horizontal overview of Iot, and followed by overview of technical details that pertain to the communication protocols and its applications. Compared to other survey papers, our main objective is to provide a summary of relevant communication protocols and applications in Iot, so that researchers and application developers can know about how the protocols fit together to deliver functionalities without the help of standard specification. Finally, the overview for an application is also included.

KEYWORDS: Internet of Things (IoT), survey, communication protocols and applications.

I. INTRODUCTION

Internet of Things is a new technology which is widely used now-a-days. The internet of things make things communicate with each other through devices and this communication takes place over the internet. The main aim is to create an environment where all the electronic devices can be connected via Internet. The range of implementation of IoT in recent time has increased correspondingly. Implementation of IoT can improve the quality of lives [1]. There are various factors which plays a major role in implementation of such technology are security, privacy, sensing, data communication, integrity and authenticity [5].

IoT can be integrated to things which have the capability of using wireless network. It can be embedded in electronics using sensors and actuators connected via internet to exchange of data with one other [17]. IoT helps the objects to see, hear and do assigned tasks by communicating with one another[1]. IoT converts the traditional objects into smart by using the latest technologies available. Objects that are compatible to communicate using wireless network can be interconnected using Adhoc network to form a network in IoT. Objects that can be identified in a network using a digital name can be used in IoT.

Objects that can interact by sensing the other objects in a local environment of interconnected objects can be used in IoT. And those objects which can be accessed via remote channel to exchange data and services can also be used in IoT[4]. There should be a strong integration between the objects that are connected in a network. In the closed network security and authenticity plays important role, not any one can access the network and detect the operations of the objects only authenticated persons have permission for getting access [5]. The evolving Technology like IoT needs to have a undisturbed security to perform well in the economy.

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Fig 1: Internet of Things

Future of the IoT is expected to have significant growth in home and business applications which improves the quality of living and increases the economical growth. For the technology to reach such extent the service of the applications need to grow according to the increase of market demands [1]. The internet of things contains many sensors in order to facilitate the communication process. The protocols are classified based on the types of secret key [4].

IoT should be built using strong protocols to achieve such security triads. It must have a authentication protocol to ensure the credibility of the user to access the network [5]. It must avoid any network attacks that are tried to break in the network. The development of IOT also plays a development of the smart sensors, internet protocols and communication technologies.

II. PROTOCOLS

A. Message Queue Telemetry Transport (MQTT):

MQTT is simple, light weight and messaging protocol, designed by Andy Stanford- Clark of IBM and Arlen Nipper of Arcom (now Eurotech) [1]. The main aim of MQTT is to connect networks and embedded devices with middleware and applications. MQTT follows the publish/subscribe pattern to provide a simple implementation and transition flexibility as depicted in Fig. 2[1]. It consists of three components, subscriber, publisher, and broker. The publishers are sensors that collect the data and send it to the broker. The broker informs the interested subscribers that new data's are available. The publishers after sending the collected data to the broker go to sleep to as soon as possible in order to save battery power[8]. This protocol has three qualities of service for message delivery, they are, At most once - where messages are delivered according to the best efforts of operating environment. Second, At least once - where message are arrived but duplicate messages can be occurred. And finally, Exactly once - where message are arrived exactly once.[12]. MQTT supports the network with low bandwidth and high latency. It minimizes transport overhead and protocol exchange in order to reduce network traffic. Two major specifications exist for MQTT: MQTTv3.1 and MQTT-SN [8].

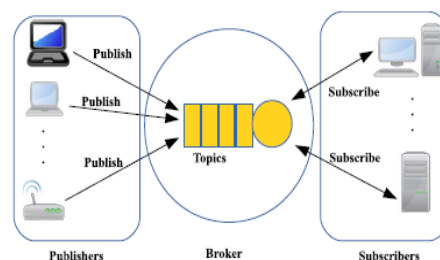


Fig 2: MQTT Architecture[1]

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B. Constrained Application Protocol(CoAP):

CoAP is an application layer protocol. It was created by the Internet Engineering Task Force (IETF) Constrained RESTful Environment (CoRE) and designed for providing a lightweight RESTful interface. In terms of computation and power consumption, REST will have overhead for lightweight applications such as in IoT. In order to avoid overhead in light weight applications, CoAP allows devices to access REST to maintain power constraints.[5]. REST represents a simple way to exchange data's between clients and servers through HTTP[1]. REST does not require any XML to exchange messages. . The overall functionality of CoAP protocol is demonstrated in Fig.3

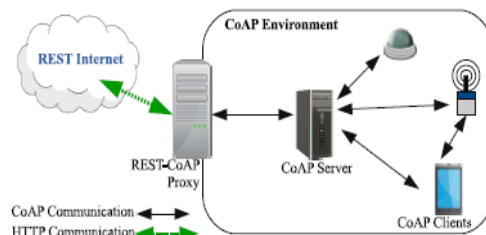


Fig 3: CoAP Functionality[1]

CoAP supports group communication and push notification , but broadcasting message cannot[10]. CoAP employs four category of messages fig 4: conformable, non conformable, acknowledge and reset. It provides some important features like Resource observation, Block-wise resource transport, Resource discovery, Interaction with HTTP, Security [8].

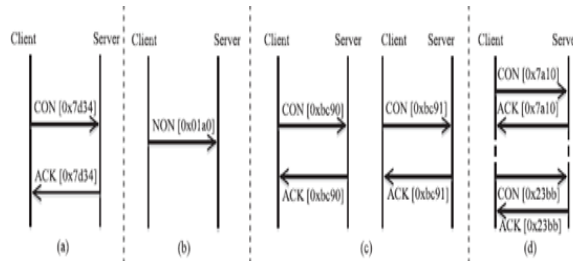


Fig 4: a) conformable b) non conformable c)acknowledge d)reset.[1]

C. Extensible Messaging and Presence Protocol (XMPP):

XMPP is a messaging protocol that can be used for video calling, voice calling and telepresence [1]. It was developed by the Jabber open source community and it supports an open, spam free , secure and decentralized messaging protocol. It uses Extensible Markup Language (XML) format for communication process. XMPP allows IM applications to achieve privacy measurement, authentication, hop-by-hop ,access control and end-to-end encryption, and compatibility with other protocols. Fig. 5 represents the behavior of XMPP[1]. In XMPP, the three roles are included: client, server, and gateway, as well as bidirectional communication is supported . The server achieves functionality of message routing and link management, the gateway supports the stable communication, and the client is connected to the server based on TCP/IP protocol and transmit context based on XML streaming protocol. XMPP supports the object to object communication with XML-based text messages, low latency message exchange and has TLS/SSL security[8].

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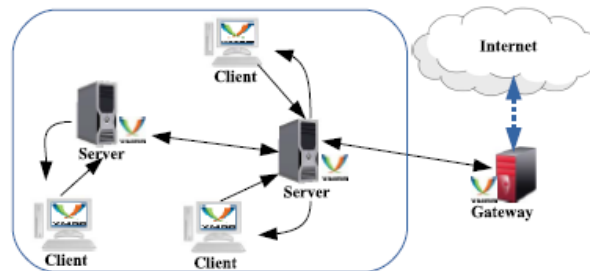


Fig 5: Communication in XMPP[1]

D. Advanced message queuing protocol (AMQP):

AMQP is an enhanced version of MQTT. It is an open standard message queuing protocol and provides message services like queuing, routing, security and reliability, etc. in the application layer [10]. The main difference between MQTT and AMQP is that in AMQP the broker consists of more than one subscriptions (queues). The publishers publish data to the broker that maintains it in a queue (subscription). A subscriber can subscribe to one or more subscription. Figure 19 shows the behavior of AMQP[5]. AMQP implements various message exchange architectures, including publish and subscribe, message distribution, store and forward, point-to-point routing, message queuing and context-based routing [10].

E. Very simple control protocol (VSCP):

VSCP is an automation protocol that is suitable for all sorts of automation jobs among which home-automation. In a VSCP network, the individual nodes are connected by physical layer (wired bus, radio link, ...) to form the automation network[14]. VSCP is a distributed system having all nodes that are autonomously working. On the bus there can be nodes that reads switches, there can be nodes that control lamps, and nodes that read temperature. All share the common framework and message field. Figure 6 represents the working of VSCP.

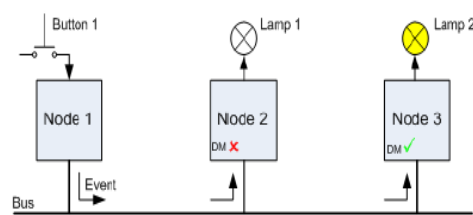


Fig 6: VSCP[14]

VSCP is an event-based. Every time an event occurs, it broadcasts to all other nodes in the network. Each node decides on its own whether the event is to be processed or not. This decision depends on node's decision matrix.

F. Simple text orientated messaging protocol (STOMP):

In STOMP the wire format is interoperable where communication of clients takes with the help of message broker to provide easy and widespread messaging interoperability among many brokers platforms, and languages. Table 1 represents the comparison table for different protocols



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TABLE I.COMPARISON TABLE FOR DIFFERENT PROTOCOLS

	TRANSPORT	PARADIGM	SCOPE	DATA CENTRICITY	SECURITY	FAULT TOLERANCE
MQTT	TCP/IP	Publish/ subscribe	D2C	undefined	TLS	Broker is the SPoF
CoAP	UDP/IP	Request/ reply[REST]	D2D	Encoding	DTLS	decentralized
XMPP	TCP	Publish/ subscribe Request/ Response	D2C, C2C	undefined	TLS+ SASL	Server in SPoF
AMQP	TCP/IP	Point-to-point message exchange	D2D D2C C2C	Encoding	TLS	Impl. specific
STOMP	TCP	Publish/ subscribe	D2C,C2C	undefined	DTLS	Broker is the SPoF
VSCP	TCP/IP	Event based protocol	D2C	undefined	TLS	-

III. APPLICATIONS

A. Smart grid:

The demand of electricity in traditional days has been done with the help of electricity producing sources such as gas, coal and petrol, but these sources will release green house gases that causes climate change in the atmosphere. Now a days the future demand of electricity has been increased this requires expansion and modernization of the power system worldwide. In this scenario the concept of smart grid is used this offers a reliable power supply system[15]. The reliability is achieved with the help of smart meters, distributed energy generators, electric vehicles. For example smart meter will monitor storage, consumption of energy and generation of energy, and it can interact with the utility providers about the customers energy demand and real time electricity pricing to the customers[10].

B. Smart Transportation

In smart transportation the transportation systems are made reliable with the help of communication networks, computing techniques, control systems, intelligent transportation management, this makes the transportation system more secure and efficient. The smart vehicles are connected with each other with the help of wireless networks. One of the example of smart vehicle is google's self driving car which can manage the speed when travelling without the help of driver and it can also detect objects that are around them [10]. Location based scheme has been used in smart transportation in which the user location is send to the server which in terms offers service based on their location [16] Here Fig represents the domain and services of the smart environment.

C. Smart cities

The service demand in the cities depends on enhancing the quality of life and to make more efficient services. In smart cities the IOT is very helpful in collecting the live status report of the people and to help them during the disasters such as volcano and earthquake. By making the smart cities it will become more easy to monitor the cities and it is also helpful in the improvement of services like consumption of energy, managing traffic and water resource [17]. Several services provided by smart city include smart health, environment monitoring, waste management, smart lightning etc [10].

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D. Smart home

The devices in smart home communicate with each other through digital devices. These devices communicate with each other irrespective of the time and place. The smart home contains smart devices such as for air conditioning, security systems, lightning, heating, ventilation etc [18]. The smart home offers streaming of video and audio and the smart home is a subcategory of smart city [19].

E. Health care

In health care the IOT plays a major role in providing services that are benefit to the user. For example, wearable IOT such as smart watches are used along with the sensors namely radiation detector sensors, blood pressure monitoring sensors to track of every day record of the user [20]. These smart wearable devices are very useful for the patients who are in need of collecting information about the heart beat, glucose level, blood pressure these are measured with the help of sensors and these recorded information are sent to the smart phones. In these ways the health status of the patients can be monitored [21]. Table II represents the comparison table for different applications

TABLE II: COMPARISON TABLE FOR DIFFERENT APPLICATION

	SMART HOME	SMART OFFICE	SMART RETAIL	SMART CITY	SMART AGRI	SMART ENERGY & FUEL	SMART TRANSPORTATION	SMART MILITARY
NETWORK SIZE	Small	Small	Small	Medium	Medium/ Large	Large	Large	Large
NETWORK CONNECTIVITY	WPAN, WLAN, 3G,4G	WPAN, WLAN, 3G,4G	RFID, NFC, WPAN, WLAN, 3G,4G	RFID, NFC, WLAN 3G,4G	WLAN, SATELLITE COMM, INTERNET	WLAN, 3G,4G, MICROWAVE LINKS, SATELLITE COMM	WLAN, 3G,4G, SATELLITE COMM	RFID, NFC, WPAN, WLAN, 3G,4G, SATELLITE COMM
BANDWIDTH REQ	Small	Small	Small	Large	Medium	Medium	Medium-Large	Medium Large
SERVICES	Entertainment, Internet access	Secure File exchange, Internet access, VPN, B2B	Customer Privacy, Business Security, Business Transaction, B2B	City Management, Resource Management, Police network	Area monitoring, Condition Sensing, fire alarm, trespassing	Pipeline monitoring, tank monitoring, power line monitoring	Traffic Status Monitoring Traffic light monitoring	Command and control, Sensor Network, Security Information

IV. CONCLUSION & FUTURE WORK

The emerging idea of the Internet of Things (IoT) is rapidly finding its path throughout our modern life, aiming to improve the quality of life by connecting many smart devices, technologies, and applications. In this survey a comprehensive review of IoT has been presented, including protocols and applications. Particularly, the relationship and difference between each protocols and applications has been clarified at the outset. The main purpose of this survey is to provide a clear, comprehensive, and deep understanding of IoT.



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REFERENCES

- [1] Ala Al-Fuqaha, Mohammed Aledhari, "Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications," vol. 17, no. 4, fourth quarter 2015 IEEE.
- [2] Rajkumar S C Dr.L.Jegatha Deborah, "Survey: Handling on Difficulties in Internet of Things (IoT) Applications and its Challenges", 2017.
- [3] DoaaAlrababah, Esraa Al-Shammari, AreejAlsuht, "A Survey: Authentication Protocols or Wireless Sensor Network in the Internet of Things: Keys and Attacks," Princess Sumaya University for Technology Amman, Jordan, 2017 IEEE.
- [4] Pallavi K N, Dr. Ravi Kumar V, Chaithra B M, " Smart Waste Management using Internet of Things: A Survey", 2017.
- [5] Muhammad Junaid, Munam Ali Shah, Imran Abbas Satti, " A Survey of Internet of Things, Enabling Technologies and Protocols ",2017.
- [6] Ms. M. Joharan Beevi, "A Fair survey on Internet of Things (IoT)".
- [7] Radia BELKEZIZ, Zahi Jarir, " A Survey on Internet of Things Coordination",2016.
- [8] Gaurav Choudhary, Dr. A.K.Jain, " Internet of Things: A Survey on Architecture, Technologies, Protocols and Challenges," National Institute of Technology, Jalandhar, India, 2016 IEEE.
- [9] Surapon Kraijak, Panwit Tuwanut, " a survey on iot architectures, protocols, Applications, security, privacy, real-world Implementation and future trends ".
- [10] Jie Lin, Wei Yuy, Nan Zhangz, Xinyu Yang, HanlinZhangx, and Wei Zhao,"A Survey on Internet of Things: Architecture, Enabling Technologies, Security and Privacy, and Applications," 2017 IEEE.
- [11] Ankush B. Pawar Dr.Shashikant Ghumbre, " A Survey on IOT Applications, Security challenges and counter measures",2016
- [12] Iman Khajenasiri , Abouzar Estebsarib, Marian Verhelsta, Georges Gielen, " A review on Internet of Things solutions for intelligent energy control in buildings for smart city applications",2016.
- [13] Sajjad Hussain Shah, Ilyas Yaqoob,"A Survey: Internet of Things (IoT) Technologies, Applications and Challenges", 2016.
- [14] [18https://en.wikipedia.org/wiki/Very_Simple_Control_Protocol](https://en.wikipedia.org/wiki/Very_Simple_Control_Protocol).
- [15] M.A. Ponce-Jara , E. Ruiz , R. Gil , E. Sancristobal , C. Perez-Molina , M. Castro," Smart Grid: Assessment of the past and present in developed and developing countries", 2017.
- [16] Jiaping Lin1, Jianwei Niu1 ☆, Hui Li2, Mohammed Atiquzzaman3,"A Secure and Efficient Location-Based Service Scheme for Smart Transportation",2017.
- [17] Mohammad Saeid Mahdavejad1, Mohammadreza Rezvan2, Mohammadamin Barekatin3, Peyman Adibi4, Payam Barnaghi5, Amit P. Sheth, "Machine Learning for Internet of Things Data Analysis: A Survey",2017.
- [18]] Mussab Alaa2, A.A.Zaidan1,2* , B.B.Zaidan1,2, Mohammed Tala2, M.L.M. Kiah2,"A Review of Smart Home Applications based on Internet of Things",2017
- [19] Iman Khajenasiri, Abouzar Estebsari, Marian Verhelst, Georges Gielen,"A review on Internet of Things solutions for intelligent energy control in buildings for smart city applications".2016.
- [20] Richard K. Lomotey, Joseph Pry, Sumanth Sriramoju,"Wearable IoT Data Stream Traceability in a Distributed Health Information System".
- [21] Bahar Farahani, Farshad Firouzi, Victor Chang, Mustafa Badaroglu, Nicholas Constan, and Kunal Mankodiya,"Towards Fog-driven IoT eHealth: Promises and Challenges of IoT in Medicine and Healthcare",2017
- [22] S. M. Riazul Islam, DaehanKwak, Md. HumaunKabir, Mahmud Hossain, And Kyung-Sup Kwak," The Internet of Things for Health Care: A Comprehensive Survey," The University of Alabama at Birmingham, AL 35233, USA volume 3, 2015 IEEE.
- [23] Sheikh Ferdoush, Xinrong Li "Wireless Sensor Network System Design using Raspberry Pi and Arduino for Environmental Monitoring Applications," Department of Electrical, University of North Texas, Denton, Texas, 76203, USA.
- [24] Shu-Tyng Lin, Wei-Hao Chen and Yuan-Hsiang Lin," A Pulse Rate Detection Method for Mouse Application Based on Multi-PPG Sensors," Department of Electronic and Computer Engineering, National Taiwan University of Science and Technology, 2017.
- [25] Shadi Al-Sarawi, Mohammed Anbar, Kamal Alieyan, Mahmood Alzubaidi," Internet of Things (IoT) Communication Protocols: Review," University Sains Malaysia, 2017, IEEE.
- [26] <https://www.rsonline.com/designspark/eleven-internet-of-things-iot-protocols-you-need-to-know-about>
- [27] <https://www.elprocus.com/different-types-of-microcontroller-boards/>
- [28] ArshdeepBahga, Vijay Madiseti, "Internet of things: a hands-on Approach," 2014.
- [29] Ahmed, Mobyen Uddin, Begum, Shahina, "Internet of things (IoT) Technologies for Health care," France, October 2017.
- [30] P. Gope and T. Hwang, "BSN-care: A secure IoT-based modern healthcare system using body sensor network," IEEE Sensors J., vol. 16, no. 5, pp. 1368_1376, Mar. 2016.
- [31] Y. Kawamoto, H. Nishiyama, N. Kato, Y. Shimizu, A. Takahara, and T. Jiang, "Effectively collecting data for the location-based authentication in Internet of Things," IEEE Syst. J., vol. PP, no. 99, pp. 1_9, Sep. 2015, doi: 10.1109/JSYST.2015.2456878.