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RESEARCH ARTICLE

A REVIEW OF THE MOST IMPORTANT TECHNOLOGIES USED IN "IOT" ARCHITECTURE.

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Abstract

Domain of Internet of Things "IoT" aims the human by the smart resolutions via Machine-to-Machine "M2M" connection in whole of world, efficiently. This was hard for ignoring internet of things domain importance field by novel applications deployment like the smartphone in current age.

Most important layer in "IoT" architecture of internet of things is the layer of network, due to the different systems (gateway, perform of cloud computing, switching, hub and so on), different technologies of connection (WiFi , Bluetooth, Long-Term Evolution (LTE), and so on) united in the layer. Layers of network must transfer information to / from the various applications /objects, via gateways / interfaces between the networks which are heterogeneous, also utilizing different technologies of connection, protocols.

The current study highlighted the state-of-the-art of "IoT" technologies used in the "IoT" architectures and the variations between them in addition to their applications in life.

Introduction:-

Sensing progresses, connection, computing altered internet to the individuals to IoTs. The internet of things consists of actuators, sensors that are mounted in daily things which are able to outright decision making, connection. Those sensors are bandwidth, power restricted by the healthcare applications, transportation, automatic, industrial, smart-home areas.

When the restricted developments the technology of battery lost for holding by improvements in the devices of computing, request to organizing the consumption of power has become important. Previously, the organization of power needs designs to assess consumption of devices power in internet of things, (1).

As more and more "IoT" devices are connected and communicated, "IoT" applications generate tremendous "IoT" traffic, since "IoT" traffic is for the communication between objects, the transmission reliability is critical, especially in a relatively unstable WSN, compared with wired network. "IoT" technology is applied in many domains, including environmental monitoring, transportation, automotive vehicles, industry, medical technology, healthcare, smart home, and smart city,(2).

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Technologies of internet of things must presents the internet connection which is safe, continuous, technologies of connection are internet of things systems basic also present the integrity connection for internet letting the devices for changing information across network, (3).

The connection in small-board, ZigBee, RFID, Wi-Fi, Bluetooth might be the logical answer. Furthermore, to the large-board connection like automation of industrial, the technologies of Cellular, ZigBee, (4). WiMAX to the sample mobile phone can be an optimal selection, (3&5).

Furthermore, prevailing impediments in the technologies of large-board connection are the high primary costs of annuity, the communications restricted amount, the high costs to the end-users. In another word, the small connection hardware devices have a profit, while they are smaller, cheaper, and also easy for set up, (6).

Necessary technologies in the architectures of internet of things in the healthcare were low-board technologies of connection like, Bluetooth (58.3%), ZigBee (25%), Wi-Fi (75%), RFID (37.5). Furthermore, 6LoWPAN was major protocol that utilized in articles (33.33%). The protocol empowers sensor networks communication by internet, has planned for guaranteeing sensor networks interoperability, also internet, (7).

In the internet of things, there are different technologies for communicating and interacting things with each other or with the internet, that here we introduce the latest technologies that provided for its implementation.

Bluetooth and Bluetooth Low Energy

Presented in the year 1999, the technology of Bluetooth is the wireless technology that is known to the capability for transmitting information across the distances which are short in the private domains of networks. Bluetooth Low Energy "BLTE" is the new add for technology of Bluetooth, expends over the Bluetooth Classic device half power, Bluetooth main version. BLTE energy output is ascribable for time of shorter required to devices of BLTE for determining the other devices: 0.6 to 1.2 milliseconds (ms) in comparison with 22.5 ms to the Bluetooth Classic (8).

Furthermore, data effective transfer along with transferring, collecting situations empowers the BLTE for delivering higher efficiency of energy in comparison with Bluetooth Classic. The higher energy efficiency becomes in lower data rates cost: BLTE protects the 260 kilobits per second (Kbps) since the Bluetooth Classic protects up to 2.1 Mbps, (9).

Existence influence, paired to the low-cost devices, states BLTE like the technology appropriated to the applications of the internet of things. Although, the stable bottleneck is interoperability now and: the BLTE is agreeable to just comparatively recent Bluetooth devices in dual-mode (known as dual mode due to that, they protect the Bluetooth Classic and BLTE), not Bluetooth Classic devices of legacy, (8).

Wi-Fi and Low Power Wi-Fi

However, the Ethernet has utilized in 1970s, the Wi-Fi is the new technology of wireless which is famous largely, also popular as the data transfer rates in high-speed privately, the arranged domain networks.

Normally, devices of Wi-Fi remain secret, and delays in data transmission, and low with keeping mobile while any information is transferred. These communications of Wi-Fi are sometimes install by the specialized line of power and batteries which require for being undertake after the usage couple of hours. The devices in higher-cost, lower-power Wi-Fi “sleep” while it is not transferring any information, require only 10 milliseconds for “waking up” while it called up , The Low Power Wi-Fi by the batteries is able to be utilized to the feeling remotely, also controlling the applications, (10).

Worldwide Interoperability for Microwave Access (WiMAX), WiMAX 2

Provided in the year 2001, WiMAX deployed with ETSI at the collaboration by IEEE. The newest technology in WIMAX family is WiMAX 2. The WiMAX 2 suggests high-speed data in 1 Gbps in comparison with 100 Mbps with WiMAX, (11).

Furthermore, for the higher-speed of data, the WiMAX 2 has the better backward agreement rather than WiMAX: the operators of WiMAX 2 network are able to present the integrated service with utilizing the 3G or 2G networks while it is needed. In the comparing, LTE, LTE-A, that presented in following, let the backward agreement, (12).

Long Term Evolution "LTE" and "LTE" -Advanced
LTE is the wireless network technology in large-domain, which was deployed with the 3rd Generation Partnership Project body members in the year 2008. The technology provides speeds of information data speeds up to 300 Mbps.

LTE-A is new add for the technology of LTE which suggests data rates in still-higher in 1 Gbps in comparison with 300 Mbps with the LTE. Here is debate between occupying of industry in whether the LTE is properly a technology of 4G or not: majority think that the LTE is technology of pre-4G, also LTE-A is the proper technology of 4G. regarded the high-bandwidth, the low secret, the LTE is attracted users like technology of more-promising to the applications of the internet of things; although, infrastructures of underlying network keeps under the deployment, like it provided in following challenges, (13).

Weightless
The Weightless is the technology of wireless open-standard WAN which is provided in the first of the year 2014. The Weightless utilizes the unutilized bandwidth mainly aimed to the broadcast of TV for transferring data; the active range assignment technical progress-based, this is able to revolve to the distances which are larger, penetrating via the walls.

The Weightless is also able to present rates of information among 2.5 Kbps to 16 Mbps in the range of wireless up to 5 kM, by the batteries remaining for 10 years. The devices of Weightless keep at the state of replacement, wake up each 15 min, remaining dynamic to 100 milliseconds for agreement, work on each messages; it guides to the sure secret. According to such features, the communications of Weightless dawn to for being well-proper to handing over the short messages in the widespread M2M connections, (14).

Zigbee
Zigbee is the technology of wireless network that especially planned to the sensors in low-rate the protocol of it consists a layer which is physical, the layer of MAC, layer of network, as well as layer of application. The layers of MAC, physical depending on the standard of IEEE 802.15.4, since layers in up specialized in the distinction of itself. In layer of network, the ZigBee determines 3 kinds of devices. The router of ZigBee is FFD by the capabilities of routing. In every network of ZigBee, a coordinator of ZigBee exists, that is the monitoring of FFD whole the network. End-device is the final kind of device. 3 topologies protected with the networks of ZigBee: tree, start, also mesh topologies. The efficiencies in the network of ZigBees layer integrate the routing which is hybrid-hop, the detection of route, security, keeping, leaving, joining to the network that 16-bit addresses allocated for newly connected the devices,(15).

Z-Wave
Z-Wave is the protocol of wireless connections that early guide is allowing a transferring which is reliable of one unit of control to the 1, much more nodes in network, this consists of 5 layers in the architecture of itself: MAC, PHY, routing, transmit, layers of application. Radio of Z-Wave necessarily acts in the bands which are near band of 900 MHz ISM. Still, the areas have different rules. Like, 868 MHz has utilized in Europe since 908 MHz has utilized in US. The frequency of FSK by the channel of Manchester encrypting is used. Early, a protocol provided by rate of data in 9,600 bits in each second, still this is recently developed to 20Kbps. Layer of MAC uses encounter abstinence by the re-transferring which is facultative mechanism ACKs-based. Layer of is computable to data transfer among 2 nodes. Contained characteristics are re-transfer, confirmations, checksum. 2 kinds of devices specialized with Z-Wave: slaves, controllers. The controllers send order to slaves, that reply/perform orders. The slaves might also work like the routers which save routes which are static, (15).

Lowpan
LOWPANs are the networks that are wireless consist of low-cost machine great amount which adapt to IEEE 802.15.4 features to layers of physical, MAC. Comparison to the wireless networks, the LOWPAN compromise like low bandwidth, devices in great amount, low-power, short-sizes of package, the unreliability of drain of battery, the problems of radio connection, physical intervention, lockups of devices (16). While it composed to IP, although, LOWPAN restrictions pleased. So, the 6LoWPAN is exist.

6LoWPAN is the protocol that the packages of IPv6 are able to be transmitted across the networks of IEEE 802.15.4. 6LoWPAN will have a lot of advantageous in comparison by using the protocols which are non-standard such as ZigBee/Z-Wire, (17):

1. At first, the gateways are not necessary for translating the messages among different protocols which are non-standard when whole of the WSNs use an IP which is standard.
2. The flexibility raised as the novel applications will not require the correction to the allocated protocols in WSN.
3. The other advantageous integrated fast connection, agreement by the architectures which are pre-existence, WSNs installation of plug-and play, applications quick development in addition uniting objects feasibility by existence of the services of Web which usage internet protocol.

For creating 6LoWPAN as the fact hard, this will need having every node require for agreeing to same protocol. Recent WSN protocols great amount constrained protect to can act via the interfaces that are standard (15). So, the complexities enhance to form the different protocols of WSN which connect to an internet that is wider. The remarkable assets of software, hardware may be necessary for transferring the protocol data of WSN for the relevant standards like TCP/IP. The answers solutions might add an overhead to transmission of data, efficiency of reduction. Like the protocols of WSN should be made for protecting IPv6, presently, the layers of software bridging different performances of 6LoWPAN should allow the connection of inter-device. Final internet of things purpose, although is having the performance fully practical.

Smart tag technology "RFID"

Smart tag technology or "RFID" refers to such systems that use radio waves to transmit information about the identity of a thing. These tags are more advanced types of barcodes, because they have both reading and writing capable, the data stored on RFID tags, can be changed, updated or even locked .This technology has succeeded in proving its capability and efficiency as an affordable tool for improving performance and reducing time and cost of manpower and resources in many cases. In a general scenario, when the manufacture parts arrive in processing step, by the tag reader, an event such as reading the RFID number and storage, gives us important information. Machine/robot will be informed by the event and will include the production part, (18).

NFC

It is considered as one of the most useful RFID subsets. NFC or Near Field Communication, is a new communication capability that can be used to securely connect between two devices that are at a short distance from each other. In addition to the adjacently of two gadgets, it is necessary for both of them to use special hardware. In fact, NFC is the latest version of RFID that its communication range limited to 4 inches .This makes NFC very useful for sensitive usages such as using credit card (like electronic payment by using Google Wallet) or entering security locations. The devices that support NFC technology can easily allow users to send or exchange information by touching or approximating their devices to another device, (19).

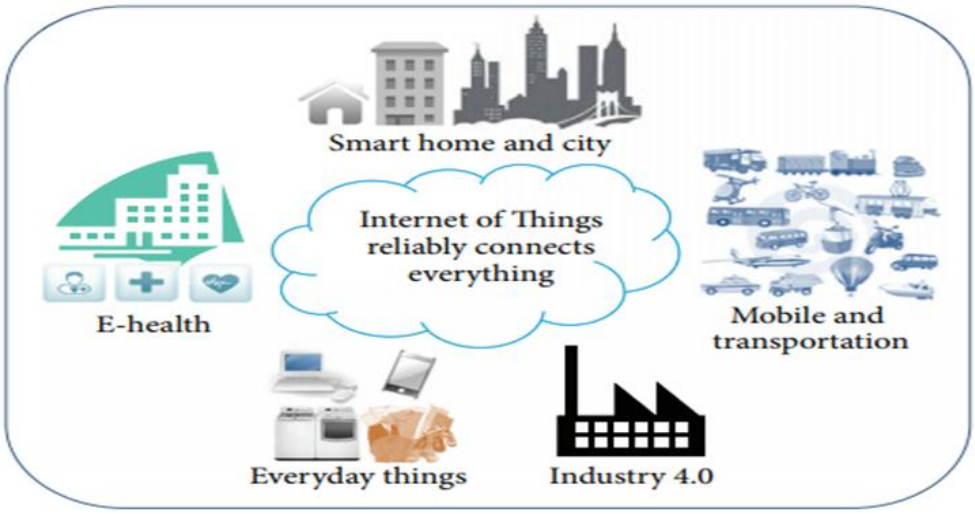
Mobile networks (5G)

5G development, the fifth generation of mobile telecommunication networks is happening with high speed. Despite the fact that some countries have not yet upgraded their communications network to 4G, but the fifth generation in under development and scientists are talking about it with excitement. Using high bandwidth, high data rates and facilitating internet-based communications, such as video calls, is just a corner of the capabilities that will be available for users through the implementation of 5G networks, (20). One of the things that increase the need of high bandwidth, is the concept of internet of things. To cope with the increasing volume of network connected devices that are part of the internet of things, we need a new level of wireless connectivity to the internet. With a look on year 2020, we hope that the implementation of projects such as smart city, smart home, smart transportation and the same things, will only be possible with the use of 5G networks. Another key feature of 5G, is the stability of this network. Researchers highlight the stability of 5G networks so high, that even these networks can be considered better that optical fiber in stability. According to the information that provided by Ericsson, the delay in 5G network is one millisecond. This feature is one of the main pillars of using this technology in areas where stability has the great importance. Among these areas, it is possible to use 5G networks in relation to smart cars without driver, as well as to do a variety of surgical procedures in the form of a remote ,these technologies are compared with each other in Table; 1. , Figure; 1 shows the fields of applications of internet things.

Table 1:-Comparison of the technologies used in " IoT" architecture.

Cost	Low	High	High	High	High	Low	Low	Low	Low	Low to High	Low

Energy consumption	Bluetooth: Medium BLE: Very Low	High	Medium	High	Low	Low	Low	Low	Low	Very Low	Low
Transmission range	8–10 m	20–100 m	<50 Km	15 km	5 km (urban)	10-100m	~30 m	25 - 50 m	3m	~ 5cm	
Data rate	1–24 Mb/s	1 Mb/s–6.75 Gb/s	1 Mb/s–1 Gb/s (Fixed) 50–100 Mb/s (mobile)	up to 100 Mbps downstream and 30 Mbps upstream	2.5 Kbps to 16 Mbps	20 kbit/s to 250 kbit/s	9.6/40 kbit/s	200 kbps	40 Kbps to 640 Kbps for FM0, 20-320Kbps(For Miller , M=2) , 10-160Kbps(For Miller, M=4), 5-80Kbps (For Miller, M=8)	106, 212, 424 Kbps	Avg 100 Mb/s Peak 20 Gb/s
Frequency band	2.4-2.5 GHz	5–60 GHz	2–66 GHz	Licensed LTE 200 MHz	470-790 MHz	969/915 MHz; 2.4 GHz	908.42 MHz	2.4 GHz	<135KHz, 13.56MHz,2.45GHz, 5.8GHz, 860 to 960 MHz, 433 MHz	13.56 MHz	27.5 – 28.35 GHz and 37 – 40 GHz pre-commercial deployments in 2018
Standard	IEEE 802.15.1	IEEE 802.11 a/c/b/d/g/n	IEEE 802.16	3GPP	Weightless SIG	IEEE 802.15.4	ITU-T	IEEE 802.15.4	1)ISO 18000-72)IEEE 802.15.33)IEEE 802.114)IEEE 802.15.4	ISO/IEC 14443 A& B, JIS X-6319-4	Single unified standard
Parameters	Bluetooth	Wi-Fi	WiMAX	LTE	Weightless	Zigbee	Z-Wave	6LOWPAN	RFID	NFC	5G



Comments and Conclusion:-

Devices of E-health which have used in the systems of internet of things substantially limits in the case of progressing, healthcare information storage. In area of e-health, the technologies of short-board connection like ZigBee, Bluetooth, RFID are more prevailing than the technologies of large-board like systems of cellular connection. So, there is request for utilizing service of gateway which interprets the messages between low-board, large-board technologies of connection, (21). So, the technologies of internet of things like smartphones, sensors have single identifier that empowers them for interacting together, by environment with concept of straight connection with the extra component like gateway, (22).

Further, analyzing, collecting of data in the applications based on sensor were organized with the agents of software, locally. Newly, the sensors remotely controlled via web. To remotely controlling such resources, protocol of HTTP is used; although, it is not the right answer due to the various bosses that participate more power of CPU than the sensors. So, for defeating such challenges, the other standards have presented, (22, 23&24).

Today, the other protocols like 6LowPAN, Simple Object Access Protocol (SOAP), Representational State Transfer (RESTful), and web services descriptive language (WSDL) have presented for making the transactions of HTTP for upgrading, reading information of sensor ,(25&26).

Noted protocols ascertain forms which utilized to alter of various information, information encryption progress, IP boss devolution to address network devices. These standards other operations contain the packages routing of the resource to the purpose, controlling data, data transmission organizing rate among two nodes and packets sending again that have miss,(27).

In the current study technologies used in "IoT" architectures were studied, main technologies in the architecture of internet of things were RFID, ZigBee, Wi-Fi, Bluetooth. In another word, 6LoWPAN was basic protocol which has utilized at the chosen papers. Such as, improved devices of feeling, triggering application IPv6, let to outright managing of health. According to this, data which were gathered in the progress would be transmitted in the terms of protocols which are standard, created accessible for the provider of healthcare for controlling the state of health. So, shorter, cheaper, good executing smart controllers, sensors are able to effectively obtain information of the environment which is physical for aiming to optimize works, also raising usefulness.

At the sure applications in great-scale, internet of things technology large development might not be feasible due to the restriction costs. Like it illustrated with some articles, the cost might be an expensive agent in the control of internet of thing. A new technology will be attractive for the potential consumer if investment on this service reveals a reasonable result.

So, architectures must be planned at the way which not just makes easy reduction of cost of mental features, however it encourages the policy makers, governments for making race to the good services management which are affordable. Like low-cost technology usage is able to develop adaptation of internet of things level, many articles are

required. Moreover, another necessary agents which must be placed for attracting consumers for accepting these technologies, are the usage, proper infrastructures establishment ease.

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