# Research Issues and Possible Solutions of heterogeneous integration using IoT

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## ABSTRACT

The Internet of Things (IoT) has emerged as a new field of application for the Internet because of the increasing usage of the Internet nowadays (IoT). For example, houses, hospitals, buildings, transportation, and cities all benefit from this technology's ability to enhance their intelligence. The Internet of Things (IoT) presents a broad range of security and privacy concerns. Designing Cross-Layer and using it in IoT technologies is the topic of this work, with the primary goal of identifying potential difficulties and proposing viable solutions to these challenges. For a heterogeneous network, a cross-layer structure would be necessary rather than the current layer protocol systems. The concept of interoperability across network levels is proposed by the cross-layer design without affecting the original attributes of the layers. The Internet of Things (IoT) is a term that describes a network of interconnected wired or wireless devices. Due to its inherent flaws, the traditional layered design is unable to adapt to changes in wireless communication. Using cross-layer design, many layers may interact with one other and overcome the architectural limits that are inherent in conventional design. This study focuses further on Internet of Things cross-layer analyses and the difficulties and potential solutions that arise.

Index Terms—Cross-layer design, Quality of Service (QoS), Internet of Things (IoT), TCP/IP, Security, Energy Efficiency

## I .INTRODUCTION

In 1999, Kevin Ashton [1] came up with the concept of the "internet of factors," which has now evolved into a broad range of devices, including sensors, smart phones, RFIDs, and many more. Bridges across different technologies are expected to be created by linking physical items together, allowing for better decision-making. IoT has been characterised by Stojkoska and Trivodaliev [2] as a worldwide network of individually accessible networked things. Internet of Things (IoT) packages include smart homes, fitness, private care, automobile production and transportation and electricity, smart communities and supply chain.

Each layer has an incredible amount of information. Layered layouts are plagued by inefficiencies and duplication, two of the most common drawbacks. It should be noted that optimising a network is quite restricted in terms of its overall performance, security and quality of service (QoS). Emerging are move-layer layouts [3]-[8]. The net of factors (IoT) is evolving as a result of the advantages of the internet, which allows goods and machines to connect and communicate with one other over the net. The idea behind this new technology is to automate tasks and link the gadgets we use on a daily basis through the internet. Sensors are attached to every item in order to gather information from the physical environment. In order to avoid unnecessary statistics and keep the facts close at hand, information is evaluated via local processing.

When an object has acquired a lot of data, it is transmitted to the cloud for storage. Finally, based on the information gathered, the correct course of action is chosen. It isn't necessary that action be taken continually utilising this data, but we can also manage and regulate the gadgets and machinery remotely and utilise the data to maintain the statistics for future use. wireless and wired networks may use the same strategy. go-layer layout removes the borders between layers in order to maximise the interaction between levels. It also encourages the exchange of information between the levels. Wi-Fi networks may benefit greatly from the use of the pass-layer conversation protocol, which can reduce power consumption and increase bandwidth. The protocol architecture doesn't cover the move-layer signalling in this design. Pass-layer signalling techniques have been described by the authors in [9]-[13]. The protocol stack of WSNs and WMSNs consists of a number of layers, each of which provides a specific purpose. A performance benefit may be gained by overlapping these layers. Problems that might be crucial to each community and the devices arise when wireless sensor technology is included into the internet of things under a pass-Layered design structure IoT devices have seen a significant rise in popularity since their introduction in 2012. Designing a unifying framework that can accommodate a wide variety of capabilities and functions is difficult because of the hardware constraints and the unique QoS requirements. When it comes to the internet, the IoT community structure inherits its centralization and hierarchical structure. Internet of Factors (IoT) pass-layer design issues are discussed here, as well as proposed solutions [14]-[20].

## II . CROSS-LAYER INTERACTIONAPPROACH

Even though each layer is aware of the changes made by the other levels, the traditional layered protocol composition is maintained in this manner. This enables the layers to retain their individual functionality. Based on the analysis done using this method, we can identify and categorise cross-layer interaction by looking at interactions across the physical, MAC and transport layers [22].

A sensor node is constructed as an agent for various sensor nodes so that the other nodes may communicate with the right node for verbal exchange in this form of cross-layer resolution. In a study of this method's energy usage, it was discovered that unmarried-hop communication is more successful when radio styles are employed.

It uses a receiver-based routing mechanism [21] for this approach. The next hop is selected at some point throughout the tournament as a hop based entirely on interaction. A basic channel and lossless hyperlinks may also be used to investigate this course-based routing [20].

Throughput optimization in a multi-hop community may be separated into two subproblems: routing at the community layer (multi-hop) and power allocation at the body layer (electricity consumption). Depending on the data prices per connection, wireless network performance is influenced by the link capabilities and the node power levels. Energy distribution is determined by connection fees and interferences, on the other hand. That's why CDMA/OFDM is utilised to distribute power and routing in a uniform manner across the network. four-way shipping

a fourth layer of material An optimization approach for congestion control and power management associated with the network, based on a CDMA-based pass-layer optimization, is considered is shown in figure 1. This method of admission may be used to govern any network type and to determine whether or not access should be provided in any way [26].

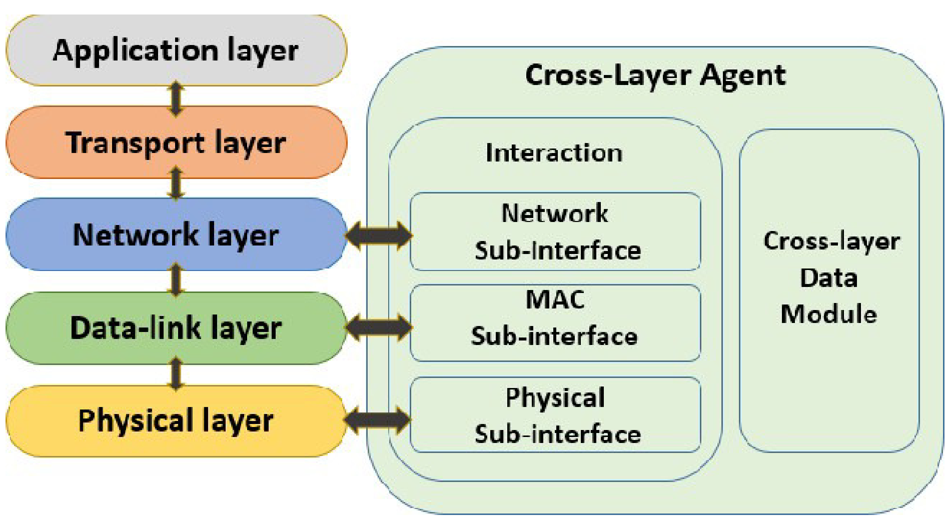


Figure 1: The proposed Cross-layer Agent

III .CROSS-LAYER MODULEDESIGN

For an effective and consistent interaction version that incorporates the MAC layer, the network layer, physiological layer, and shipping layered cross-layer model is used. In place of the traditional layered protocol structure, the go-layered form incorporates all of the layered protocols into a single character protocol. In an XLM, the essential precept is a "leading principle." Nodes in a network may choose whether or not they want to participate in the interaction. The advent concept blends the WSN's intrinsic capabilities with the user's comfort level. Using this aspirational way, each node imagines involvement in the dialogue. All of the nodes in your network have a binary way for setting their own ambition level. The RTS (Request to send) signal is shifted by a node in the network to indicate that it has information to send. Nodes in the same community may see the sign and decide whether or not to engage with that node based on the initiative determination operation. As a result, each node has the power to select their own involvement in the communication system. XLM's hop-by-hop communication and dispersed operations are improved by this method, as well as its ability to accurately handle congestion.

IV .CROSSLAYEREDDESIGNINWIRELESS NETWORKS PERFORMANCEISSUES.

The connectivity between the centre of the community and the end-user is being referred to as the "ultimate mile connection" by the prominent technologies. As far as community issues go, this one is the biggest one in recent memory. Performance flaws in wireless networks may be found in a variety of ways. TCP/IP protocol stack stacking is the most common cause of these issues, since it places an excessive demand on the system. TCP/IP built for wired connections often fails to work well in the wireless environment. According to  other reasons why the overall performance isn't up to snuff. Wireless technology has the most to do with it. Aside from the above mentioned aspects, there are others like high-quality service (QoS), mobility and strength efficiency.

nice of carrier (QoS).

TCP, RTP, the integrated services (IntServ), and (DiffServ) designs developed by the Internet Engineering Task Force (IETF) have been offered as QoS solutions that encompass more than one protocol layer. Since these solutions are based on the OSI reference model, no pass-layer communication or quality of service (QoS) features are included in the protocol stack. in the wireless that changes over time. In spite of this, the necessity to communicate protocol country information from the physical and link levels to the utility layer, and to use it for enhanced QoS (e.g., in real-time data flows) needs a cross-layer configuration. It is thus necessary to market the facts about QoS and coordinate the delivery of QoS across different tiers.

QoS in IoT.

Every layer of the IoT architecture must have a QoS technique in order to ensure an acceptable level of security. Many safety-critical items may be affected by a problem in an undefined layer between the physical sensor and the user, ranging from healthcare to automated motors. To ensure that the structure may be intended with setbacks at any level, QoS solutions that can avoid and notify previously mentioned obstacles are highly desired. This mapping identifies the areas where modern-day study is concentrated, as well as the areas that need further attention. As long as there is enough security for the layers of IoT, there is room for negotiation and feedback between the unique levels is shown in figure 2. If we recognise that there may be any delay on the network level that might maintain a middleware technique as a means to reduce the barrier or raise an alarm in order to not be able to meet carrier-level compliance in a substantial utility.

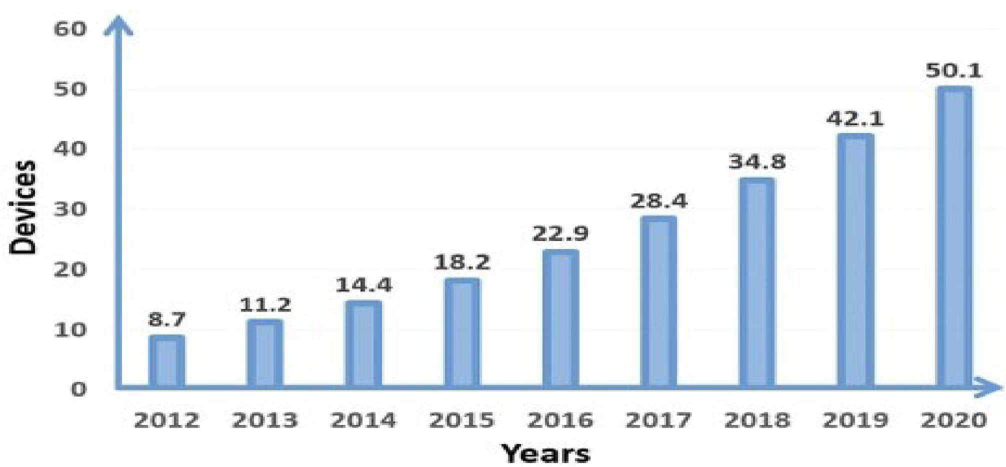


Fig. 2. **Number of connected IoT devices from 2012 to 2020** .

## V. RELATED WORK

These distinct communication models have different interfaces, and this abstraction layer is in charge of creating a single interface for them. In addition, this tool abstraction may be expanded to provide other features. When IPv4 and HTTP proxy services are available to device abstraction, the layer will provide more options for interfacing. Additionally, tool abstractions may be found inside the layer.

Machine-to-machine communication is a critical use case for IoT systems. Monitoring and setting M2M devices is one of the most common issues in the field. When it comes to M2M, the Open Mobile Alliance (OMA) has established a set of hard and fast standards for device control: lightweight M2M. CoAP and RESTful methods have been chosen by LWM2M as the primary protocol for communicating with gadgets. In addition, they recommend the use of DTLS for security and a resource directory to locate devices. As a result of our platform and LWM2M share the same components for creating and deploying services, we can easily integrate the OMA interfaces (i.e. CoAP assets) for bootstrapping, administration, and service provisioning.

M2M systems often use SMS services instead of IP-based communications as a means of communication. Many low-strength and lossy community kinds were considered while creating the CoAP protocol, and a model of CoAP to SMS shipping is provided in [23]. This means that both SMS and IP-based limited devices may be connected using the same software protocol. Additionally, we can easily add SMS capabilities to our platform's structure at the abstraction and access levels. A unique mobile phone number will be assigned to each digital device, allowing them to be accessed by machines that can only communicate by SMS. It would also be possible to use an SMS gateway in the access layer to map digital devices to SMS-restricted devices. Machine-to-machine communication is a critical use case for IoT systems. Monitoring and setting M2M devices is one of the most common issues in the field. When it comes to M2M, the Open Mobile Alliance (OMA) has established a set of hard and fast standards for device control: lightweight M2M. CoAP and RESTful methods have been chosen by LWM2M as the primary protocol for communicating with gadgets. In addition, they recommend the use of DTLS for security and a resource directory to locate devices. As a result of our platform and LWM2M share the same components for creating and deploying services, we can easily integrate the OMA interfaces (i.e. CoAP assets) for bootstrapping, administration, and service provisioning.

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Interoperability requires to be contemplated by means of each software developers and IoT tool producers to promise the shipping of offers for all customers despite the specifications of the hardware platform that they utilize. The IoT and Cloud Computing integration may in part eliminate this issue, but in a few scenarios as the above-referred to Fog Computing, the interoperability is a vital necessity. additionally, numerous corporations employ the interoperability to reach specific items which can be easiest effectively matched with every different. The study in this area for a more variety of criteria, and their acceptance by means of agency components will permit the building of intelligent scenarios utilizing heterogeneous items when not needing to stress about interoperability. So on the path to change the device specific to the layers may be very tough yet inside the basic layered layout complexity is not easy due to the fact each layer is independent of every other but in case of move layer design the dependency results in the complication is shown in figure 3.

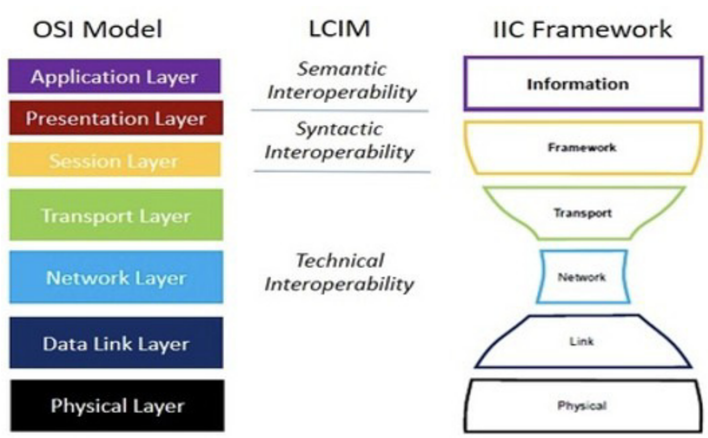


Fig. 3. **Interoperability**.

A. Mobility

Node movements are typical in advert-hoc networks, in order that the events as a consequence of the node motion, e.g., channel switch and route alternative, are vital to be located and handled to guarantee the communique no longer to be unbroken. Channel fading, transmission delay, increased bit errors rate, and other calamities that reduce QoS may also influence the mobility as nicely. Mobility is the key attribute of wi-fi technology. The TCP/IP protocol built for the continuous net services does no longer give flexibility in connecting the wi-fi devices. therefore the mobility within the standard TCP/IP has challenges in managing IoT networks. The mobility supports the wireless tool motions through handoffs. The mobility manage- ment challenges normally arise inside the traditional structure as there is a logical department into network and link layer replies. The move layer concept got suggested due of this.

As there's a natural divide for community and link layer replies,those levels wants to be cross-layered within the networks to give ultimate answers to the mobility difficulties . The 3GPP business is thinking about the pass-layer to minimize the handoffs delay. any other approach to this difficulty is Handoff-related layer-2 triggers may furthermore lower the put off be- tween layer-2 handoff finishing touch and the associated layer-3 handoff activation which became suggested by way of Tseng et al].

B. electricity efficiency

Zhou et al highlighted how strength intake is a problem in wi-fi senser networks (WSN) (WSN). The writers provide the energy fashions of the node core additions, such as CPUs, RF modules and sensors. They simulated the electricity styles of node additives and then evaluate the strength consumption of community protocols relying solely on this node electricity version. Authors provided a version that can be used to explore the strong popularity of WSN nodes and structures, to assess the verbal exchange protocols and to help to deploy nodes and develop WSN programs. Howitt et al presented an approach based entirely on increasing power control principles which bear in mind the sensor community's set up- ment properties and the RF environment in which the sensor community is placed. The electricity models established for maximizing the transmit energy are based on IEEE802.15.4/spl change/ gadgets, notably the Chipcon CC2420. The suggested methodology supplies an honest way for analyzing the feasibility of a network deployment strategy as well as supplying insight into alterations to the wireless community structure to reach improved energy efficiency [24-33]. D. Zhang et al \s to clear up the difficulties among protocol layers in wi-fi sensor network, failure to serve community wants in time and so on, introduced move-layer optimization method to stay away from network congestion and save community power. They suggested set of regulations demonstrated to beautify community throughput, shop net- paintings power and increase network lifespan.

## VI. CONCLUSION

The Internet of Things (IoT) paradigm presents us with a wide range of opportunities and difficulties. Many protective mechanisms have been put in place to deal with the ever-increasing security and privacy threats. As a result of this paper, the impact of our technique on limited devices is minimal, while providing a tangible benefit in provider integration of low-useful resource IoT devices. In order to demonstrate this, a dashboard for restricted devices that can be implemented to the provided platform serves as a proof of concept. Using the results of our research, service providers may more easily implement and set up solutions that span a broad range of IoT application areas. With this new IoT architecture, we'll be able to use pattern recognition services, cross-layer discussion and new tariff systems in a live network with actual customers and scalable packages.

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