A Survey on Scheduling Based Mac Protocol for Congestion Minimization in Internet of Things (IoT)

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Abstract: Recently, in Internet era the most common technology ubiquitous to develop smart environment is Internet of things (IoT) and Wireless Sensor Networks (WSNs). These technologies deployed enormously to formulate wide applications in area of Smart homes, Industrial automation, and security destined applications and information trailing. The huge development in wireless technology is due to great exploration in MEMS concept and Embedded Systems. Huge evolution in this technique leads to access different Medium Access Control (MAC) protocol and this protocol used to access multiple nodes peculiarly in wireless channel. The projected MAC protocol designed to enhance network lifetime. Essentially, the network leads to lot of congestion due to non-availability of IoT equipment and less available resources for various environmental applications. The simulated performance ensures that the conventional algorithm limits their dynamic service quality for IoT based applications. The above setbacks motivate the researches to develop the survey in existing scheduling-based MAC protocol by highlighting their parameters.
Keywords: MAC protocol, Scheduling, IoT, Traffic, Optimization, Wireless channel.

1. Introduction

The futuristic hybrid Internet of Things (IoT) and envisioned Wireless arrangement furnish the stage for forthcoming linked societies, this helps to constitute to communicate business, people and societies (Sharma, 2018). The abundant increase in number of connected IoT devices exponentially increases from around 27 billion in 2017 to about 125 billion by. Nevertheless, emerging technology 5G and most highly popular networks furnished with most cost-effective and suitable for IoT applications. Recent technology designed to support 30,000 IoT devices per cell. Traditional cellular networks and Advanced cellular networks are conventionally most suitable for human-type communications, the conventional type is not suitable for Machine Type Communications (mMTC), Traffic channels in accessing the wireless networks will lead to congestion due to enormous deployment of IoT devices in the network (Loganathan, J, 2016).

Ultra-dense IoT access networks concentrate to high demand traffic leads to congestion within a network. Data traffic congestion within a network may occur due to several basic reasons. Firstly, each and every cell inside the network deployed with an enormous amount of IoT sensors and mMTC devices and those devices are crowded within the cell for data transmission (Kiran, 2018). Secondly, the IoT generate a small sized data packet for transmission and overhead associated with single data packet is high. Thirdly, the access time of IoT devices is dynamic in nature and data traffic created by an IoT devices are dynamic Therefore, the IoT network supports irregular transmission and simultaneous behaviour of data. Accessing nature of the network is randomized and in some cases the data traffic is not regularized and some IoT strategies can generate very high amount of traffic in IoT accessible network. This unusual data flow in IoT network requires addition radio resources alternatively the radio resources are allocated through average flow of data traffic.
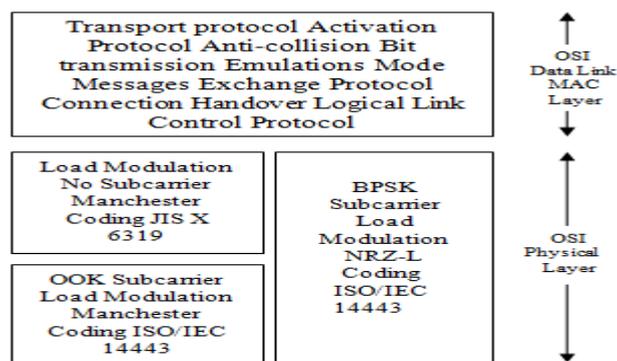
Figure 1 Communication protocol stack in IoT

The requirements for traditional Wireless networks is always furnished with an availability of radio resources to access the MAC protocols ,the conventional networks requires multiple transceivers at each and every node and

this leads to high medium access control overhead. Radio Duty Cycling (RDC) techniques uses IoT access networks ,the above techniques uses Half duplex communicating medium to transfer data between transceiver and receiver, so the radio resources is used alternatively to minimize and saves the Energy (Algora, 2017). The control overhead data packets are significantly less in this technique. The above setback is overcome d by MAC protocols and specially designed for an IoT access networks. Figure 1 Schematic diagram of the communication protocol stack of an IoT defined the standard IEEE 802.11 for local area networking, the IEEE 802.15.4 standard for low-power wireless networks for the physical layer of IoT (Vasanth, V., 2017). Most of IoT networks use non-licensed band so it causes nosiness to other networks in the systems. The major challenging issues in IoT access network is resource-constrained in wireless networks, In case of resource constrained the spectrum of the network is used by some other wireless network. The coexistence problem exist in-case of the devices operating with the same ISM band, this will lead to decrease in metrics of output for IoT such as throughput, delay and robustness for various applications (Fan, Bo, 2018).

The purpose of this paper is to analyze about various MAC layer protocols in the features if coverage, data transmission, efficiency, resource availability and interoperability. The existing Medium Access Layer methods have shown many benefits in terms of coverage area, data broadcast, broadcasting proficiency, in terms of both physical resources and proficiency features. These features tend to achieve other performance metrics.

2. Survey on Scheduling based Techniques

(Battula, B. 2020) the researches projects power allocation algorithm and Dynamic user scheduling algorithm to minimize the total power consumption problem for NOMA (Non- Orthogonal Multiple Access). Hybrid algorithms scheduling and power allocation is used extensively in downlink IoT networks. Optimizing techniques low in computation level and easy in simulation level is Lyapunov optimization technique and the branch-and-bound method .The projected algorithm is an instantaneous decision making approach decides the system states assurance the long-term network performance.

(HanefiCinar, 2019) projected a new technique for multi-channel allocation and it is used widely in WSNs and it is named as Hybrid Multi-Channel Allocation for WSNs (HMCAWSN) and this technique is modelled on the basis of multiple Access and it uses a hybrid Time Division Multiple Access (TDMA)–Frequency Division Multiple Access (FDMA) and use two radio signals for multi-channel communications. The simulated performance portrays that metrics End-to-End delay and Mean shows considerable improvement by consuming the considerable amount of Energy in Sensor node. Simulated performance is compared to the conventional and the present projected scenario evaluates the results and says that projected HMCAWSN ensures firm and Enhancement in packet delivery ratios than existing works. The performance is carried out with the hundreds of sensor nodes. The projected work leads to 100% delivery ratio with less latency and this achieves a futuristic demands on high the researches projects power allocation algorithm and Dynamic user scheduling algorithm to minimize the total power consumption problem for NOMA (Non-Orthogonal Multiple Access).

Hybrid algorithms scheduling and power allocation is used extensively in downlink IoT networks. Optimizing techniques low in computation level and easy in simulation level is Lyapunov Optimization technique and the branch-and-bound method .The projected algorithm is an instantaneous decision making approach decides the system states assurance the long-term network performance in terms of throughput and bandwidth whereas it achieves real-time information communication in WSNs. The projected work HMCAWSN consumes a less volume of energy and this technique is used in all small to large scale networks. The all congestion based traffics is supported by the projected techniques (HMCAWSN) .The limited use of wireless sensor node resources by a projected techniques will enhance the overall performance of the network. Specially, the HMCAWSN is most applicable for the real-time data transfer in the networking environments which has high throughput and low delay.

(Garikapati, P., 2020) proposed a technique beacon scheduling in Cluster-Tree network topology to synchronize beacon .To transmit the Beacon a 2-hop transmission for information and organization to calculate beacon transmission offsets, the above process optimize to apply the existing time periods with less communications and achieves high scalability, the projected techniques proposes the re-synchronization mechanism, the inter-dependencies between synchronization and duty-cycling techniques effectively diminish the synchronization overhead, In case of when synchronization among devices is lost.

(Taewoon Kim, 2018) proposed energy efficient scheduling method (EESM) to overcome the energy hole problem. This is done by triggering the optimal node which tends in more accuracy and extensive explosion.

(Duan Ying, 2018) the author projected a technology Industrial IoT for an industrial automation, to monitor the production and risk pre-warning. The researches use a reliable and stable data for complicated and extremely variable industrial environments. The model is designed on the basis of hybrid based (static and dynamic) features for the industrial wireless sensor networks and the model is task-oriented. The industry is automated dynamically by an Automated Guided Vehicles (AGVs) the set-up is done within the industry. The projected techniques uses a heuristic modelling method to assign task, the targeted output is sent to the controller. The AGVs is tracked by a collaborative routing algorithm on specific mechanical phenomenon,

analysis from the simulated performance portrays the collaborated solution can overcome the challenges and repair the network or detected quality is low, the performance signifies the improvement in the overall throughput, reducing the energy consumption and reliability of industrial IoT systems.

The performance of the networks is highly affected by various parameters such as reliability, throughput and Energy efficiency; the Scheduling and Routing determine the data packets to get communicated inside the networks. Resource constraints is a major setbacks in wireless networks and it is furnished by Scheduling techniques, Existing packet scheduling techniques is not accountable for effective Scheduling and the current network suffers lot of resource constraints and so the Sensor network is unsuitable to communicate highly sensitive critical data. Scheduling and routing will be a trade-off if QoS parameters like energy, delay, network lifetime, etc., are not taken into account. The Researches projected some Scheduling techniques to overcome the critical challenges and research challenges, the projected techniques classifies the techniques on the basis of types, channel access and multilevel traffic based IoT applications.

In this work, (Anitha Christy Angelin, 2018) projected an IoT aided techniques for disaster announcement and to trace the service in a remote car that meets an accident .The alert system is generated continuously in the network to rescue's anyone's life, then alert message can be eliminated in absence of emergency and it terminated by the driver to confront wasting the medical rescue team. The scheduling algorithm is used to deliver the critical messages in case of rescues.

3. Survey on Routing based Techniques

(Latchoumi TP, 2018) the researches projects a Survivable Path Routing techniques to overcome the collision and interference in network. The protocol is designed to work with high demand traffic network. It accepts the data from various sources and send the datas to a end point within allotted time. This scenario is one of IoT applications for medical field. The successive hop node is selected by integrating the functions of three factors: Estimating the survival rate of the node and path to the next node to the destination, analyzing the noise ratio by calculating signal to interference and noise ratio of the link and the congestion level at the next hop node. The Simulated performance portrays that projected techniques has a much better outcomes in packet delivery ratio, end-to-end delay, throughput and Energy consumption of the packets. The amount of packet drops is lesser in case of heavy traffic scenarios in projected techniques than existing MAC layer protocols. The major setbacks in MAC layer designs and the cross layer design is adapted along with broadcast power control systems and traffic adaptive dynamic contention window.

(Ayadi 2018) suggested two procedures to enhance the energy conservation in network. Initially, the reason of energy leakage during data transmission should be found out. Secondly, residual energy is calculated for the entire network. This residual energy can vary at every duty cycle. These two procedures ended with the advantage of high energy conservation but the limitation is high density network is not suitable.

(AbdellahChehri, 2019) the researches projects dynamic channel coding (DCCMAC) protocol for very low radio spectrum ultra wide band, the ad-hoc networks uses UWB energetic channel coding with interference alleviation. This protocol is coincide with physical and MAC layer, the main task is to optimize the rate and by allowing the interfering sources to transmit the data .In this approach the researchers suggest to use both data link and multiple access layers to consume less power and thereby enhance the network lifetime.

(Won, 2020) the researches proposes first Geographic Routing framework for LoW Power and Lossy Networks (GROLL).The various routing ways are Unicast, Multicast and convergence cast are collaborated as Routing engine ,The Network holes and cuts is determined by an effective Complex Network Topologies (CNT). The detected CNTs and conception boundary information significantly reduce the memory size.

(Vasanth, A. V., 2018) projected scheduling sleep/wake up based artificial intelligence (AI). This method enlarges the quality of network by activating the clusters and optimal path in network. Apart from that, this scheduling method has lower energy consumption between the cluster heads. Therefore, the new highly technology based is collaborated with an IoT in Wireless Sensor Networks is used extensively for Smart homes, Weather Monitoring Systems, Smart cities etc. The IoT based Networks the nodes are highly resource constraints ,the various resources are computing resource, Storage resource and Energy resource etc, the lifetime of the network depends mainly on the highly technology based Routing protocols.

Here (Abdul WasayMudasser, 2019) suggested a novel method using optimization concept, which are mainly for energy conservation and better lifetime. Here, a set of algorithm is followed to create cluster and cluster heads, which helps to circulate the available nodes in network. The remaining energy usually called as residual energy is evaluated in the appropriate position. In the analysis part, some of the traditional protocols such as Low-energy adaptive clustering hierarchy (LEACH), Game theory based Energy Efficient Clustering (GEEC) was compared. Proposed method showed 78% of overall energy conservation.

The wireless networks faces lot of challenges and issues and those networks are energy strained networks; those networks are dynamic and need reliable efficient mechanisms. Specifically, the MAC protocol is designed for dynamic wireless networks and this protocol to get enhanced for the enormous variance WSN deployments. The conventional system support the multi-user to access the same channel, it is very tough to

achieve Energy-Efficient communications in case of duty cycled networks. The wind turbines use a cyclical channels and it has got lot of constraints to use Duty cycled networks.

Such networks needs topographic point protocols for data communication and those challenges are not overcome by the traditional mechanism. So the researches (DasariSailaja, 2019) focus on various MAC protocols to overcome the issues in those conventional constraints. The MAC protocol is configured to be useful for insights and directions that is more suitable for dynamic cyclical channel and it is used mostly in Wind Turbines.

4. Survey on Optimization Techniques

Optimization methods are used extensively in the area of computational analysis and minimizing the massive data. Previously many research works had been carried out to optimize the IoT infrastructure by analyzing various problems.

(Kalyani, 2019) projects a new integrated optimization algorithms as Lion Algorithm (LA) and Cuckoo Search Algorithm (CS) named Cuckoo Mated-Lion Algorithm (CM-LA).The techniques designed on set of IEEE standard as IEEE 802.15.4 MAC standards, the MAC header coined with additional security field, the information is authenticated by optimum authentication keys and the field is added in the MAC header ElGamal public key cryptosystem is partially homomorphic encryption. To attain confidentiality of IoT data the ElGamal public key cryptosystem generate the optimal private key.

(Kun Cao, 2018) the researches proposes the novel based techniques for battery- powered IoT applications for mobility-aware network to enhance the network lifetime thereby increase the Quality-of-Service (QoS) confinement. The projected technique analyzed the concept in two step process offline and online stages. At offline steps, to enhance the network lifetime optimized mobility-aware task schedule furnished by using mixed-integer linear programming (MILP) technique. The IoT devices uses other radio resources due to availability of unlicensed ISM band leads to overlapping of a single task on various IoT devices and helps to save Energy. At online stage, optimized based cross-entropy designed to conform task execution to the dynamic QoS demand. Simulated performance ensures enhanced outcomes in handling time-efficient, QoS-adaptive and performance-guaranteed QoS-adaptive.

(NailahSaleh Alhassoun, 2019) proposed a novel based energy constraints perpetual home automation by an IoT system. The techniques guarantee safety of occupants by a Power cell-operated and Battery-powered IoT devices.

The technique deduct the Activities of daily living (ADLs) sensor information actuate from Energy-aware Optimized Sensor activation and this is achieved by a linguistic based semantic approach. The above techniques is evaluated by using a conventional based fall detection system which emphasizes by applying an in-situation sensing and Multi-personal devices traced from real world deployments in emerging project. The technique use a initial parametric value to undergo the huge simulation, the energy consumption achieved by the projected Cost-Function- Gradient algorithm achieve large reduction in Energy dissipation and by enhancing the lifetime of the battery power without reducing the sensing accuracy. The major challenges is to modify and guarantee the non-structural and multiple structural needs on applications by investing new rising technologies.

(Sengathir Janakiraman, 2018) the researches proposed a device to perform wide range applications in Intelligent homes, Environmental Monitoring and Industries by deploying a enormous amount of Internet of Things (IoT). Meanwhile, in recent years postulate to elect the Cluster heads in cluster member of IoT devices is common in Wireless Sensor networks (WSNs).The researches projects the reliable integrated optimization technique for Cluster head selection is Hybrid Ant Colony and Artificial Bee Colony Optimization Algorithm-based Cluster Head Selection (HACO-ABC-CHS) the techniques overcome the critical challenges faced by the ACO and ABC correlative mode. The critical issues of inactivity in step-up activity of ACO are precluding by employing exploration and similarity in employee bee agents. The process of separating the procedure of exploitation into two ways to solve latency collaborated challenges in onlooker bee steps of ABC and it basic process is exploitation. Simulated performance of projected HACO-ABC-CHS mechanism achieves a significant cluster head election approaches in terms of percentage of throughput, Energy, alive nodes, residual energy and in-active nodes.

Autonomous Wireless Sensors (AWSs) is the main kernel point of all Wireless Sensor Network (WSN).Recent AWS techniques has allowed a enormous evolution in various IoT-based applications, it ranges the education, industry, military to bio-engineering. The optimized energy of AWSs depends mainly on: Infrastructure, functional and application specifications.

The design technique conveys the whole methodology process of all factors mentioned above. Therefore, the novel based architecture has been projected to solve the above issues and in this process the transceiver has been duplicated along with Battery source exploitation an integrated storage system. A proper techniques is enforced to limit the Power flow and also assigning the task of Energy Consumed by transceivers.

(Paul NicolaeBorz, 2019) the researches framed a scenario for AWS on basis of spectrum content by

accented the collaboration between Energy consumption, information and Communication from transceivers. The sensor node design is analyzed on the basis of specific characteristic and inter-dependencies by the techniques, where the reliable AWS is furnished by Optimization of the system, this technique emphasizes autonomous sensors along with an energy harvesting element.

(Behzad,2019) the researches proposes the novel based optimized framework for Internet of Things (IoT) settled for forthcoming Sensor networks. Specifically, two major research challenges is overcome by computationally-convenient system in sensor networks. Initially, the traditionally-tackled resource optimization constraints is utilization the resources inducted the drainage of battery at a high speed amount inside network. The high utility rate of the battery resources leads to sudden failure of the network and promotes the low inefficient drainage resources. The second main constraints of the networks are data degradation due to unavoidable presence of noise and these degrade the data communication via wireless channel. This type of network is inapplicable for real time applications. The author projected a 3-tier communication by layer-adaptive method communication techniques by using reliable and efficient resources. The author manipulated the techniques by using a mathematical approach trade with an arrangement of coverage holes. The unrefined data is removed effectively by approaching transform-domain based robust algorithm .The projected framework overcome the critical challenges by applying the handy algorithm and applicable for all real-time applications and it evaluated from an extensive results.

Table 1: Summarization of Literature Review

Methods	Techniques	Advantages	Disadvantages
Scheduling based	Dynamic user scheduling and Power allocating Algorithm	This algorithm provides more prolonged lifetime among each nodes in the network	Interference is more during the scheduling process
	Hybrid Multi- Channel Allocation for WSNs (HMCAWSN), based on hybrid Time Division Multiple Access (TDMA)– Frequency Division Multiple Access (FDMA) techniques	It has the advantage of increased throughput and packet delivery ratio	It has more channel switching delays and complications during synchronization
	Distributed Beacon synchronization scheme	since the transfer of data on similar slots there is advantage on time	Energy consumption overhead is more during coordination process
Routing protocol based	Survivable Path Routing	periodic beaconing process results in more latency	Finding the optimum path is suffered from energy depletion
	Dynamic channel coding (DCCMAC) protocol	Perfect channel selection leads to save considerable amount of energy in destination side.	More communication overhead
	scheduling sleep/wake up based artificial intelligence (AI)	It improves the lifespan of the whole network.	There is high energy exhaustion among the cluster head which leads to increased hot spot problem in network
Optimization based techniques	Cuckoo Mated-Lion Algorithm (CM-	it checks an opposition from identifying interrupted	Computation cost is very low

5. Problem Identification

Huge evolution in various IoT leads to access various Medium Access Control (MAC) protocol in communication stack whereas, the channel allocation and scheduling process takes place. Even though, there are numerous number of availability in MAC protocols in terms of routing, scheduling and optimization, still there are some problems. The packet delay is more common among multipath MAC protocol and hence it ends up in degradable network performance such as delay and less network lifetime. Moreover, the sleep/awake cycle in scheduling process makes the network to have more traffic and more energy consumption. To overcome these issues some existing works concentrated on applying contention window for traffic reduction which again result in optimization criteria issues. Some architecture such as 3- tier architecture is very luxurious to construct and transfer the data.

6. Conclusion

Recently, the current IoT based applications plays a significant role in real time world and the Wireless Sensor Network is best domain platform for IoT based applications. This literature survey offers basic ideas about various scheduling methods to maintain the sustainable congestion in Internet of Things. The features denoted here are mainly associated to Medium Access Control protocols, optimization based techniques used and scheduling techniques exists in previous study. The discussion elucidates the various performance measures of various protocols and it is used in various applications with the determined constrained with various technologies.

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