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# UNDERSTANDING THE BASIC CONCEPT OF RESOURCE ALLOCATION IN WIRELESS POWERED VIRTUALIZED SENSOR NETWORKS

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***Abstract:***

*The virtualization technique was first implemented in in order to further improve resource usage and lengthen the network life cycle for the WSN. The WSN was separated into network-level virtualization and node-level virtualization inside this article, which established the theoretical foundation for the investigation of virtualized WSN. Sensor nodes are typically powered by batteries or other integrated energy sources. However, there are several exceptions. On the other hand, these nodes may be installed on a vast scale in hazardous environments, the framework of buildings, or even the human body itself. As a result, it is not easy to replace the battery once all of its energy has been used up. As a result, the question of how to overcome the performance barrier brought on by a lack of available energy has become an important focus of study.*

***Keywords: Virtualization, lifecycle, batteries, human body, performance, etc.***

## 1. INTRODUCTION

The application field of wireless sensor networks (WSNs) has gradually developed from the military to precision agriculture, smart health, intelligent transportation, and other fields, all of which play an increasingly important role in the everyday lives of humans as a result of technological advancements in the Internet of Things, such as sensing, communication, computation, and caching. This is one example of how the Internet of Things is playing an increasingly important role in the lives of people. The deployment of sensor nodes is often geared toward the completion of a certain job. The problem of poor resource utilization is one that plagues WSN since it is plagued by the intermittent use of node resources by a single specialized activity. For instance, both homeowners and government agencies in the same region each deploy their own comparable sensor nodes in order to independently monitor the temperature. This kind of duplicate deployment of infrastructure could result in an unwarranted waste of financial resources. Sensor nodes are typically powered by batteries or other integrated energy sources. However, there are several exceptions. On the other hand, these nodes may be installed

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on a vast scale in hazardous environments, the framework of buildings, or even the human body itself. As a result, it is not easy to replace the battery once all of its energy has been used up. As a result, the question of how to overcome the performance barrier brought on by a lack of available energy has become an important focus of study. There are two different sorts of techniques, which are referred to as "throttling" and "open source," that may be used to extend the life of sensor nodes. The term "throttling" refers to the process of lowering the amount of energy that is consumed or increasing the amount of energy that is used efficiently via the application of various optimization strategies. To be more specific, and in the same vein as the traditional Internet, which is required to support a wide variety of applications, WSN is also able to implement virtualization technologies in order to enhance its resource efficiency. To be more specific, applications that have varying needs for their levels of performance can have their operations carried out invisibly by virtual sensor nodes that are centrally managed by a WSN service provider. In contrast to "throttling," "open source" extends the life of the sensor by the use of wireless energy transfer (WET) technologies such inductive coupling, magnetic resonance coupling, and electromagnetic wave radiation. Both the "throttling" and the "open source" based strategies have contributed, to varying degrees, to an increase in the overall performance of the present WSN. On the other hand, in the future, when everything will be connected to the internet, the ever-increasing applications may subject the WSN to a larger strain and significantly higher performance needs. If either "throttling" or "open source" are implemented by themselves in this scenario, it is possible that they will no longer be effective. As a result, integrating these two strategies together offers an attractive option for overcoming the limitations of the existing WSN.

## 2. RESOURCE ALLOCATION IN WIRELESS

One of the most rapidly expanding sub-sectors of the telecommunications industry today is wireless service. Cellular voice is well-established as a premium service in the majority of regions, despite the fast growing demand for this service. It is anticipated that personal communications services, sometimes known as PCS, would become available as a mass market phone service over the next several years. There is a rise in the use of wireless data services such as cellular digital packet data (CDPD), wireless local area networks (LANs), and wireless modems. However, capacity is quickly becoming the most important concern for each of these services. The existing cellular system uses reserved bandwidth for the transmission of analogue voice signals. This bandwidth is then divided into many (usually seven) parts that are permanently allotted to individual cells, which are relatively tiny geographical areas. Some suggestions for increasing capacity include:

- **Cell Splitting**: By breaking up larger geographical cells into smaller ones, one may make more efficient use of the spectrum that has already been allocated and achieve a greater level of spatial reuse. There is, however, a minimum cell radius, and in certain regions this limit has already been surpassed.

- **Allocation of New Spectrum** Within the Emerging Technologies Band, more frequency spectrum is now being put up for sale (ETB). It is anticipated that this spectrum would encourage the development of new services such as PCS.

- **Alternative Multiple Access Architectures**: It is anticipated that a large capacity boost would be achieved after analogue transmission is replaced by digital transmission. There is a lack of consensus

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on the optimal multiple access technique and the capacity gain that it will produce.

- **Dynamic Channel Allocation**: At the moment, the existing cellular frequency spectrum is quite precisely segmented amongst the various cells. This utilization of the currently available spectrum is ineffective. Increasing capacity can be accomplished by increasing complexity and loosening the rules governing channel allocation.

These several options are not mutually exclusive with one another. In the existing cellular system, the primary way for expanding capacity is the process of cell division, often known as cell splitting. Carriers are now implementing a strategy that involves several facets, including the purchase of additional spectrum, the evaluation of dynamic channel allocation systems, and the creation of the digital system of the next generation. The same pattern may be seen in the research conducted in this field. In the field of multiple access, a heated debate is taking place between proponents of time division multiple access (TDMA), frequency division multiple access (FDMA), and code division multiple access (CDMA), all of whom are attempting to test the capabilities of these methods to their absolute maximum. Within the realm of dynamic allocation, a slew of different approaches have been proposed recently.

## 3. RESOURCE ALLOCATION AND DESIGN ISSUES IN WIRELESS SYSTEMS

A system that facilitates communication between two or more users may be referred to as a wireless communication system (or people or devices). Mobile communication systems, satellite communication systems (such as GPS), AM/FM radio systems, and under-water communication systems are a few examples of the types of systems that fall under this category. The mobile communication system is currently the most prevalent form of wireless communication in the modern world. This system enables users to communicate with one another who are equipped with wireless devices such as laptops, smartphones, and tablets by utilizing a network of service-nodes that include relays, base-stations, and femtocells. In this dissertation, we are going to investigate several problems that might occur while designing these kinds of systems. During the course of the past ten years, there has been a significant increase in the utilization of mobile communication systems for the purpose of the conveyance of information (or data), often in the form of web-based data or voice-data. This expansion may be ascribed to the proliferation of wireless devices, in particular smartphones, as well as an increase in the amount of web-based services. Some examples of these services include video streaming, cloud computing, banking, and other similar services. It is necessary to create more effective communication networks in order to fulfil the growing demand for data from an expanding population of consumers. The comprehensive examination of such large systems would be extremely challenging and would go beyond the purview of this dissertation. In this section, we will concentrate on one of its features known as "resource allocation," which is a tool that can be used to improve the effectiveness and performance of the system. The development of improved application-specific protocols, improved data compression algorithms, and improved channel-coding schemes are a few examples of some additional ways that might be effective in meeting the rising data demand of consumers. The wireless link between the transmitter(s) and receiver(s), which enables data transfer from transmitter(s) to receiver(s), is the fundamental basis of any wireless communication system from a system's point of view. The amount of information that can be

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transferred from transmitter(s) to receiver(s) over this link is limited by the amount of resources that are available at the transmitter (s). At most cases, the resources in question are bandwidth and electricity. In addition, the availability of these resources—power and bandwidth—is restricted in virtually every type of communication system. As a result, effective strategies for resource allocation need to be devised in order to ensure that existing resources are utilized in the most effective way possible and that high data transfer rates are consistently made accessible to all users. Within the scope of this dissertation, we investigate three distinct categories of mobile communication systems (point-to-point, single-cell OFDMA, and multi-cell OFDMA), and we suggest a variety of resource allocation strategies that are either optimum or near-optimal for each category. We also provide design guidelines for service providers to use in order to design large multi-cellular communication systems while simultaneously satisfying the Quality-of-Service (QoS) requirements of users and the revenue-targets of service providers. In point-to-point networks, there is only one transmitter that sends data to one receiver using wireless transmission. As was covered in the prior section, the transmitter has a finite quantity of resources, including power and bandwidth, at its disposal. In the event that there is a limit on the amount of instantaneous power available, the transmitter will use all of the available power and bandwidth for each channel it uses in order to optimise both the dependability of the transmission and the quantity of data that can be sent.

## 4. OPTIMIZATION TECHNIQUES IN RESOURCE ALLOCATION OF WIRELESS COMMUNICATION SYSTEMS

Regardless of the mobility and location of the users, the future Wireless Communication Systems (WCS) are expected to be able to handle personal and multimedia conversations at a high data rate regardless of how they communicate. The following types of traffic are included in these services: voice, file transfer, web browsing, wireless multimedia, teleconferencing, and interactive game play. Over the course of the past few years, data and multimedia services have emerged as crucial components of cellular communications. As a result, bandwidth need and number of users become critical challenges. It is essential to allocate the limited resources in the most effective manner possible in order to support the high data rate requirement for future WCS. The dynamic nature of the wireless channel, limited resources such as power and frequency spectrum, and diverse Quality of Service (QoS) needs are the primary obstacles.

OFDM, or orthogonal frequency division multiplexing, is a kind of multicarrier transmission that is capable of handling large data rates. OFDM is a method of modulation and multiplexing that is suitable for both existing wireless networks and those that will be developed in the future. OFDM takes the available bandwidth and splits it up into a number of orthogonal subchannels that are independent of one another. The bandwidth of these subchannels is significantly lower than the coherence bandwidth of the channel. The frequency selective fading channel for the wide band is turned into numerous flat fading channels for the small band. OFDM is a fantastic technique for overcoming the challenges posed by multipath fading effects.

WCS intends to increase the channel's carrying capacity as one of its primary objectives. The Several Access Technique, sometimes known as MAT, makes it possible for multiple mobile users to effectively share the available

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bandwidth. Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Code Division Multiple Access (CDMA), and Space Division Multiple Access are the four primary forms of multiple access that may be implemented (SDMA). In TDMA, FDMA, and CDMA, respectively, MAT is utilised in the form of set time slots, fixed subchannels, and unique codes. SDMA is able to maximise the available bandwidth since it takes use of the physical separation of users. When it comes to frequency, time, or coding isolation between users, MAT can be coupled with OFDM. Allocating limited radio resources like subchannels, time slots, bits, and power to various users may be a challenging and time-consuming job.

## 5. VIRTUALIZED SENSOR NETWORKS

In the fields of computers and telecommunications, a virtual sensor network (VSN) is a sort of collaborative wireless sensor networks that is only beginning to emerge. VSNs make it possible for wireless sensor networks to be multi-purpose, collaborative, and resource efficient. This is in contrast to early wireless sensor networks, which were only used for a single application (such as target tracking). One of the most distinguishing characteristics of VSNs is the emphasis placed on shared work and resources. Nodes are able to accomplish application goals in a manner that is less resource intensive thanks to this practise. These networks may also incorporate users and/or dynamically changing subsets of sensor nodes (for example, as a phenomena moves sensors that detect the phenomenon change over time) (users that are accessing the network changes with time).

It is possible to create a VSN by establishing logical connection between collaborating sensor nodes. The task that nodes carry out or the phenomena that they monitor (such rock slides as opposed to animal crossings, for example) can be used to categorise them into distinct VSNs. It is anticipated that VSNs will offer protocol support for the construction, use, customization, and upkeep of subsets of sensors that are working together on a particular job (s). Even nodes that are not equipped to detect a particular event or phenomena can nevertheless be a member of a VSN if they are ready to let other nodes who are equipped to detect it interact with them. As a result, virtual private networks (VSNs) make use of intermediary nodes, networks, or even other VSNs in order to effectively carry messages throughout the members of a VSN.

The emerging concept of the internet of things (iot) is considered to be the next technological revolution, one that realizes communication between an unprecedented number of different kinds of items, machines, and gadgets. WSNs can be considered the foundational components of the Internet of Things (IoT) due to their ability to assist users (whether they be people or robots) in interacting with their surroundings and responding to happenings in the real world. These wireless sensor networks are built from nodes that are composites of microelectromechanical systems, wireless communications, and digital electronics. These nodes are equipped with the capacity to perceive their surroundings, execute calculations, and interact with one another. The present wireless sensor networks (WSNs) have a number of drawbacks, the most glaring of which is that they are domain-specific and task-oriented. This means that they are customised for certain applications, and there is little to no potential of reusing them for newer applications. This technique is wasteful and will result in duplicate deployments if new apps are considered. With the advent of the Internet of Things (IoT), it is not impossible to imagine that future deployments of WSN will need to

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serve several applications all at once. The term "virtualization" refers to a well-established technique that enables the abstraction of actual physical computer resources into logical units. This makes it possible for several independent users to make effective use of such resources. Multiple applications will be able to co-exist on the same virtualized WSN thanks to this innovative method, which has the potential to make it possible to make effective use of wireless sensor network installations. It is absolutely necessary to investigate virtualization in the context of wireless sensor networks (WSNs), since it is an essential method that must be implemented in order to bring about the Future Internet. The virtualization of wireless sensor networks (WSNs) has a number of advantages. One of these advantages is the potential for applications that were not initially conceived to make use of already-deployed WSNs. The loosening of the tight linkage that previously existed between WSN services and applications and WSN installations is the second advantage associated with this topic. This makes it possible for inexperienced application developers as well as seasoned professionals to create new WSN apps without having to have prior knowledge of the technical particulars of the WSNs that are being utilised. One other advantage is that apps and services provided by WSN may be used by third-party applications as well as being used by those applications. Defining a business model with responsibilities such as physical WSN provider, virtual WSN provider, and WSN service provider might also be of assistance in this endeavour. The idea of virtualizing WSNs may be utilised in a number of different and potentially useful application domains. Multiple on-board sensors are now a possibility thanks to recent technological developments that have made it feasible for autonomous cars and smart phones to operate without human intervention. One application that stands to benefit from the virtualization of these sensors is mobile crowd sensing, which can take use of participatory and opportunistic sensing as well. The paper presents a hypothetical example of opportunistic urban sensing in which it is necessary to make use of thousands of sensors in order to monitor the level of $CO_2$ in an urban area. WSN virtualization may be utilised as a major enabling technology to employ sensors from people to supply the essential data, rather than deploying these sensors and controlling them.

## 6. CONCLUSION

Resource Allocation in Wireless Networks is the topic of the research presented in this thesis. The issue of Quality-of-Service analysis has also been thought about in relation to LTE networks. So, an ' QoS Analysis Framework' was developed to examine and evaluate 'Fairness of Allocation' for both GBR and non-GBR users of the system. By extracting QoS parameters gathered after a certain RAA has been put into use by the system's users, the analytical model may establish both intra- and inter-class fairness. Modules in the proposed QoS analysis framework measure intra-class fairness, where a novel discrimination index and the popular Jain's Index determine fairness and discrimination indexes for allocation values of users, and inter-class fairness, where a novel utility function determines fairness as utility of satisfaction of QoS requirements.

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