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Resources Allocation for Distributed Systems: A Review

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Abstract:
Resource allocation in a distributed system is the process of allocating the workload across multiple resources to optimize the required performance criteria. Different techniques are used to manage resource allocation in such distributed systems. The resource allocation for distributed systems such as cloud computing, cellular network, Software-Defined Networking (SDN), Radar Imaging and 5G Networks are used. In this paper many resource allocation algorithms in different environment and area that mentioned before are reviewed, compared and summarized. for instance, Cloud-based computation algorithm implementations in cloud computing, Direction Method of Multipliers (ADMM) algorithm for SDN Networking, FFR algorithm application in cellular network, Fairness-based Distributed Resource Allocation (FDRA) algorithm for 5G networks, then each the results in each area are discussed in critique point of view.

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1. Introduction

Distributed system, is when distributed computer systems and distributed networks are related and unit-coordinated (Dino et al., 2020; Haji et al., 2020; Shukur, et al., 2020; Zeebaree et al., 2020). Typical features of distributed general systems include: distributed management, service transmission, open environments, structure of networks, allocation of resources and heterogeneous nodes (Vasilenko, 2016; Zebari et al., 2019; Zeebaree, et al., 2020). Then; to satisfy the demand for high performance and sizeable Computing; categorizes existing task allocation and load balancing based on how the features of distributed networks can be performed, including the following aspects: control models, optimization of resources, reliability assurance, communication mechanisms, and network structure consideration measures (Alzakholi et al., 2020; D'Amato et al., 2016; Zeebaree et al., 2019). Several types of distributed systems exist, including peer-to-peer (P2P) systems, cloud computing systems, grids, online social networks and ad hoc networks. A distributed system is a system with multiple components that interact and coordinate behavior on various devices in order to appear as a single coherent system to the end user, also known as distributed computing (Jader et al., 2019; Jiang, 2015; Zebari et al., 2018; Zeebaree et al., 2020). For example, there is limited bandwidth on a network that needs to be distributed to several nodes. Virtual machines (VMs) in cloud systems need to be distributed to various cloud users. Therefore, resource distribution is a central issue in distributed systems. The allocation of distributed resources is especially difficult when nodes work under various control spheres and may not be willing to cooperate (Zeebaree et al., 2020; Haji, et al., 2020). A resource allocation that assumes that a given algorithm is executed by all nodes may break if nodes can take advantage by deviating from the expected actions. For example, network user attempting to monopolize the use of bandwidth (Abdullah et al., 2020; Haji et al.,2021; Khan et al., 2016).While sometimes distributed systems can be unknown, they typically have three key features: (1) all components operate simultaneously, (2) there is no global clock, and (3) all components fail independently of each other. It is necessary to handle efficiently restricted computing and network resources management. Many of the critical resource management issues for cloud computing, cellular network, SDN network, these are modeling requirements and allocating resources to users (Dino et al., 2020; Shukur et al., 2020; Zehra & Shah, 2017). The potential advantages of solving these problems include improvements in usage, scalability, quality of service (QoS) and efficiency, as well as reductions in latency and costs (Dino et al., 2020.; Kim et al., 2017). The researchers in the past years proposed several algorithms to resolve that problem on cloud computing distributed resource allocation, cellular network, SDN network, and so on. In this paper we focus on several researchers' studies in recent years, and summarize several algorithms are used in this field in order to solve the above issue.

The contents of this paper will be structured as follows: section 2 presents brief information about resource allocation, section 3 presents the areas in which the distributed resource allocation are needed, and finally, section 4 provides a description and ideas for possible directions for researchBackground Theory

2. Resource Allocation

In allocating the most relevant resources to applications, resource allocation (RA) structures play an important role. The frameworks delegate tasks to the tools in order to guarantee the application's QoS according to user requirements. RA often adopts dynamicity by assigning resources. These structures are referred to as dynamic RA structures and are considered more successful than static structures (Haji et al., 2020; Kim et al., 2017; Sallow et al., 2020). Another presumption is that to prevent underutilization of resources, RA structures should

be built in such a way. RA structure provide two basic services: Resource monitoring, and Resource scheduling. Monitoring of resources periodically measures the performance, capability, and use of resources and related reservations. These resources include processors, disks, memories, and channel bandwidths. The data is then obtained by the scheduler who decides on the allocation of the request to the underlying resources (Ahmed & Abduallah, 2017; Aral, 2016; Saeed et al., 2021).

3. Distributed Systems

Dynamic systems are named distributed systems, separated into several elements sub-systems by the sparsity of their inter-component relations. Allow to technological and Plants for financial reasons, manufacturing systems and networks are developed with an ever-increasing complexity (Misik et al., 2016; Rashid et al., 2018; Zeebaree, et al., 2019). Here we give describe some of the distributed systems.

3.1. Cloud computing

Cloud computing offers inexpensive and fast access to computer resources including: servers, networks, storage, and services. Cloud providers need to control, distribute and assign these resources effectively to offer services to cloud users based on service level agreements (SLAs) whereby both parties agree to use the services prior to the user. An appropriate and scalable resource allocation system is required to properly distribute these resources and satisfy the demands of users (Dwivedi et al., 2016.; Rashid et al., 2018) .

3.2. Cellular network

The fifth generation communication is a system that has features beyond the present generation technology. In the fifth generation of mobile networks, one of the most important developments is device-to-device connectivity. Increased spectral performance, power and energy, capacity, and service networks, decreased congestion and latency, enhanced reliability, improved coverage and cost effectiveness are the advantages of using device-to-device communications. In cellular networks, device-to-device communication creates interference, which interferes with device-to-device communication users and cellular users. The way to avoid or decrease interference is to properly distribute resources. Power management or spectrum allocation is the object of resource allocation. Optimal spectrum allocation implies how to optimally distribute user-available frequency sources that maximize qualitative or quantitative criteria (Huang et al., 2019; Zeebaree & Jaksi, 2015; . Zeebaree, et al., 2019).

3.3. Software-Defined Networking (SDN)

The Software Defined Network (SDN) is a system that provides scalability and network efficiency by detaching the control plane and the data plane. Depending on task styles and user requirements, it is often hard to assign resources. The central SDN controller offers a global view of the network that makes the allocation of resources more reliable (Qaqos et al., 2018; Zehra & Shah, 2017).

3.4. Radar imaging

Radar imaging has been commonly used in monitoring the environment and disasters through remote sensing. The processing of high resolution images with minimal device resources is of major importance for early warning and disaster prevention. In order to expand in space and achieve a large spatial spectrum, the conventional distributed radar system utilizes a large number of transmitters and receivers. Under a particular geometry setup, the limit resolution is deduced by evaluating the spatial spectrum. In a traditional

distributed radar system that uses multiple platforms, a large number of array elements are needed (Xu et al., 2019).

4. Literature review

Aral (2016) presented an allocation of computational and network capital to cloud activities that in each case of cloud data centers need creative approaches, Inter-Clouds and geographically distributed clouds in order to optimize various performance criteria, such as latency, throughput and cost. Problems in cloud systems in many resource allocation including Inter-Clouds and Mobile Clouds are innovated to investigated solutions of these problems. The authors worked in three different areas which are Data Center Resource Management, Inter-Cloud Resource Management and Geo-Distributed Resource Management. The results are shown that maintaining utilization rates similar to each other actually increases utilization significantly. Cheng et al. (2016) stated that in hybrid data center and edge server network, where integer constraints are added to the allocations, the hybrid network is comprised of one virtual cloud center and several edge servers, they specified the problem of resource allocation. When assigning them to adjacent edge servers and the cloud center, The endpoint request method may be separated into smaller fragments at random and allocated to various end servers and the cloud core. The optimization model should not take the specificity of network services and service demands into account. To solve this non-convex program, the authors developed two successful optimization algorithms, both based on the multiplier alternating path method (ADMM) and a distributed integral projection scheme. The first algorithm avoids the integer limitations in the optimal solution and resolves the flexible convex program, while the second algorithm maintains the integer restrictions.
Khan et al. (2016) the resource allocation auctioneer was introduced in decentralized systems. Nodes in decentralized systems must also work along with each other in a fair manner to access shared resources. Depending on auction processes is one solution to carrying out such arbitration. A failure of a centralized reliable control point in many networked systems including cloud of cloud, edge clouds, and community networks among others. By making theoretical and practical contributions, the authors did share the function of the auctioneer. On the theoretical side, the authors proposed a model of auctioneer distributed simulations that are resilient to coalitions and asynchrony in Nash equilibrium. And, from a practical side, to parallelize the execution, the protocols exploit the distributed design of the simulations.

Dwivedi et al. (2016) presented the allocation of cloud computing resources in the cloud framework to information storage, data collection and delivery of services to anywhere in the world with the help of the Internet. In this case, cloud computing is a fundamental factor, offering greater versatility and scalability with the ability to minimize associated costs. Current approaches prioritize VM migration and physical resource allocation to VM, resulting in cloud service suspension due to the mandatory shutdown of related VM migration. At the application level, the goal of better resource utilization in the cloud environment author implemented resource allocation. The experimental findings show that the resource allocation scheme based on the threshold increases resource utilization and reduces user consumption costs. Vasilenko (2016) dynamic allocation of cloud services for telecommunications applications has been implemented. The advantages of using cloud computing and networking services for the implementation of telecommunication applications have been generally understood by telecommunication operators, while the scalability of hardware capacity is the telecommunication operator's. In order to ensure the cost-effective development of new services, operators are seeking the ability to dynamically assign appropriate, but not excessive, hardware capabilities that meet elastic end-user

requirements. To address a large variety of ideas for resource allocation presented by telecommunication operators, the author optimized technological process technique based on Technological Process Diagram, Balanced Technological Process and Technological Functions with Recipes. Allybokus et al. (2017) the real-time reasonable resource allocation task issue has been discussed in the scope of a distributed Software Specified Networking (SDN) network control model. Unloading the network control(e.g., routing, resource allocation) to powerful remote systems that capture and manage a local or global based on the network state in full detail, SDN technologies are fundamentally changing network architectures and forcing continuous configuration changes to the network equipment. For a distributed algorithm for equitable resource distribution, the author defined two primary criteria. First, in a limited number of iterations, converging to a "good" equitable solution and second, in all iterations, generating feasible solutions. In a distributed SDN control system, the Alternating Direction Method of Multipliers (ADMM) algorithm gives an acceptable issue of resource allocation. The ADMM-based algorithm contribution to make a set of solutions for allocation of resources that correlate to a rational allocation while still remaining feasible.

Bui and Jung (2017) presented in Heterogeneous Network Distributed Resource Distribution. Small cells are lesser cellular radio access networks that reuse the same frequencies several times within a geographical area to allow the most use of the available bandwidth. However, they initiated the deployment of small cells (e.g., femtocells), such as interference with cross-tier (macrocell-femtocell) and co-tier (femtocell-femtocell). Femtocell is suggested to provide higher throughput coverage with low cost in the wireless cellular field as promising problems. In order to prevent cross-tier interference in each cell, they used the FFR scheme to delegate macrocell sub-bands. Kim et al. (2017) proposed a resource distribution controller for key-value data stores, such as Aero Spike, with an ever growing need for large-scale real-time data processing. Although these data stores will improve security significantly, they are also struggling through workload increases to achieve Quality of Service (QoS). The efficient data storage model for storing and handling data as associative arrays that they support, key-value data store engines have recently gained significant attention. They presented the issue of QoS-aware allocation of resources in key-value data stores for workload surges. For such a platform, the authors suggested a resource allocation controller that increases the overall efficiency of query processing in keeping with QoS specifications. The results are maintaining operational request rate for every client. Ren et al. (2017) in cache-enabled cellular networks, presented a distributed user group and resource allocation approach. For network operators, cache-enabled cellular networks have been seen as a viable solution to deal with the expected increase in data traffic in upcoming 5G networks. A mixed integer nonlinear programming (MINLP) problem is a problem of user association, that the authors formulated it. The goal is to balance the overall usefulness of the bandwidths with the total bandwidths collected from caches. They suggested a distributed relaxing-rounding approach to solve this problem, the authors then round up the solution obtained to create a single association solution and it solves the resulting problem. Shi et al. (2017) presented distributed optimization under directed topology for resource allocation with event-triggered communication. Concentrate on the issue of resource distribution with limitations of equity and inequalities in a fixed weight-balanced directed or undirected network. It is aimed at optimally allocating a certain amount of services to various agents. A completely decentralized sub-gradient algorithm was proposed with event-triggered based on first-order nonlinear multi-agent structures to solve the above resource allocation problem. Where each agent only interacts with its neighbors, only local information is needed for the triggering function. Also an algorithm to decrease the total cost was presented. By utilizing the states

obtained from themselves and their adjacent agents at their final triggering moment, each agent updates its state. The solution is to minimize the cost of multi-agent.

Alam et al. (2018) proposed communication-efficient distribution of distributed multi-resource. Many resources should be shared to competitive Internet-connected devices which are interconnected by different resources. Issues are harder to explain than those of a resource. The authors implemented the algorithm of additive-increase multiplicative-decrease (AIMD) that only requires a little system-agent coordination. Which include, if one of the assigned services exceeds power, a control device sends a one-bit signal to agents. Agents then reply in a probabilistic way to this signal. Each agent takes a decision on its resource requirements locally in the proposed algorithm and an agent is ignorant of the resource allocation of other agents. The result is that the average allocations of multiple resources converge over time to the optimal solution. Dominic and Jacob (2018) discussed, in a device-to-device (D2D) network, cellular network foundation in a moment environment, resource allocation and sharing channel. One of the several interesting approaches for fulfilling the need for increased bandwidth in future networks is a D2D network that underlies cellular networks. They suggested allocating channel and power levels to D2D pairs while maintaining the cellular user equipment's quality of operation. The issue is constructed as a Stackelberggame with costing. The rates for the networks to guarantee the QoS of the CUEs are fixed at the base station. Also an uncoupled stochastic learning algorithm was proposed to fixed the channel speeds and levels of power while minimizing the accumulated measured interference. Nabati and Yu (2018) a derandomized algorithm of distribution for charging EV was presented. Effective distribution of resources is difficult where user privacy is relevant. Two distributed resource allocation methods, AIMD algorithm and competition, the authors compared a collection of AIMD-based distributed algorithms for successful and private resource allocation in application areas. Two types of application-based utility functions for users were discovered. First, growing concave features explicitly to reflect software greediness, and second, sigmoidal functions to explain the usefulness of products that are only useful in appropriate quantities. The allocation of resources is known as a complete problem of utilitarianism, which is an optimization issue of the value of user utility functions that are due to power constraints. To the probabilistic comparison version, the stochastic AIMD algorithm is derandomized and the issue is designed as a competition game to determine the performance characteristics of a particular balance when parameters of resource distribution change. Karimianfard and Haghighat (2018) introduced a generalized method for the delivery network allocation of active and reactive power resources. The proposed method was based on the traditional AC load flow model and can be used to assign arbitrary resource numbers while preserving unchanged method computational tractability. The model of AC load flow which can have detailed outcomes without solving advanced optimization programs, and the result is reliable by that model is produced. Dhiah El Diehn et al. (2018) presented admission control and resource allocation in system-of-systems for distributed services. System-of-Systems (SoS) is a model that has been implemented in large-scale systems to deal with the evolving new services that not only require extensive computing resources, but it may also have extra-functional features such as narrow time requirements A complex task is usually classified into subtasks in SoS that have a lower complexity and can be consider individual from each other by several distributed systems. Two main structures needed to manage the distributed functions between the systems are admission management and resource allocation. The distributed admission control problem with resource preparation and allocation for System-of-Systems were established. The solutions were addressed by adding a coordinating protocol that is responsible in a distributed way for the scheduling of resources among all.

Toporkov and Yemelyanov (2018) suggested a concurrent work execution slot co-allocation algorithm; a single slot is a period that can be allocated to a task that is part of a sequential work. A co-allocation of a given number of slots that begin and finish synchronously is necessary for the task start. The authors discussed the issue of distributed slot collection and co-allocation for concurrent work. A general window allocation algorithm was suggested and considered for this reason. To address a general case optimization problem, a special slots subset allocation protocol is applied. The authors find that it is based on a three-dimensional dynamic programming model that is also ideal for use in an instructional method. Xu and Zhuang (2018) in heterogeneous wireless connectivity presented an uplink problem of resource allocation in cross-layer which is modeled as min-max variable stochastic programming based on incorrect Channel State Information (CSI). The allocation of resources is vulnerable to delay limitations, probability of service interruption, radio frequency of the system, and overall power usage. At the physical layer, the sharing bandwidth and capacity allocations are focused on CSI, and at the connection layer on the Queue State Information (QSI). The author designs the challenge of power bandwidth and power allocation as min-max variable stochastic programming in order to determine and problem the transmission delay to solve the above resource allocation. Then, the techniques of Dinkelbach-type and dual decomposition are used to construct the ODBPA, and the SDBPA is recommended to reduce the complexity of the computation. The results are shown that energy efficiency and data rates are significantly improved. Zhang et al. (2018) a Joint Computation Offloading and Resource Allocation Optimization (JCORAO) method has been proposed in heterogeneous mobile computing networks. The combination of wireless network service and cloud computing to enable MTs to widely enjoy the available wireless resources and powerful processing capacity are a typical model of Mobile Edge Computing (MEC) system. An optimization dilemma is proposed by Uplink sub channel allocation to achieve the right computer offloading technique, uplink data transmission allocation and computer resource planning. The efficiency issue is subdivided into two sub-problems, and according to NP-hard method. They developed wireless resource allocation algorithm (CWRAA) sub-algorithm. The mechanisms for sub-channel allocation include of the uniform zero frequency reuse method (UZFR) despite interference and the variable limited frequency method. The results are shown that the decrease the energy consumption and task completion time with lower complexity. Wang et al. (2020) suggested a dispersed assignment of time-varying services. In order to solve the optimum resource distribution problem with time-varying cost functions and resources for continuous-time multi-agent systems, the authors proposed distributed algorithms. A significant type of distributed optimization problems is the Optimal Resource Allocation Problem (ORAP), where all agents fulfill any common demand while minimizing global cost functions. Continuous Time (CT) algorithms for the ORAP were spread by the authors with time-varying cost functions and tools. The suggested distributed dynamic system has been shown to resolve the ORAP with time-varying cost functions by integrating the prediction-correction technique with the concept of finite time unity, under the expectation of equivalent time varying functions for all specific function optimization. The experiment also demonstrated that the optimal results of continuous-time of the energy storage system in the grid-connected battery are obtained.

Deng et al. (2019) investigated Problems of resource distribution, where agents' cost functions are non-smooth and agent choices are constrained by heterogeneous local constraints and resource constraints of the network. To obtain the ideal distribution of resources, an algorithm which was based on distributed sub-gradient was developed. The authors evaluated the algorithm's convergence towards the accurate value. With the functions of strongly convex quality and weight-balanced digraphs, and that algorithm could resolve the issues of resource allocation. Fu et al. (2019) the distributed resource allocation

problem was presented, where and agent's individual value attempts to decrease as both the overall resource and the local agents' capability are reduced. In many functional implementations, such as demand response, cloud computing systems and economic dispatch of power systems, the issue is encountered. Under limits, the form of issue can be conveyed as an optimization issue. For solving general resource distribution issues, a distributed primal-dual algorithm was introduced. This algorithm was used for the multi-agent network to interact with the convex optimization problem, taking minimal the sum of the optimal solution. The result is minimized by convex optimization. Huang et al. (2019) distributed resource allocation presented in heterogeneous network entities. Mobile networking (5G) of the fifth generation would provide ultra-high bandwidth consumption and energy efficiency, and the ultra-dense heterogeneous network will become the primary infrastructure to increase internet traffic. The authors proposed problems with resource distribution in heterogeneous two-tier networks. Small cell networks have been seen as one of the potential alternatives because of the non-convex property of constraints and the objective function, where interference control and efficient resource distribution are unsolved problems allow to several smaller access points. They broke down the initial problem by deriving the network's average failure probability function. In fact, a Fairness-based Distributed Resource Allocation (FDRA) algorithm is suggested to ensure equality between cognitive smaller access points in order to increase the overall throughput. The result is proposed to further increase the area's throughput. Huang et al. (2020) the distributed network slicing was investigated using both the data network bandwidth capabilities and the processing resources of a coexisting fog computing network, which, can be deployed between base stations and fog nodes to organize and control their bandwidth and computing resources. Thus, the authors suggested a distributed architecture. A distributed resource distribution algorithm was suggested based on Alternating Direction Method of Multipliers with Partial Variable Splitting (DistADMM-PVS). They have shown that DistADMMPVS minimizes the average latency of the entire network and guarantees adequate latency efficiency for each type of service provided. Deng (2020) a distributed resource allocation issue of high order systems, where agent options are limited by network resources, was introduced. The high-order dynamics of agents are involved in this problem, resulting in the uselessness of current algorithms for distributed resource allocation. Through state feedback and gradient descent, a distributed algorithm is developed. The high-order agents globally converge exponentially to the accurate value via the algorithm.

5. Discussion

The algorithms that are used in the study of this paper are summarized based on the algorithms/methods, the objectives and the results, as shown in Table 1.

Table 1: Summarization of the literature

Authors	Year	Algorithm/methods	Objectives	Results
(Aral, 2016)	2016	Cloud-based computation algorithm	To maximize different efficiency criteria, such as latency, throughput, and cost to cloud operations requires innovation.	Increasing utilization by keeping utilization rate close to each other.
(Cheng et al., 2016)	2016	Tow efficient algorithms that are the (ADMM) and integral projection schema.	Resource allocation in hybrid data center and edge server network.	Relaxed convex program is solved by first algorithm while the process is optimized by using integer constraints.
(Khan et al.,	2016	Resource Allocation	Sharing resource	The approach can be

2016)		Auctioneer, theoretical and practical.	auctioneer for resource allocation in decentralized system.	used to implement resource allocation in decentralized network.
(Dwivedi et al., 2016)	2016	Dynamic resource allocation scheme.	In terms of mapping physical resources to VMs at physical level, the goal of improved resource management in the cloud world, resource distribution at the application level to minimize associated costs with larger flexibility and scale ability.	Resource allocation scheme utilization is improved and the cost of user use is decreased.
(Vasilenko, 2016)	2016	Technological process diagram model	To be able to dynamically change resource allocations to fulfill the multiple data center cost and capability proposals.	The costs for implementation And applications are improved.
(Allybokus et al., 2017)	2017	(ADMM) algorithm	Solving the efficient allocation of resources in a distributed SDN control architecture in actual environments.	Fair allocation is remained feasible.
(Bui & Jung, 2017)	2017	Fractional Frequency Reuse schemes (FFR)	To be provide low cost in wireless cellular with higher throughput service to resource allocation in heterogeneous network.	The co-tier interface for femtocells sub-bands is reduced.
(Kim et al., 2017)	2017	Controller of resource allocation	In key-value data stores, QoS-aware allocation of services.	Maintaining operational request rate for every client.
(Ren et al., 2017)	2017	Distributed relaxing-rounding method	The goal is to balance the overall utility of the data rates with the caches' total data rates.	The total utility of data rates in the caches is improved.
(Shi et al., 2017)	2017	Fully Decentralized sub gradient algorithm	The resource distribution problem with equity and inequalities restrictions in a set weight-balanced focused or unfocused network.	The total cost on first order discrete-time multi-agent systems is minimized
(Alam et al., 2018)	2018	(AIMD) algorithm.	Multi-resource allocation via multiple resources among competing internet-connected devices.	improving the average allocations converge over time to optimal solution.
(Dominic and Jacob, 2017)	2018	Uncoupled stochastic learning algorithm	Allocation of channel and power levels to the cellular network underlying device to device network.	Ensuring of the CUEs Without any data exchange between pairs of devices Without CSI's understanding.
(Nabati and Yu, 2018)	2018	(ADMM) algorithm	Efficient and private resource allocation in real life application, when privacy of user is	Identify functions of users are strictly increased

			very important.	
(Karimianfard and Haghighat, 2018)	2018	AC load flow	Active and reactive power resources allocation in the distribution network	Without solving complex optimization programs, the model produced reliable results.
(Dhiah El Diehn et al., 2018)	2018	Coordination protocols	Resource distribution and admission management for system-of-system distributed services.	The resources of all CSs of the SoS in a distributed system are easily scheduled and maintained.
(Toporkov and Yemelyanov, 2018)	2018	General window allocation algorithm	Maintaining non-dedicated and heterogeneous resources	The research proved the utility of optimization of algorithms according to parameters for resource allocation.
(Xu and Zhuang, 2018)	2018	(ODBPA) algorithm, and (SDBPA) algorithm	Reaching the maximum packet delay on each mobile terminal (MT).	Energy efficiency And data rates are significantly improved.
(Zhang et al., 2018)	2018	(CWRAA) algorithm	Determine power transmission and computation resource for offloading of each MTs in the heterogeneous networks	The energy usage is reduced, and with lower difficulty of task completion time.
(Wang et al., 2020)	2019	Continuous-time CT algorithms	Resource allocation for Continuous-time in multi agent system with the cost function of time varying	Optimal results of continuous-time of the energy storage system in the grid-connected battery are obtained.
(Deng et al., 2019)	2019	Sub gradient-based algorithm	Achieving resource allocation in heterogeneous network	Strong convex cost function and Wight-balanced diagraphs
(Fu et al., 2019)	2019	Primal-dual algorithm	The perfect resource Allocation in limited condition and the global aim. The function is the sum of each individual cost function of all local agents.	Multi-agent network by convex optimization is minimized.
(Huang et al., 2019)	2019	(IFDRA) algorithm, and (FDRA) algorithm	To guarantee the resource allocation in two tier heterogeneous networks.	The overall throughput is reduced in heterogeneous networks.
(Huang et al., 2020)	2020	Distributed continuous-time algorithm	Optimally allocate the decisions of agents in the network resource.	The optimal resource utilization is converging exponentially by high-order agents.
(Deng, 2020)	2020	(DistADMM-PVS) algorithm.	Controlling bandwidth and computational resources in frog nodes.	The average latency of the entire network by DisADMMPVS is minimized.

6. Conclusion

As distribution system continues to grow and more complicated, the number of resources that used in distributed computing are also increased, this includes the basic services virtual machines to most complicated instances such picocells and femtocells in 5G cellular networks. The open challenges in this area are how to allocate and distributed such

resources to the millions of users and clients without having a failure or disconnection. So that many algorithms in this filed are conducted in the literature which they are presented in this paper. Firstly, in this study different distributed resource allocation, modeling requirements and allocating resources to multi-agent systems have been studied. In each algorithm all strong and weak points are discussed. Furthermore, the factors that affect the quality and performance of each environment-based algorithm are summarized. As many researchers have tried and are still trying to find optimal solutions for resource allocation in distributed system by using several algorithms there is still required to conduct further advanced algorithm in each area to avoid restrictions that faces the researchers.

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