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Heterogeneous Network Resource Allocation using Improved 0-1 Knapsack Problem

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Abstract

In this paper, a dynamic resource allocation problem is considered that arise in wireless networking. Specifically transmission scheduling problems are studied in cases where a user can dynamically allocate communication resources such as transmission rate based on current channel knowledge as well as traffic variations. We assume that arriving data are stored in a transmission buffer, and allocating the hardware resources between clients average transmission power and average buffer delay for allocation. A general characterization of this trade-off is given , and the behavior of this trade-off in the system of asymptotically large buffer delays is explored. An extension to a more general utility based quality of service definition is also discussed. In this study , the improved weighted 0-1 knapsack problem is applied to yield more efficient results.

Keywords: wireless networks, resource allocation, knapsack problem, quality of service .

1. INTRODUCTION

Since network resources, such as link bandwidth, are limited, many researches in the field of resource allocation have received extensive attention in recent years. The goal of this paper is to provide schemes to allocate the resources in a fair and efficient manner. Thus , a number of centralized and distributed resource allocation schemes have been suggested [1]. Having predictability desirable and fairness in the shared resources allocation has several practical benefits.

Fairness over resources allocation is done in network imparted around various streams of movement which will be an intuitively alluring property for large portions useful benefit . Fairness done to movement administration might move forward the seclusion of the middle of movement streams, to achieve certain guaranteed services such as minimum bandwidths and delay bounds , offers an additional predictable performance , serve as a critical component of a strategy , and eliminate certain kinds of transient bottlenecks . Fairness in allocation of bandwidth capacity through a imparted join need on wide domain.

Flows of traffic passing the computer network, they share not just bandwidth resources, but several kinds of resources " buffer, energy in mobile systems , and processor". Becomes possible to a network which is to be unfair in allocating any of the shared resources, because an excessive use to resource. Therefore, the wanted consequent objective may be Generally speaking fair in the utilization every one of resource in the system[2].

- **Knapsack Problem**

  There are several types of Knapsack Problem these are some of them

- The 0-1 Knapsack Problem (KP) is a combinatorial optimization problem . It derives its name from the problem faced by someone who is constrained by a fixed-size knapsack and must fill it with the most valuable items .Given a set of items, each item has a weight (w_i) and a profit (p_i) .The problem determines the quantity of each item to be included in a knapsack so that the total weight is less than or equal to a given limit, and the total capacity value (C)of the problem could be as large as possible [3] .
- Bounded Knapsack Problem is a simplification of the (0-1 KP) where a specified amount of items is accessible. The most effective algorithm for Bounded Knapsack Problem converts the data instance to a tantamount (0-1 KP), that is solved effectively by a particular algorithm. A specialized algorithm is which solves the problem of expanding core by use of Dynamic problem , such that the number of calculated item kinds is minimum [4].
- Improved Weighted 0-1 Knapsack Method (WKM) provides an optimal solution for resources allocation as a Dynamic programming problem when the total items weights exceed the total capacity. First , a fraction of capacity to total original weights (Wf) is calculated as in equation (1). The improved weight that is proposed in WKM (NW_i) is a ratio of original weight as in equation (2) . The new proposed weight (NW_i) ensures allocating the available resources for all items.

$$Wf = \frac{c}{\sum_{i=1} wi} \quad (1)$$

$$NW_i = Wf \times wi \quad (2)$$

By applying these equations (1 and 2) to algorithm 1, the value of NW_i will be the optimal weight to ensure allocating the required resources for all the involved items[5].

2. Related work

The proposed method is concerned with specific topics of resource allocation that have been studied in related literatures

In 2010 , Yu Sheng , studied A fair and optimal mechanism is required for allocating bandwidth to virtual machine migration in a WAN environment. propose a dynamic resource allocation algorithm running in either centralized or distributed environments[1].

In 2013 , Andr´es Ferragut and Fernando Paganini, studied network resource allocation between users that manage multiple connections, possibly through various paths, wherever every connection is subject to congestion control.They formulate a user centric Network Utility Maximization problem that takes into account the aggregate rate a user obtains from each connection, and suggest decentralized means to obtain this fairness objective [6].

In 2014 , Sarah Lynn Bird, designed a resource allocation framework designed to provide responsiveness guarantees to a simultaneous mix of high throughput parallel , real-time applications in an efficient , scalable and interactive manner. By measuring application behavior directly and using convex optimization techniques, Performance-Aware Convex Optimization for Resource Allocation is used to perform near optimal allocation of resource [7] .

In 2016 , Houda Jmila, enabled dynamic and preventive virtual network resources provisioning to deal with demand fluctuation during the virtual network lifetime, and to enhance the substrate resources usage. She proposed adaptive resource allocation algorithms for evolving virtual network requests , considering a virtual node extension , i.e. an embedded virtual node requiring more resources, when the hosting substrate node does not have enough available resources. And improving the proposal to consider the substrate network profitability. Here work, deals with the bandwidth demand variation in embedded virtual links[8].

3 Classifications of a Network Resources Allocation [9]

Resources allocation include the absolute practice of resources division in the system. Resources allocation will be classified as:

1. Possession: The concept of possession reflects the owners of the resources. two possession types of resources will be adopt: global and individual resources. Single resources are seized by singles and the single level for allocated. Global resources related to systems and are allocated at the system level. For example, global resources are wireless networks channels but single resource is a battery-energy.
2. Consumability : that specifies if the resource reduction in the next resource allocation iteration such as , battery power is consuming but channels are non-consuming
3. Allocability : that believes whether resources can be re-allocated .some resources are single in nature one node can be used only one battery . However, bandwidth in wireless networks may be reallocated to various nodes at the same time.
4. Quantity: multi-resource or single-resource assignments clarify those amount of the quantity allocation of resource. as just one kind of resources is process in an allocation, it's a single resource allotment. Wile when large number of kinds of resources need aid acknowledged at those same time On allocation, it may be multi resource allotment. such as, channel duty for remote networks will be An single resource allocation. But, The point when it will be acknowledged mutually with bandwidth, the allocation becomes a multi resource allotment. Multi resource allotment generally recognizes associated assets at those same time, for example, " radio, rate and control together, or channels What's more battery vitality together ". That what makes the "multi-resource allocation" greater amount perplexing over "single-resource allocation" is the complex relationship between resources and their impact on the network
5. Management: Allocations can be either in a dole out style or controlled centrally. In the localize management, a single dominance unity do allocation decisions usually depend on complete information of the system. While done conveyed management, the hubs make allotment choices themselves, basically In view of neighborhood data of the framework . Often, disseminated administration will be not as a reasonable Likewise unified control due to absence of data. though, there will be insignificant management correspondence overhead, insignificant calculation What's more shorter data accumulation occasion when with dispersed oversaw economy.
6. Scope: depend on the scope of allocation it will be arranged Likewise local or global. The local allocation considers allocation locally, while global allocation allocates resources at the overall system phases. Worldwide allocations might hold numerous local allocations. such as, channel allocation done in a large area remote network contain different local allocations since channels can be allocated in various domestic region if no interference is cause.
7. Static What's more changing individual Set: Resource allocation might Additionally make ordered Similarly as dynamic individual and static individual allocations by knowing whether the individual set is dynamic alternately static . For example , in mobile ad hoc networks , remote hubs associate Furthermore clear out those networks rapidly requiring the asset

allotment with Think as of topology transforms where as in IEEE 802.22 networks, the nodes would generally static.

4. The Fairness in a Resource Allocation

Fairness is a predictability eligible property in the resources allocation in a diversity of situations. In economics and sociology, fairness strategies and metrics have been exhaustively studied in the allocation of welfare and wealth [2]. In OS, they have been mulled over in task scheduling and the access allocation to resources for example I/O, memory and bus [10,11]. In the networks of the computer, they have been mulled over in the available bandwidth allocation among competing flows [2]. having predictability desirable and fairness in the shared resources allocation has several practical benefits.

5. The General Structure of The Proposed System:

The proposed system consists of two main sides. The first side(client side) , where each employee needs to entering each member of the (printer , scanner , screen , CD and USB) . And the second side (server side) is responsible for exchanging information about and processing as shown in figure 1. The database contains a set of tables, each table resource of network resources. Each resource contains a number of suppliers as well as their status (on / off) , as well as a table containing the priority of each client, and the capacity of each resource .

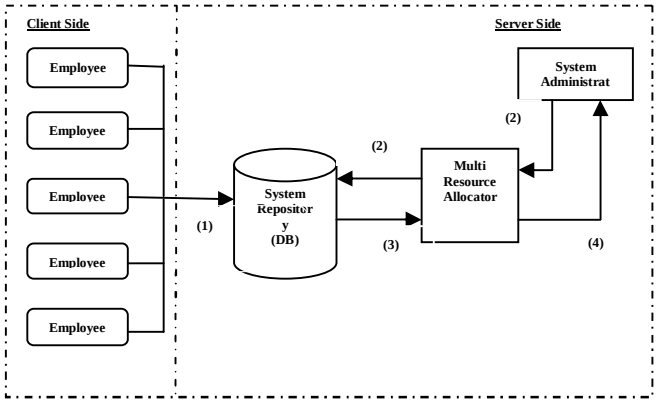

Figure 1 Functional diagram of the proposed system

the results obtained by implementing the improved algorithm(1) WKM to network resource allocation , The allocation of network resources for (printer , scanner , screen , CD and USB) by the every need client of resources .

Algorithm 1- Improved Weight 0-1 Knapsack Algorithm

Input:$W_{resource}$: Weight of each resource ,$P_{resource}$: Profit of each resource, C : Capacity
Output: W : new weight before update , SP : array of subproblem to find an optimal solution, X : 0 or 1 select resource or not

Step1: $SP_{i,j} \leftarrow \{(0,0)\}$ // resource : number of resource , TN :total number of resource
Step2:for resource = 1 toTN − 1 do
sum ←sum + $W_{resource}$
end for
fraction ← C / sum
for resource = 1 toTN − 1 do
$W_{resource} \leftarrow W_{resource}$ * fraction
End for
Step3: for resource = 1 toTN do //Capcount: Capacity count
for Capcount ← 0 to C do
if $W_{resource} \leq$ C then //
if $P_{resource}$ + SP[resource − 1, Capcount − $W_{resource}$] > SP[resource − 1, Capcount]then
SP[resource, Capcount] ← $P_{resource}$ + SP[i − 1, j − $W_{resource}$]
else
SP[resource, Capcount] ← SP[resource − 1, Capcount]
Endif
else
SP[resource, Capcount] ← SP[resource − 1, Capcount] // $W_{resource}$>C
Endif
end for // Capcount
end for // resource
Step4: resource←TN,Capcount←C
Step5: while resource and Capcount> 0
if SP[resource−1,Capcount] ≠ SP[resource,Capcount] then
resource← resource−1, Capcount←Capcount-$W_{resource}$
$X_{resource}$=1
else
resource←resource−1
$X_{resource}$=0

endif
endwhile

6. Proposed system implementation

This part clarify the implement of the proposed system data entry and the results as well as information about each client and the validity resource allocation for all client as in the following :

- **Employee Feeding**
  At each client , there is at least one employee who is responsible for entering the necessary information needing the resource to be allocated (printer , scanner , screen , CD and USB) as shown in figure 2.

Figure 2 employee Feeding.

These information are stored at the proposed system's database (Repository) .

- **The Request of Resource Allocation**

After entering data for each client in the client side, they are stored in the database for each client , The system administrator will send request to the DB about the capacity for each resource allocation problem, and data for client in order to be processed by algorithm (1) of step 2 in figure (1) to allocate resource for each client . On server side , administrator will check the priority for all client as shown figure (3) and The validity resource allocation for all client as shown figure (4) .

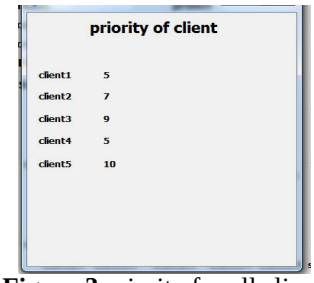

Figure 3 priority for all client

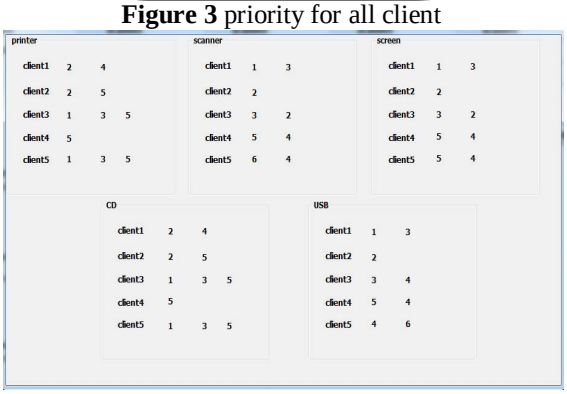

Figure 4 The validity resource allocation for all client

After the tests have been processed in the algorithm that previously is reported in the section 5 and have been stored in the database they can be retrieved by the system administrator and the algorithm developed in section 5 is applied to get the best allocation of resources for each client shown in a Figure 5

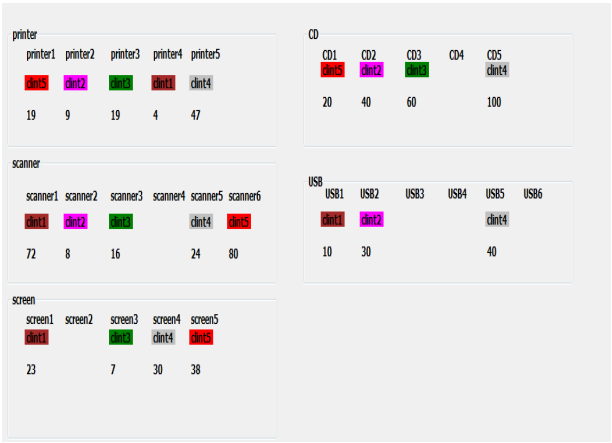

Figure 5 Resource allocation the to client

7.Conclusions

The DP technique is one of the most important mathematical methods in decision making, the fact is this technique works to raise the ability of search for the optimal solution for many problems, and so by fragmentation of partial problems, then re-install these partial decisions and assemble for optimal resolution .The application of proposed system (WKM) will ensure the reduction of problems' cost and time , and increase the optimality of resource allocation .

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