

Resource Allocation Technique to Obtain Energy Efficient Cloud تقنية تحديد المصادر للحصول على سحابة تستخدم الطاقة بفعالية

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Resource Allocation Technique to Obtain Energy Efficient Cloud

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ABSTRACT

Cloud Computing has emerged the information and communication technology by

providing end users by on-demand computing resources. The enormous demand on cloud

computing services resulted in setting up datacenters around the world with thousands of

computer stations. However, these datacenters consume huge amount of power thus

increasing operational costs in addition to the negative impact on the environment. This thesis

presents an enhanced resource allocation technique, proposes a model, and employs a broker

that uses the enhanced resource allocation technique taking into consideration two factors; the

CPU and the RAM.

This thesis surveys the field of resource allocation for a better green cloud and studies

the impact of several parameters rather than one parameter. We took the CPU and the RAM

into consideration unlike other studies where they took only the CPU utilization into

consideration. In this research, we proposed a new formula to combine the two resource

factors which are the CPU and the RAM instead of including only one factor which was the

CPU. We enhanced the resource allocation algorithm and we designed a model.

Experiments and simulations were conducted in order to check power consumptions

throughout different scenarios. Accordingly, we could find the weight of each parameter to

formulate this relation and use it in the enhanced algorithm. We evaluated our work by

implementing a broker that uses the enhanced algorithm for virtual machine distribution and

the result was 17% energy saving.

Keywords: Cloud Computing, Datacenters, Green Cloud, Virtual Machine

تقنية تحديد المصادر للحصول على سحابة تستخدم الطاقة بفعالية

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ABSTRACT IN ARABIC الملخص

ظهرت سحابة الحوسبة وتكنولوجيا المعلومات والاتصالات من خلال تزويد المستخدمين من موارد الحوسبة عند الطلب. أدى الطلب الهائل على خدمات الحوسبة السحابية في إنشاء مراكز البيانات في جميع أنحاء العالم مع الآلاف من أجهزة الكمبيوتر. ومع ذلك، هذه مراكز البيانات تستهلك كمية كبيرة من الطاقة وبالتالي تزداد التكاليف التشغيلية بالإضافة إلى الأثر السلبي على البيئة. تقدم هذه الأطروحة تعديل على خوارزمية تقنية تخصيص الموارد، وتقترح نموذجا، وتوظف وسيط يستخدم تقنية تخصيص الموارد المعدلة مع الأخذ بعين الاعتبار عاملين اثنين؛ وحدة المعالجة المركزية وذاكرة الوصول العشوائي.

هذه الأطروحة تستعرض مجال تخصيص الموارد لسحابة صديقة للبيئة أفضل، كما تدرس تأثير العديد من المعاملات بدلا من معامل واحد. أخذنا وحدة المعالجة المركزية وذاكرة الوصول العشوائي في الاعتبار على عكس الدراسات الأخرى حيث أخذوا فقط استخدام وحدة المعالجة المركزية في الاعتبار .في هذا البحث، اقترحنا معادلة جديدة للجمع بين معاملين من الموارد التي هي وحدة المعالجة المركزية وذاكرة الوصول العشوائي بدلا من استيعاب عامل واحد فقط وهو وحدة المعالجة المركزية. كما قمنا بتعديل خوارزمية تخصيص الموارد وصممنا نموذجا للعمل.

أجريت تجارب ومحاكاة من أجل التحقق من استهلاك الطاقة في سيناريوهات مختلف . وفقا لذلك، أوجدنا وزن لكل معامل لصياغة العلاقة واستخدامها في تعديل الخوارزمية. قمنا بتقييم

عملنا من خلال توظيف وسيط يستخدم الخوارزمية المعدلة لتوزيع الأجهزة التخيلية وكانت النتيجة 17% توفير للطاقة.

كلمات البحث: سحابة الحوسبة، مراكز البيانات، السحابة الصديقة للبيئة، الجهاز التخيلي.

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LIST OF ABBREVIATIONS

A Amperes

CO2 Carbon Dioxide

CPU Central Processing Unit

CPUC Number of CPU Cores

CPUS CPU Speed

CRUO Minimum Usage of CPU

CTDS Cache Data Size

Data Amount of Data on RAM

FSBS Front Side Bus Speed

Gbit Amount of Data to be Processed by the CPU

GHG Greenhouse Gas

I Current

IaaS Infrastructure as a Service

MM Minimization Migration

OCCUR Operating System Use Rate

OSRU Operating System RAM USE

PaaS Platform as a Service

PT1 Total Power Used in Type (1) Data Load

PT2 Total Power Used in Type (2) Data Load

PT3 Total Power Used in Type (3) Data Load

RAM Random Access Memory

RAMS Ram Size

RLOR Reserved Location on RAM for CPU

RT1 RAM Size in Type 1 Data Load

RT2 RAM Size in Type 2 Data Load

RT3 RAM Size in Type 3 Data Load

S Seconds

SaaS Software as a Service

V Volts

VM Virtual Machine

CHAPTER 1

Introduction

1.1. PREFACE

Recently, organizations and industries used to face a lot of problems; doing certain office and business tasks, retrieving information and gaining services while paying huge amounts of money. Nowadays, using up-to-date technologies and computing services can help solving severe problems with a click of a button; one of the suggested solutions was designing a cloud full of services and resources.

Cloud Computing is a model that permits computing to be obtained as a service, thereby changing computing from a capital rigorous activity to an expense item. Cloud computing empowers consumers to focus on solving their specific business problems rather than on constructing and maintaining computing infrastructure. Cloud computing is likely to be one of the good solutions found during hard times; where cloud proved to be a considerable benefit to any organization due to its flexibility and pay-as-you-go cost structure (Beik R. 2012).

The increasing demand on cloud computing services was empowered as a result of embracing features like convenience and on-demand access to shared resources. Many computing services moved to the cloud, and cloud computing had to scale-up dynamically to support new demands without losing quality of service. However; scale-up leads to more

energy consumption since it requires deploying new resources and as a result; there will be more environmental impact and carbon dioxide emissions (Beloglazov A & Buyya R. 2013).

Attention has received regarding the energy usage in a cloud computing model and there is recognition of the need to manage energy consumption across the entire information and communications technology.

It is essential that cloud providers use the cloud resources more efficiently so there won't be huge amount of energy consumption. There will be several suggestions to reduce the amount of energy to be consumed, for example; the use of hardware devices with less energy consumption, sleep scheduling, and the use of virtualization to improve resource utilization in cloud computing datacenters and eases the software customization, patching and the portability (Kaur M & Singh P. 2013). Data can be even transferred from one cloud to another using virtual machines or hypervisors through the Open Virtualization Format in case any compatibility issue arises. As a result, the term "Green Cloud" was introduced.

Prangchumpol defined the Green computing as "the study and practice of using computing resources efficiently" (Prangchumpol D .et al. 2009). Wu proposed Green Computing as applying power management in cloud (Wu Z & Wang J. 2010). One of the main characteristics of the Green Cloud Computing is to achieve a balance between the resource consumption and quality of service (Geronimo G. et al. 2013).

In the contrary; it is important to know how to reduce energy consumption in datacenters that host cloud computing services without sacrificing service availability (Geronimo G .et al. 2013), it is also important to consider the energy required to transport data to and from the client and the energy consumed by the client interface.

We should not focus only on the energy consumed within the datacenter but we also have to get a clear image of the total energy consumption of a cloud computing service, and understand the potential role of cloud computing to provide energy savings, therefore comprehensive analysis is required.

Several studies were conducted to ensure power savings, where in this research we performed different tests to gather information and results in order to find a solution for the energy consumption problem and the ongoing increase in it.

We took several factors into consideration; we applied several experiments and used simulators in order to ensure results accuracy. Depending on these results we could formulate a relation between the CPU and the RAM. Furthermore, this relation was used to enhance the resource allocation algorithm.

1.2. RESEARCH PROBLEMS

In this research; we emphasized on Virtual Machine energy efficient consolidation based on task and jobs' specifications in the Infrastructure as a Service "IaaS" environments.

This research discusses the problem of how to maintain a cloud to provide services with minimum energy consumption. We developed (enhanced) a technique that maps between the client requirements and the most proper way to allocating the resources in order to reduce energy consumption. Enhancing cloud computing services to achieve modified services and to ensure reducing energy consumption and as a result; green cloud

computing services has been achieved. Goals will be accomplished by answering the following questions:

- 1. What are the main factors that affect the energy consumption in the cloud environment?
- 2. How to enhance the existing algorithm in the domain of resource allocation in order to reduce energy consumption?
- 3. What are the main improvements, mainly in resources allocation algorithms, that can be done on the cloud computing model to be a green cloud?

1.3. RESEARCH OBJECTIVES

The main objective of this work is to build a green cloud thus ensuring minimal energy consumption. This will be accomplished by deploying a broker, which can handle resource allocation with minimum energy consumption. In order to accomplish this; we enhanced a resource allocation algorithm designed by Buyya and make it take into consideration two parameters; the CPU and the RAM. Additionally, number of issues to be addressed, such as:

- ❖ The implementation and evaluation of the proposed system.
- ❖ How the broker will help reducing energy consumption.
- ❖ Explore, analyze, and classify the research in the area of energy-efficient computing to gain a systematic understanding of the existing techniques and approaches.

- ❖ Conduct competitive analysis of algorithms for VM consolidation to obtain theoretical performance estimates and insights into the design of online algorithms for dynamic VM consolidation.
- Enhance online algorithms for energy-efficient distributed VM consolidation for IaaS environments.
- Design and implement a VM consolidation system that can be used to evaluate the proposed algorithms.
- Draw the conclusion that clarifies and explains the process and the results briefly.

1.4. MOTIVATION

The main motivation to conduct this project is that scientists all through the years focused on improving better services for end users and how to provide them with golden experiences using the cloud without taking into consideration the negative impact affecting different aspects in our lives. Recently, major attention was received on carbon footprint caused by the cloud effecting the environment which caused us to mitigate our work on how to introduce energy-efficient cloud.

Cloud computing formation has resulted in creating large datacenters around the world containing thousands of computer nodes. Thus huge amounts of electrical energy are consumed so high operational costs and carbon dioxide (CO₂) emissions into the environment were introduced. Furthermore, recently the global emissions of carbon dioxide

in the ICT industry have been estimated to be 2% (Koomey K. 2011), which is equivalent to the emissions of the aviation industry.

Energy consumption in datacenters will continue to grow rapidly unless advanced energy efficient resource management solutions are developed and applied.

One of the outcomes of green cloud computing is that it is less taxing on the environment due to lower carbon emissions.

Energy consumption is certainly a major concern in the datacenter and it is being highly highlighted in this research, and cloud solutions are more efficient than traditional systems.

It is necessary to reduce inefficiencies and waste in the way electricity is delivered to the different resources in the resource pool so as a result the problem of high energy consumption will be tackled, and in the way these resources are utilized to serve application workloads. This can be done by improving both the physical infrastructure of datacenters, and the resource allocation and management algorithms.

1.5. RESEARCH METHODOLOGY

The main idea in this research is to enhance the resource allocation algorithm designed by Buyya which takes into consideration one factor only. Make the enhanced algorithm take into consideration both factors the CPU utilization in addition to memory instead of one factor.

We established a model to conduct an evaluation based on a hardware simulation and a simulation. This model implies to requirements as input and the best resources' allocation as output and finds the optimal way to allocate these resources according to minimum power consumption taking two parameters the CPU and the RAM, while existing algorithms take into consideration one parameter only.

1.6. CONTRIBUTION TO KNOWLEDGE

After conducting this research, several contributions were reached. We related the CPU to the RAM after series of testing and scenarios to study the effect of several factors instead of one, and as a result we could enhance the resource allocation algorithm. We can summarize in the points listed below:

- Survey the field of resource allocation for a better green cloud.
- Study the impact of several parameters rather than one.
- Propose a new formula to combine two resource factors which are the CPU and the RAM.
- We designed a model and enhanced the resource allocation algorithm.
- An evaluation was implemented and the result was 17% energy saving.
- Based on the results of this study; the larger the RAM is the less the power consumption will be depending on the task.

1.7. THESIS LAYOUT

The layout of the thesis corresponds to the structure of the work, as undertaken throughout the study. Following this introductory chapter, the thesis includes five more chapters, references and appendices. A brief content description for the five chapters is presented below:

Chapter 2 provides the summary of the literature review and related works that are related to the MSc project to fully understand the main aspects. It details and analyses to the project elements and identifies all of the factors for each element and their assessment methods. In addition, this chapter also highlights the main shortcoming found from both this stage and the literature review stage.

Chapter 3 provides the design of the proposed model and includes the main performance factors with their assessment methods. Furthermore, chapter 3 includes the procedure that was followed to build hardware simulation and the study for the initial performance evolution.

Chapter 4 presents the method and the main outcomes of the test. This test was carried out based on the performance factors, in order to determine the optimum interface setup, which will be used to improve the performance.

Chapter 5 concludes the project and suggests future work in order to improve the final setup and lead to a better implementation of the system.

2. CHAPTER 2

BACKGROUND AND LITERATURE REVIEW

2.1. PREFACE

This chapter provides a background and literature review on the main concepts covered by this research. It is divided into three sections. Section 2.2 discusses the necessary background information that is needed to better understand topics embedded in the thesis. The most related studies in the field of green cloud computing, resource allocation and load balancing are discussed in section 2.3. Finally, section 2.4 presents a summary.

2.2. BACKGROUND

2.2.1. CLOUD COMPUTING

Cloud computing is a subscription-based service where networked storage space and computer resources can be gained by a subscriber. Using cloud; information can be accessed from anywhere at any time (Huth A & Cebula J. 2011).

In a traditional computer setup; it is required for a person to be in the same location as data storage device is, the cloud takes away that step. The cloud removes the need for a

person to be in the same physical location as the hardware that stores the data. Cloud providers can both own and house the hardware and software necessary to run your home or business applications (Lodha P & Wadhe A. 2013).

For small businesses that cannot afford the same amount of hardware and storage space as a bigger company; it is really helpful to use the cloud as a solution. Small companies can store their information in the cloud, removing the cost of purchasing and storing memory devices. Additionally, because you only need to buy the amount of storage space you will use, a business can purchase more space or reduce their subscription as their business grows or as they find they need less storage space.

Having an internet connection is the only requirement that you need to have in order to access the cloud. This means that if you want to look at a specific document you have housed in the cloud, you must first establish an internet connection either through a wireless or wired internet or a mobile broadband connection. The benefit is that you can access that same document from wherever you are with any device that can access the internet. These devices could be a desktop, laptop, tablet, or phone. This can also help your business to function more smoothly because anyone who can connect to the internet and your cloud can work on documents, access software, and store data.

2.2.2. Types of Cloud

There are different types of clouds that you can subscribe to depending on what services and requirements a subscriber needs.

- 1. **Public Cloud** A public cloud can be accessed by any subscriber with an internet connection and access to the cloud space.
- 2. **Private Cloud** A private cloud is established for a specific group or organization and limits access to just that group.
- 3. **Community Cloud** A community cloud is shared among two or more organizations that have similar cloud requirements.
- 4. **Hybrid Cloud** A hybrid cloud is essentially a combination of at least two clouds, where the clouds included are a mixture of public, private, or community.

2.2.3. Types of cloud providers:

A person can subscribe to any of the three types of cloud providers: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS).

These three types differ in the amount of control that a subscriber has over the information, and conversely, how much is expected from the provider to do for the subscriber. Briefly, here is what expected from each type.

1. **Software as a Service** - A SaaS provider gives subscribers access to both resources and applications. SaaS makes it unnecessary for you to have a physical copy of software to install on your devices. SaaS also makes it easier to have the same software on all of your

devices at once by accessing it on the cloud. In a SaaS agreement, you have the least control over the cloud (Huth A & Cebula J. 2011).

- 2. **Platform as a Service** A PaaS system goes a level above the Software as a Service setup. A PaaS provider gives subscribers access to the components that they require to develop and operate applications over the internet (Huth A & Cebula J. 2011)..
- 3. **Infrastructure as a Service** An IaaS agreement, as the name states, deals primarily with computational infrastructure. In an IaaS agreement, the subscriber completely outsources the storage and resources, such as hardware and software, which they need (Lawal B et al. 2013).

2.2.4. GREEN CLOUD COMPUTING

Efficient processing and utilisation of computing infrastructure are not only the main goals to be achieved by green cloud, but also minimising energy consumption that leads to control Carbon Dioxide "CO2" emissions that effects the environment. This is essential for ensuring that the future growth of Cloud computing is sustainable. Otherwise, Cloud computing with increasingly pervasive front-end client devices interacting with back-end datacenters will cause an enormous escalation of energy usage. To address this problem, datacenter resources need to be managed in an energy-efficient manner to drive Green Cloud computing (Beloglazov A & Buyya R. 2013).

Green computing is the environmentally responsible and eco-friendly use of computers and their resources. In broader terms, it is also defined as the study of designing, manufacturing/engineering, using the disposing of computing devices in a way that reduces their environmental impact.

Many IT manufacturers and vendors are continuously investing in designing energy efficient computing devices, reducing the use of dangerous materials and encouraging the recyclability of digital devices and paper. Green computing practices came into being in 1992, when the Environmental Protection Agency (EPA) launched the Energy Star program (Shindeh S et al. 2013).

2.2.5. Green Cloud Architectural Elements

Leading to a Green Cloud computing datacenters is a main aspect lately, to satisfy competing applications' demand for computing services and save energy.

There are basically four main entities involved:

a) **Consumers/Brokers:** Cloud consumers or their brokers submit service requests from anywhere in the world to the Cloud.

It is important to notice that there can be a difference between Cloud consumers and users of deployed services. For instance, a consumer can be a company deploying a Web application, which presents varying workload according to the number of "users" accessing it.

b) **Green Resource Allocator:** Acts as the interface between the Cloud infrastructure and consumers.

- c) Virtual Machine: Multiple Virtual Machines (VMs) can be dynamically started and stopped on a single physical machine to meet accepted requests, hence providing maximum flexibility to configure various partitions of resources on the same physical machine to different specific requirements of service requests. Multiple VMs can also concurrently run applications based on different operating system environments on a single physical machine. In addition, by dynamically migrating VMs across physical machines, workloads can be consolidated and unused resources can be put on a low-power state, turned off or configured to operate at low-performance levels (e.g., using DVFS) in order to save energy (Buyya R et al. 2008).
- d) **Physical Machines:** The underlying physical computing servers provide hardware infrastructure for creating virtualised resources to meet service demands.

2.2.6. CPU UTILIZATION

CPU utilization refers to a computer's usage of processing resources, or the amount of work handled by a CPU. Actual CPU utilization varies depending on the amount and type of managed computing tasks. Certain tasks require heavy CPU time, while others require less because of non-CPU resource requirements.

2.2.7. CARBON FOOTPRINT

A carbon footprint is a measure of the environmental impact of an organization, event, person or product. It measures the total greenhouse gas (GHG) emissions of a given activity or group of activities to provide a measure of the extent to which these activities

produce harmful emissions and therefore contributes to global warming. It is estimated that computing produces up to 3 percent of the world's carbon dioxide emissions. As a result, the carbon footprint has become an important measure in computing (Murock R et al. 2010).

2.2.8. VIRTUALIZATION

The term virtualization broadly describes the separation of a resource or request for a service from the underlying physical delivery of that service. With virtual memory, for example, computer software gains access to more memory than is physically installed, via the background swapping of data to disk storage. Similarly, virtualization techniques can be applied to other IT infrastructure layers including networks, storage, laptop or server hardware, operating systems and applications (Garg V. 2012).

2.2.9. VIRTUAL MACHINE (VM)

A virtual machine is likely to be as a physical computer that runs applications and an operating system, but it is a software computer. The virtual machine consists of a set of specification and configuration files and is backed by the physical resources of a host. Every virtual machine has virtual devices that provide the same functionality as physical hardware and have additional benefits in terms of portability, manageability, and security (McHugh & Michalewics M. 2012).

2.3. RELATED WORK

Adhikari and Patil S simulated a datacenter that comprises 10 heterogeneous physical nodes. Each node is modeled to have one CPU core with performance equivalent to 2500 Million Instructions Per Second (MIPS), 1 GB of RAM, 100 Mb/s network bandwidth and 1 GB of storage. Power consumption by the hosts is determined by the model. They conducted simulations and experiments to verify their algorithms. Results showed that their proposed work can reduce the number of power-on physical machine and average power consumption compare to other deploy algorithms with power saving. Also, the comparison between their algorithms and the Round Robin scheduling algorithms in other cloud shows significant improvement in saving power (Adhikari J & Patil S, 2013).

Armstron enhanced an approach that aligns with the assessment methodology developed by the Global e-Sustainability Initiative (GeSI). The model quantifies energy use and carbon emissions on a per-user basis. To account for the fact that on-premise server counts do not follow a linear scale as user counts increase. They analyze the impact among three different sizes of user groups: small (100 users), medium (1,000 users) and large (10,000 users) (Armstron A. et al. 2010). A demonstration on how associations are taking advantage this technology is bringing, not only in terms of cost but also efficiency and the environment. Sultan gave numerous examples of cloud users and a case study of the University of Westminster was presented and explored in depth. It was argued in this

research that educational organizations are likely to embrace cloud computing as many of them are bound to suffer from under-funding due to the economic crisis. (Sultan N. 2010).

Rajeshkhannan held an investigation about producing a framework including web services and ad-hoc clouds harvesting unused computing resources in a non disturbing manner. The harvested resources can be made available in the form of ad-hoc clouds which can be configured dynamically based on the resource availability and service demands. He proposed an extending concept of the cloud to cover not only server-farm resources but all resources accessible by the user. This brings the resources of the home personal computers and personal mobile devices in to the cloud and promotes the use of highly-distributed component based applications with fat user interfaces. End users were provided with a web application deployed on a cloud; presented as a web application deployed on a separate web server (Rajeshkannan R. 2011).

Berral proposed a methodology of autonomic energy aware scheduling that adapts to differing task styles and workloads dynamically, and even to varying infrastructure. The main contribution is the mixture of technologies such as virtualization and consolidation, mathematical programming and machine learning and data mining (Berral J. et al. 2011). Beloglazov and Buyya found and proved competitive ratios for the optimal online deterministic algorithms for resource allocation problems. They have proposed novel adaptive heuristics that are based on an analysis of historical data on the resource usage for energy and performance efficient dynamic consolidation of VMs taking into consideration one factor (Bolaglazof A & Buyya R. 2011).

Hulkury and Doomun proposed an integrated green cloud architecture; that consisted of a client oriented Green Cloud Middleware to help managers in better supervision and configuring their access to cloud services in the most energy-efficient way. He used predefined system specifications for decision making, whether to use local machine processing, private or public clouds. Analytical model was used to show the feasibility to attain efficient energy utilization while choosing between local, private and public Cloud service provider (Hulkury M & Doomun M. 2012). Beloglazov developed the Cloud computing field in two ways, by playing a significant role in the reduction of datacenter energy consumption costs, and thus helping to develop a strong and competitive cloud computing industry, plus letting consumers increasingly becoming conscious about the environment. They planned to develop a software platform that supports the energy-efficient management and allocation of cloud data center resources (Beloglazov A. et al. 2012).

Beik proposed an energy-aware layer in software architecture that is responsible for automatically evaluating micro-metrics and macro-metrics of energy consumption in datacenters, and provides some policies based on these metrics to evaluate energy consumption of cloud sites, and then makes services to migrate to hosts consuming energy more efficiently (Beik R. 2012).

2.4. SUMMARY

Based on the previous studies and the literature review; there is limited studies taking into consideration RAM and CPU utilization to minimize power consumptions in datacenters around the world.

Most of the previous studies emphasized on how to migrate virtual machines among the servers based on CPU utilization thresholds among servers and to consolidate them in the right way using certain algorithms where they find optimal solutions for such cases.

The next chapter proposes the enhanced algorithm and the model designed which took into account the RAM and CPU utilization.

This chapter has concluded with a discussion of the scope and positioning of the current thesis in the context of the presented arrangement and reviewed research. The proposed research direction of this thesis is energy-efficient distributed dynamic VM consolidation certain constraints in IaaS Clouds. Nevertheless, there are many other open research challenges in energy-efficient computing that are becoming even more important in the age of Cloud computing.

3. CHAPTER 3

GREEN POWER CONSUMPTION MODEL

3.1. Introduction

Several research studies have been done to improve the resource allocation algorithm in order to distribute the virtual machines efficiently taking into consideration one parameter only which is the CPU utilization. These improvements reduce the power consumption within the context of providing sufficient and important information for the broker such as task requirements. The broker will take the role of distributing the virtual machines and provisioning them on hosts. This research proposed a model to conduct an evaluation on power consumption; in addition, Hardware Simulation and simulations have been conducted and will be detailed throughout this chapter. The results of this research could be generalized in different datacenters.

3.2. THE PROPOSED ALGORITHM

In this section we will focus on two factors which are the CPU and the RAM. We will study their effects on the power consumption through different scenarios while conducting the live experiment and the simulation. However, an enhancement has taken place in the previously designed algorithm by Buyya; where he used only one factor which

was the CPU utilization, unlike our work where we included two factors which are the CPU and the RAM.

Based on the resource allocation algorithm which was designed by Buyya, this section explains briefly the role of the algorithm.

The algorithm is split into two parts:

1. Virtual Machine Placement

VM provisioning can be concluded in two:

A - The access of new tasks and requests for VM allocating and placing these VMs on hosts.

B- The current VM allocation optimality.

In the first part of the algorithm presented in figure 3.1, a main factor will be taken into consideration which is the current CPU utilization; where all the VMs will be sorted in a descending order according to their current CPU utilization. Once the sorting phase is over, every single VM will be placed to a host that provides the minimal power consumption for such a placement. As a result, the most power-efficient nodes will be chosen first (Beloglazov A et al. 2012).

```
1 Input: hostList, vmList Output: allocation of VMs
2 vmList.sortDecreasingUtilization()
3 foreach vm in vmList do
      minPower \leftarrow MAX
      allocatedHost \leftarrow NULL
      foreach host in hostList do
6
7
          if host has enough resource for vm then
             power ← estimatePower(host, vm)
8
             if power < minPower then
9
                 allocatedHost ← host
10
                minPower \leftarrow power
11
      if allocatedHost \neq NULL then
12
         allocate vm to allocatedHost
13
14 return allocation
```

Figure 3. 1 Virtual Machine Placement (Beloglazov A et al. 2012).

While in the enhanced algorithm, two factors will be addressed and taken into consideration which is the current CPU utilization and the RAM size; where all the VMs will be sorted in a descending order according to their current CPU utilization and RAM sizes. Once the sorting phase is over, every single VM will be placed to a host that provides the minimal power consumption for such a placement. As a result, the most power-efficient nodes will be chosen first.

2 - The Minimization of Migration Policy.

The Minimization of Migrations (MM) policy is used to decide on picking the least number of VMs to be migrated from a host in order to decrease the CPU utilization below the upper utilization threshold if the upper threshold is violated.

The pseudo-code for this algorithm for the over-utilization case is presented in figure 3.2. The VMs will be ordered in a descending order of the CPU utilization. It repetitively looks through the VMs list and finds the best VM to be migrated from the host (Beloglazov A et al. 2012).

The best VM is the one that satisfies two conditions.

- A- The VM should have the utilization higher than the difference between the host's overall utilization and the upper utilization threshold.
- B- If the VM is migrated from the host, the difference between the upper threshold and the new utilization is the minimum across the values provided by all the VMs.

If such a VM is not found, the VM with the uppermost CPU utilization will be selected, removes it from the list of VMs, and goes on to a new iteration. The algorithm stops when the new utilization of the host is below the upper utilization threshold.

```
1 Input: hostList Output: migrationList
 2 foreach h in hostList do
      vmList ← h.getVmList()
      vmList.sortDecreasingUtilization()
      hUtil ← h.getUtil()
      bestFitUtil ← MAX
while hUtil > THRESH_UP do
          foreach vm in vmList do
             if vm.getUtil() > hUtil - THRESH_UP then
10
                    -vm.getUtil() - hUtil + THRESH_UP
11
                 if t < bestFitUtil then
12
                    bestFitUtil ← t
13
                    bestFitVm ← vm
14
                 if bestFitUtil = MAX then
15
16
17
                    bestFitVm ← vm
                 break
18
19
          hUtil ← hUtil – bestFitVm.getUtil()
          migrationList.add(bestFitVm)
20
          vmList.remove(bestFitVm)
21
      if hUtil < THRESH_LOW then
          migrationList.add(h.getVmList())
          vmList.remove(h.getVmList())
24 return migrationList
```

Figure 3. 2 The Minimization of Migrations algorithm (Beloglazov A et al. 2012).

We took a further step in our research in order to enhance the previous algorithm designed by Buyya. Where the best VM is the one that takes into account both the CPU and the RAM utilization, which were not used in the previous algorithm. The reason for

choosing the RAM size as a second parameter is that the CPU processes the tasks that are being fed by the RAM. However, if the RAM performance is low, this will affect directly the CPU performance which leads to delay in the CPU process; which will increase the power consumption. Furthermore, the RAM parameter has a major impact on the CPU for the reason that the first step of the tasks to be processed will be loaded in RAM and then will be transferred to the CPU.

Based on the enhancement which included the both factors (RAM and CPU) the following three steps should be satisfied:

A- The utilization level for the VM should be higher than the difference between the host's overall utilization and the upper utilization threshold.

B- If the VM is migrated from the host, the difference between the upper threshold and the new utilization is the minimum across the values provided by all the VMs.

C- The RAM size will be checked to match the utilization level of the VM.

If such a VM is not found, the VM with the uppermost CPU utilization will be selected, removes it from the list of VMs, and goes on to a new iteration. The algorithm stops when the new utilization of the host is below the upper utilization threshold.

To increase the power consumption savings and based on the enhanced algorithm; after collecting the data, we found out that in order to formulate the two parameters we have to find the weight of each. The best match between the RAM size and CPU speed was found. The 2.5 GHz CPU will best match a 3 GB RAM and we can formulate it as "2.5 CPU + 3 RAM") which is proved and explained in details in Chapter 4.

3.3. THE ENHANCEMENT

In this section, we presented how we implemented the hardware simulation and the simulation in order to collect the desired results that help us formulate the relation between the CPU and the RAM. This formula will be used to enhance the resource allocation algorithm designed by Buyya.

3.3.1. HARDWARE SIMULATION

In this experiment, it is highly focused on measuring power consumption due to different changes in programs and their resource requirements (i.e. end users' task requirements), in addition to Virtual Machines' specifications.

Managing available resources and efficient scheduling for resources are a great concern in modern datacenters. Cloud computing which is based on virtualization automates the process of distributing available resources among virtual machines. The decision accuracy in the process of virtual machine allocation to proper physical machines will be enhanced. Usually, CPU of physical machines is considered in decision algorithms. However, in this experiment a method will show that to have a balanced cloud, it is necessary to consider more parameters in resource allocation algorithm such as CPU and RAM.

Moreover, the importance of considering weights for the parameters in decision algorithm is presented. It is shown that some parameters are more important than the others and should have higher impact.

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The main purpose of this experiment is to measure the energy consumption with

regards to resource allocation (CPU and RAM). Measuring the energy consumption will be

handled using different devices that are listed below:

1- Voltmeter.

2- Ammeter.

3- Physical Machine.

An ammeter is a measuring instrument used to measure the electric current in a

circuit. Electric currents are measured in amperes (A).

Where a voltmeter is an instrument used for measuring electrical potential

difference between two points in an electric circuit.

Electrical potential difference is measure in volts.

Different codes were implemented and ran by the virtual machines; one to give

extra load on the CPU and one to give extra load on the RAM, and then the power

consumption was measured accordingly.

Procedure:

The experiment was applied on a physical machine with the below specifications:

Processor → Pentium 4

CPU → 3.00 GHz

RAM \rightarrow 2.00 GB

System Type \rightarrow 32 – bits OS

The properties for the power supply, which were used in this experiment, were AC (IN) 220 V, 6 A and DC (OUT) 12 V, 16 A (maximum).

Readings have been taken for the electric potential from the voltmeter in volts (V) and the current from the ammeter in amperes (A). Readings were different depending on what task was given.

Several virtual machines with different specifications were created depending on the host/physical machine's specification. The evaluation took into consideration the task requirements, and then power consumption was calculated following different scenarios.

- 1- RAM over loaded X CPU low level load.
- 2- RAM low level load X CPU over loaded.
- 3- RAM over loaded X CPU over loaded.
- 4- RAM low level load X CPU low level load.

Different virtual machines were created, with different specifications and readings were taken accordingly. Virtual machine specifications were varying; where the CPU was 3 GHz and the RAM was varying 1 GB, 2 GB and 3 GB.

The results are explained in details in chapter 4 which shows that there is a difference between the variance of using RAM. The major limitation that was found in this

experiment was the lack of resources so a further step was taken; a simulation has been done to support the outcomes that were found from the hardware simulation which will be discussed in the next section.

3.3.2. SIMULATION

In this scenario; the model is built as a computer simulation to measure the power consumption in different load levels which will reflect similar environments to real life based on the user tasks' requirements. Furthermore, the computer-based simulation will be more flexible, less cost and less effort avoiding real life experimentation problems; such as mistaking data and readings correctly from the voltmeter and ammeter. In this study a computer-based simulation has been employed to measure the power consumption. The following sections explain the phase of creating the computer-based simulation.

The CloudSim simulator has been chosen since it is a type of simulator that its main goal is to provide a comprehensive and extensible simulation structure that enables modeling, simulation, and experimentation of emerging cloud computing infrastructures and application services. One more reason is that cloudsim has power package that supports our work.

Some important features are offered by CloudSim, such as:

- Support for modelling and simulation of large-scale Cloud computing environments, including datacenters, on a single physical computing node (Kumar R & Sahoo G. 2014).

- A self-contained platform for modelling Clouds, service brokers, provisioning, and allocation policies (Kumar R & Sahoo G. 2014).

The main approach of the cloud computing environment in this research is the Infrastructure as a Service (IaaS) where the supplier is unaware of applications and workloads served by the hosts in datacenters and the hosted virtual machines, and can only monitor the process externally.

The proposed approach mainly emphasizes on dividing the problem into four subproblems, plus decisions should be taken according to the listed below four problems:

- 1. When to migrate virtual machines.
- 2. Where to place the virtual machines.
- 3. When and which physical nodes to switch on/off.
- 4. How to enhance VM consolidation algorithms.

Virtual Machines should be migrated from its current host; if this host is considered to be under-loaded, and the host should be turned into sleep mode. Unlike some Virtual Machines; where these virtual machines should be migrated from a host into other or reactivated hosts; if the current host was considered to be overloaded.

In this case, we can improve resources' utilization and minimize energy consumption. In addition to determining the best placement of VMs onto servers which is another fundamental feature that influences the energy consumption.

In order to decrease energy consumption, there should be further actions to be done, such as: VM allocation should be accompanied with active switching off the power states

of nodes, which addresses the problem of narrow power ranges of servers by eliminating power consumption in the idle state. To set the energy consumption in optimal state by the system, it is necessary to efficiently decide when and which physical nodes should be deactivated to save energy, or reactivated to handle increases in the demand for resources.

Moreover, we will discuss how the algorithm enhancement has been taken care of, in order to afford scalability and reduce any possibility of failure; taking into consideration two factors including CPU speed and RAM size.

Workload Data

In order to ensure results accuracy; certain variables were fixed as constants where the CPU cache is to be 2-MB, the CPU VM value is 400MHz process speed, 650MB of RAM reserved for the CPU and 200MB of RAM used basically by the CPU. However, in this research, only some factors have been changed to test the power consumption, such as: task, RAM and CPU specifications.

In this research varying CPU and RAM specifications have been used, these specifications are:

- CPU speed in GHz (2, 2.2, 2.5 and 3).
- Number of cores (2, 3, 5).
- RAM sizes in GB (1, 2, 3, 4, 5, 6, 7 and 8).

Different types of task have been applied in this research where the amount of data to be processed by the CPU, the data on RAM to be processed and the transfer rate were

varying to find the best matching between the RAM and the CPU under the load of this particular task. Different CPU, different RAM and different tasks' specifications were used in order to put the CPU and RAM under heavy loads in several scenarios. The tasks specifications were used to set the load onto either the CPU or RAM or both. The results will be discussed in the next chapter.

3.4. THE MODEL

The proposed model, which is shown in Figure 3.3, incorporates three main components: broker, servers and tasks. The Green Power Consumption Factors consists of three factors: RAM utilization, CPU utilization and tasks' specification. The following sections explain the role of each component along with their justification.

3.4.1. THE PROPOSED MODEL

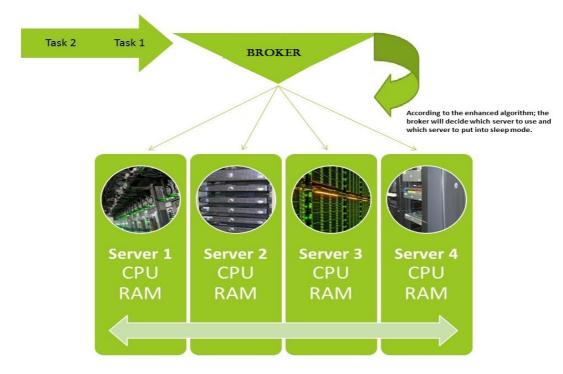


Figure 3. 3 The Proposed Model

Broker

This component is to receive any task and any information that the user will ask to run; such as playing music or running a video game, etc... However, it is the first step to prepare the information about the task requirements needed by the broker so it can run the two algorithms properly where this algorithm requires the CPU and RAM utilization.

In phase one, this component analyses the task coming from the interface and checks the required resources for it. Then, the broker will go through phase two, where it will create a virtual machine with certain specification that complies with the task. Phase three, the broker will handle the VM migration to a suitable server depending on the two algorithms.

The servers/Physical Machines:

The underlying physical computing servers provide the hardware infrastructure for creating virtualized resources to meet service demands.

In this research; two algorithms were used. The first algorithm takes care of virtual machine placement, and the second, takes care of minimizing virtual machine migration.

3.5. DEPLOYMENT AND EVALUATION

Gathered results from both experiments were analyzed, formulated and used in the resource allocation algorithm enhancement. This enhancement focused on the fact that the best RAM for a 2.5 GHz CPU is a (3 GB RAM).

We created a broker that takes into consideration both parameters the CPU and the RAM. We ran the simulation using both methods; the old resource allocation technique taking into consideration one parameter and then the enhanced technique that takes both parameters so as to compare the results.

As a result, we succeeded in increasing energy saving to make it reach 17%. The results will be further discussed in the next chapter.

CHAPTER 4

RESULTS AND ANALYSIS

4.1. Introduction

In this chapter the result has been analyzed, this analysis was related to both; the hardware simulation and the simulation. Furthermore, the result has clarified the relation between the CPU and the RAM and power consumption under the different load of data. The first part of this analysis is to explain the real life experiment result which used the matrix that includes the different loads on CPU and RAM, which has been explained in details in the previous chapter. Moreover, the second part of this analysis is to analyse the results that are related to the simulation, which has tested the power consumption in different scenarios within the CPU speed (2, 2.2, 2.5 and 3) GHz, different CPU cores (1, 2, 3 and 5) GB. The other variables were set as constants where the cache CPU is 2-MB and the CPU VM value is 400MHz process speed, 650MB of RAM and 200MB of RAM used basically by the CPU. Here we should mention that the load differs among the below scenarios.

4.2. HARDWARE SIMULATION

In this test and after the results have come out, ordering on these results were implemented to make it ready to be used in the SPSS analysis program to clarify the difference in electrical consumptions in the matrix which includes:

- 1- RAM over loaded X CPU low level load.
- 2- RAM low level load X CPU over loaded.
- 3- RAM over loaded X CPU over loaded.
- 4- RAM low level load X CPU low level load.

The mean value of the power consumptions was different between the three different sizes of RAM (i.e. 1 GB, 2 GB and 3 GB). The 1 GB RAM had the biggest mean value (2.23 A) compared to 2 GB (1.75 A) and 3 GB RAM (1.67 A) and a slight difference in means was between 2 GB and 3 GB RAM. However, the mean values do not show the differences are statistically significant or not. Therefore, the T-test was conducted to find out if there are any significantly differences between the three different RAM sizes.

A T-test has been applied on the results which are related to "RAM over loaded vs. CPU low level load" which has been tested on 1 GB, 2 GB, 3 GB and 3 GHz CPU. The T-test was used to determine if the two sets of data are significantly different from each other. The analysis of these results showed that there is a statistical significant difference in power consumptions between the various sizes of RAM where the difference between the 1GB and 2GB was ($\alpha = 0.00 < 0.05$) which means that the 2 GB is saving more power consumption. However, also there is significant differences between the 1 GB and the 3 GB which was ($\alpha = 0.00 < 0.05$) and the mean value between the 2 GB RAM and the 3 GB

RAM was ($\alpha = 0.015 < 0.05$); that means that the 3 GB achieved the best result to save the power consumptions comparing to 1 GB and 2 GB in this case which the RAM is being under high level load and the CPU low level load. The results are illustrated in table 4.1.

Table 4. 1 T-test results – RAM overloaded vs CPU Low Level Load

		Mean (A)	N	St. Deviation	Mean Differences	St. Deviation	T Value	DF	Sig
1 GB Vs 2 GB	1G	2.2310	29	.21398	.47931	.27565	9.364	28	.000
	2G	1.7517	29	.19202					
1 GB Vs 3 GB	1 G	2.2310	29	.21398	.55862	.24859	12.101	28	.000
	3 G	1.6724	29	.11921					
2 GB Vs 3 GB	2 G	1.7517	29	.19202	.07931	.16557	2.580	28	.015
	3 G	1.6724	29	.11921					

The second part on this matrix is to test the power consumptions which are related to "RAM low level load vs. CPU over loaded". Also in this case the mean values of the power consumptions were different between the three different sizes of RAM (i.e. 1 GB, 2 GB and 3 GB). Where the 1 GB RAM reached the biggest mean value (2.31 A) compared to 2 GB (1.91 A) and 3 GB RAM (1.90 A) and there was no difference in means between 2 GB and 3 GB RAM. Therefore, by applying the T-test; significant differences were found between the three different RAM sizes. The analysis of these results showed that there is a statistical significant difference in power consumptions between the various sizes of RAM where the difference between the 1GB and 2GB was ($\alpha = 0.00 < 0.05$) which means that the 2 GB is saving more power consumption. However, also there is significant differences between the 1 GB and the 3 GB which was ($\alpha = 0.00 < 0.05$); and there is no significant difference between 2 GB and 3 GB RAM, which was ($\alpha = 0.455 > 0.05$) that means that the

2 GB and the 3 GB RAM achieved better results to save the power consumptions comparing to 1 GB in this case which the CPU is being under high level load and the RAM low level load. The results are illustrated in table 4.2.

Table 4. 2 T-test results – CPU overloaded vs RAM Low Level Load

		Mean (A)	N	St. Deviation	Mean Differences	St. Deviation	T Value	DF	Sig
1 GB Vs 2 GB	1G	2.3172	29	.08892	.41724	.15135	14.846	28	.000
	2G	1.9000	29	.10000					
1 GB Vs 3 GB	1 G	2.3172	29	.08892	.41724	.15135	14.846	28	.000
	3 G	1.9000	29	.10000					
2 GB Vs 3 GB	2 G	1.9172	29	.15369	.01724	.12268	.757	28	.455
	3 G	1.9000	29	.10000					

The third part on this matrix is to test the power consumptions which are related to "RAM low level load vs. CPU low level load". The mean values of the power consumptions did not have any difference between all the three different sizes of RAM (i.e. 1 GB, 2 GB and 3 GB). Where the means were similar, 1 GB RAM (0.975 A), 2 GB RAM (0.975 A) and 3 GB RAM (0.958 A). Therefore, by applying the T-test; there were not any significant differences found between the three different RAM sizes. The analysis of these results showed that the ($\alpha = 1.00 > 0.05$) between 1 GB RAM and 2 GB RAM. The same result was found between 1 GB RAM and 3 GB RAM where was ($\alpha = 0.202 > 0.05$). Also, there was no difference between 2 GB RAM and 3 GB RAM which was ($\alpha = 0.134 > 0.05$) that means there was not saving for power consumptions between the three different sizes in case of the RAM and the CPU with low level load. The results are illustrated in table 4.3.

Table 4. 3 T-test results – RAM Low Level Load vs CPU Low Level Load

		Mean	N	St. Deviation	Mean Differences	St. Deviation	T Value	DF	Sig
		(A)							
	1G	.9759	29	.04355					
1 GB Vs 2 GB					.00000	.05976	.000	28	1.000
	2G	.9759	29	.04355					
	1 G	.9759	29	.04355					
1 GB Vs 3 GB					.01724	.07106	1.307	28	.202
	3 G	.9586	29	.05012					
	2 G	.9759	29	.04355					
2 GB Vs 3 GB					.01724	.06017	1.543	28	.134
	3 G	.9586	29	.05012					

The last case on this matrix is to test the power consumptions which are related to "RAM over loaded vs. CPU over loaded. In this case the mean values of the power consumptions were different between the three different sizes of RAM (i.e. 1 GB, 2 GB and 3 GB). Where the 1 GB RAM reached the biggest mean value (2.74 A) compared to 2 GB (2.37 A) and 3 GB RAM (2.24 A) and there was difference in means between 2 GB and 3 GB RAM. Therefore, by applying the T-test; significant differences were found between the three different RAM sizes. The analysis of these results showed that there is a statistical significant difference in power consumptions between the various sizes of RAM where the difference between the 1 GB and 2 GB was ($\alpha = 0.00 < 0.05$) which means that the 2 GB is saving more power consumption. However, also there is significant differences between the 1 GB and the 3 GB which was ($\alpha = 0.00 < 0.05$); and there is significant difference between 2 GB and 3 GB RAM, which was ($\alpha = 0.00 > 0.05$) that means that the 3 GB RAM

achieved better results comparing with both 1 GB RAM and 2 GB RAM to save the power

		Mean	N	St. Deviation	Mean Differences	St. Deviation	T Value	DF	Sig
		(A)							
1 GB Vs 2 GB	1G	2.7414	29	.06823					
					.36552	.11109	17.719	28	.000
	2G	2.3759	29	.07395					
1 GB Vs 3 GB	1 G	2.7414	29	.06823					
					.49310	.08422	31.529	28	.000
	3 G	2.2483	29	.05085					
2 GB Vs 3 GB	2 G	2.3759	29	.07395					
					.12759	.08822	7.788	28	.000
	3 G	2.2483	29	.05085					

consumptions. In this case which the CPU is being under high level load and the RAM high

level load. The results are illustrated in table 4.4.

Table 4. 4 T-test results - RAM Over Loaded vs CPU Over Loaded

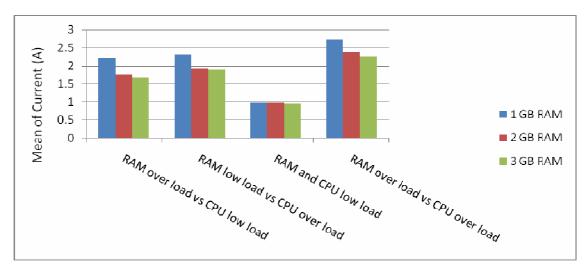


Figure 4. 1 Hardware Simulation Power Consumption

We can conclude in this section that power consumptions will be reduced efficiently when deploying 3 GB RAM with the 2.5 GHz CPU.

4.3. SIMULATION

In this chapter, we used the SPSS program to analyse the data we got from CloudSim with many claims we had before (Brace, N et al. 2006); to conclude statement result. For scientific purposes, we designed three types of data load, each one of them has its own major, and all the details are listed below:

Type (1) is designed to test CPU power of use while the RAM is almost idle.

Type (2) is designed to test the CPU and RAM with minimum bus where the frequency is 800 MHz, at the same time we assume that the RAM is half full in that system and formulate by (RAM/2).

Type (3) is designed to test the system while whole RAM in use except for the last 1024 MB of it, just to be able to use from OS "Operating System" and formulate by (RAM-1024).

These previous types are presented in table 4.5.

Table 4. 5 Load Data Types

Load	Gbit Processing	Data(MB)	CPU using MHz
Type (1)	0.5	50	1600
Type (2)	0.1	RAM/2	800
Type (3)	0.5	RAM-1024	150

In table 4.6, we viewed all the types of CPU which have been studied and ordered them in the "#" column, while the CPU speed by "CPU GHz", as well as the number of cores by "# core".

Table 4. 6 CPU Types with their Specifications

#	CPU GHz	# core
1	2	1
2	2.2	1
3	2.5	1
4	3	1
5	2	2
6	2.2	2
7	2.5	2
8	3	2
9	2	3
10	2.2	3
11	2.5	3
12	3	3
13	2	5
14	2.2	5
15	2.5	5
16	3	5

The study questions are formulated as claims.

- What are the main factors that affect the energy consumption?
- What are the suggested techniques to improve energy consumption?
- What are the main improvements, mainly in resources allocation, that can be done
 on the cloud computing model to be a green cloud?
- How can the energy consumption be measured in data canters?

In order to answer the research questions, we have to go through the below claims:

- 1) A big capacity of RAM saves more power with same CPU speed and load of data.
- 2) A large speed of CPU saves more power with same RAM size and load of data.
- 3) There is a relation between CPU speed, RAM size and the data load.

We formulate the previous claims with many statements to able be analyse using SPSS program as:

1) If same CPU speed was set and the load of data type (1) are positively related with RAM's size, then biggest capacity of RAM saves more power.

Based on the simulation results shown in table (4.7). The minimum value of means was at 3GB, which was (9.12) of RAM in data type (1). In order to complete the analysis, a K-Independent test has been applied on the results related to data type (1). The test showed that the data is not a normal distribution model. In this case the hypothesis was rejected, which means that the biggest capacity of RAM does not save more power. However, alternative claim has been accepted, which showed that significant differences between the varying of RAM sizes have been found, where was

(α <0.05). The 3GB RAM with different CPU's speed is the most power saving for load type (1). *Refer to Appendix 1*.

2) If same CPU speed was set and the load of data type (2) are positively related with RAM's size, then biggest capacity of RAM saves more power.

Based on the simulation results shown in table (4.7). The minimum value of means was at 3GB, which was (2.71) of RAM in data type (2). In order to complete the analysis, a K-Independent test has been applied on the results related to data type (2). The test showed that the data is not a normal distribution model. In this case the hypothesis was rejected, which means that the biggest capacity of RAM does not save more power. However, alternative claim has been accepted, which showed that significant differences between the varying of RAM sizes have been found, where was (α <0.05). The 3GB RAM with different CPU's speed is the most power saving for load type (2). *Refer to Appendix 2*.

3) If same CPU speed was set and load of data type (3) are positively related RAM's size then biggest capacity of RAM saving more power.

The minimum value of means was at 2GB, which was (13.83) of RAM in data type (3). An ANOVA test has been done on the results, which are related to data type (3). The ANOVA test was used to analyze the differences between group means and their associated procedures. The test showed that the data is not a normal distribution model, so the hypotheses have been rejected and the alternating claim was accepted. This showed that insignificant differences between the 2 GB and the 3 GB of RAM sizes have been found.

However, there was a significant difference between the 2 GB and the 3 GB RAM with the other RAM sizes, where the significance was (α <0.05). The 2GB and 3GB RAM with different CPU's speed is the most power saving for load type (3). The reason behind the increase in power consumption after the 3 GB RAM is the memory waste and paging. *Refer to Appendix 3*.

Table 4. 7 The Data Types Means in Different RAM Sizes

	1 GB	2 GB	3 GB	4 GB	5 GB	6 GB	7 GB	8 GB
RT1	17.29	9.98	9.17	9.23	9.26	9.32	9.6	10.01
RT2	4.47	2.77	2.71	2.86	3.1	3.37	3.71	4.06
RT3	17.41	13.83	14.45	16.89	19.37	22.06	25.03	28.04

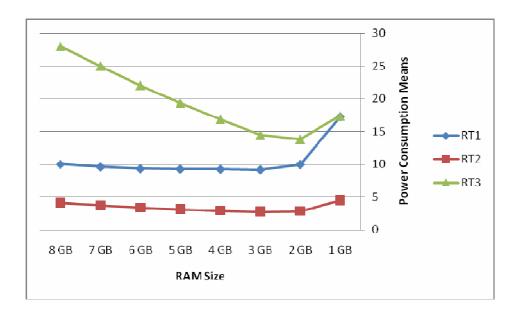


Figure 4. 2 The Data Type Means in Different RAM Sizes

4) If same RAM size was set and load of data type (1) are negatively related with CPU's speed, then the fastest CPU speed saving more power.

Based on the simulation results shown in table (4.8). The minimum value of means was for the CPU at VM 16, which were (6.53) of CPU speed in data type (1). In order to complete the analysis, a K-Independent test has been applied on the results related to data type (1). The test showed that the data is not a normal distribution model. In this case the hypothesis was rejected, which means that the fastest CPU speed saves more power. However, alternative claim has been accepted, which showed that significant differences between the varying CPU speeds have been found, where the significance was (α <0.05). The CPU in VM (16) with the same RAM size is the most power saving for load type (1). *Refer to Appendix 1*.

5) If same RAM size was set and load of data type (2) are negatively related CPU's speed, then the fastest CPU speed saving more power.

Based on the simulation results shown in table (4.8). The minimum value of means was for the CPU at VM 16, which were (2.52) of CPU speed in data type (2). In order to complete the analysis, a K-Independent test has been applied on the results related to data type (2). The test showed that the data is not a normal distribution model. In this case the hypothesis was rejected, which means that the fastest CPU speed saves more power. However, alternative claim has been accepted, which showed that significant differences between the varying CPU speeds have been found, where the significance was (α <0.05). The CPU in VM (16) with the same RAM size is the most power saving for load type (2). *Refer to Appendix 5*.

6) If same RAM size was set and load of data type (3) are negatively related CPU's speed, then the fastest CPU speed saving more power.

Based on the simulation results shown in table (4.8). The minimum value of means was for the CPU at VM 16, which were (15.51) of CPU speed in data type (3). An ANOVA test has been done on the results, which was related to data type (3). The test showed that the data is not a normal distribution model, so the hypothesis has been rejected and an alternative claim was accepted. This showed that significant differences between the varying CPU speeds have been found, where the significance was (α <0.05). The CPU in VM (16) with the same RAM size is the most power saving for load type (3). *Refer to Appendix* 6.

Table 4. 8 The Data Type Mean for VMs

VM	RT1	RT2	RT3
1	18.86	5.06	27.84
2	17.57	4.8	26.55
3	16.02	4.48	25
4	14.13	4.09	23.11
5	11.64	3.57	20.62
6	11.01	3.45	19.99
7	10.25	3.29	19.23
8	9.32	3.09	18.3
9	9.32	3.09	18.3
10	8.89	3.01	17.88
11	8.39	2.9	17.37
12	7.77	2.77	16.75
13	7.46	2.71	16.44
14	7.21	2.66	16.19
15	6.9	2.59	15.88
16	6.53	2.52	15.51

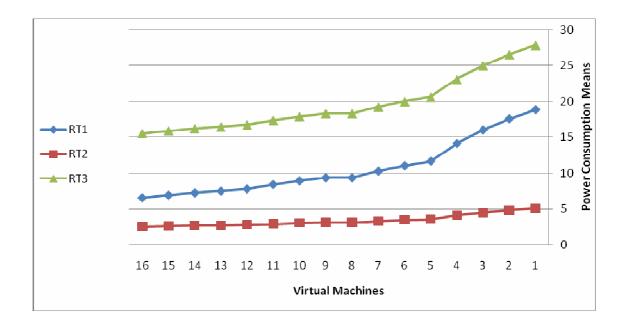


Figure 4. 3 The Data Type Means for VMs

As part of this work we try to discover the best RAM for each CPU kind, for that purposes we built our model of statistical analysis which uses the means, median, differences and standard deviation. That relation is formulated mathematically in table 4.9.

Table 4. 9 The Best RAM for each Kind of CPU depending on the Types of Data Load

CPU	Core	RAM	Pt1	Pt2	Pt3	Difference
2	1	4	15.65	4.14	23.31	0.69
2	2	3	16.37	4.03	15.81	0.59
2	3	3	14.87	3.73	13.52	0.85
2	5	3	13.04	3.36	11.68	0.88
2.2	1	3	9.81	3.32	21.43	0.14

2.2	2	3	9.37	2.78	15.18	0.27
2.2	3	3	8.84	2.63	13.10	0.54
2.2	5	2	9.59	2.44	9.22	0.54
2.5	1	3	8.15	3.21	19.93	0.27
2.5	2	3	7.81	2.30	14.43	0.38
2.5	3	2	8.34	2.26	10.81	0.35
2.5	5	2	7.51	2.14	8.81	0.41
3	1	3	6.62	2.65	18.10	0.25
3	2	2	6.75	2.03	12.06	0.19
3	3	2	6.34	1.97	9.98	0.16
3	5	2	5.84	1.89	8.31	0.41

CPU is the CPU speed GHz, Core is the number of cores for that CPU, RAM is the RAM size GB, (PT1, PT2, PT3) is the total power used in data load type (1),(2),(3) respectively.

The difference is an average value that depends on choosing the best RAM size where each type of data load has its own best RAM size. Furthermore, several mathematical calculations have been applied to find the best RAM size but with average value of power losses depending on changing data load type.

For evaluation purposes, the old resource allocation technique taking into consideration one parameter which is the CPU was applied using the broker and we checked the amount of power consumption. Then the broker with the enhanced resource

allocation algorithm was applied, and the amount of power consumption was taken. In table (4.10) we found the average for the different cases. We compute the average for all cases for the old algorithm which was (13.68), and we compute the average for the enhanced algorithm which was (11.26). In this case we can claim that the power saving from the old resource allocation algorithm to the new resource allocation algorithm is (17%). It has been computed by ((13.68 - 11.26)/13.68) * 100%). Refer to Appendix 8.

Table 4. 10 The Difference in Power Consumption between the Enhanced and the Old Algorithms (Sample)

	Enha	inced				Old				Differer	nce
PT1	PT2	PT3	AV	PT1	PT2	PT3	AV				
36.56	8.75	36.69	27.33	35.96	8.52	35.96	26.81	0.61	0.23	0.73	0.52
22.09	4.91	24.56	17.19	23.15	7.30	23.15	17.87	-1.06	-2.39	1.41	-0.68
17.62	4.28	22.68	14.86	20.35	8.07	20.35	16.26	-2.73	-3.79	2.33	-1.40
15.65	4.14	23.31	14.37	20.05	9.34	20.05	16.48	-4.39	-5.20	3.26	-2.11
14.69	4.21	24.93	14.61	20.75	10.82	20.75	17.44	-6.06	-6.61	4.19	-2.83
14.22	4.37	27.06	15.22	21.95	12.39	21.95	18.76	-7.73	-8.01	5.11	-3.54
14.75	4.74	30.18	16.56	24.14	14.16	24.14	20.82	-9.39	-9.42	6.04	-4.26
15.28	5.11	33.31	17.90	26.34	15.93	26.34	22.87	- 11.06	-10.83	6.97	-4.97
18.86	5.06	27.84	17.25	24.09	10.82	24.09	19.66	-5.23	-5.75	3.76	-2.41

After finding the average, we checked the difference in power consumption between the enhanced algorithm and the old algorithm, and the difference average was (-2.43).

Table 4. 11 The Difference in Power Consumption between the Enhanced and the Old Algorithm

CPU	core	Ram	Difference
2	1	1 - 8	-2.41
2	2	1 - 8	-4.39
2	3	1 - 8	-4.67
2	5	1 - 8	-4.64
2.2	1	1 - 8	-0.45
2.2	2	1 - 8	-2.45
2.2	3	1 - 8	-2.88
2.2	5	1 – 8	-3.13
2.5	1	1 – 8	-0.18
2.5	2	1 – 8	-1.98
2.5	3	1 – 8	-2.43
2.5	5	1 – 8	-2.72
3	1	1 – 8	-0.19
3	2	1 – 8	-1.73
3	3	1 – 8	-2.15
3	5	1 – 8	-2.44

Finally, we can conclude the results that came out from the

hardware simulation and the simulation, where both has the same finding which is the power consumptions based on both the CPU speed and the RAM size to save the power. However, there are such properties that should be taken into account which are related to the size of the RAM and the speed of the CPU which found that every 2.5 GHz CPU needs a 3 GB RAM size to reach to the optimum saving for the power. Based on this contribution, the broker has been enhanced to include both the CPU and RAM under the facts which have been found. Furthermore, by applying the enhanced algorithm and compare it with the

old algorithms techniques a difference on power savings has been found which gave strength to the enhanced algorithm to be used in the datacenters which will save more power and become a green environment.

CHAPTER 5

CONCLUSION

5.1. CONCLUSION

The general purpose of this research is to use certain techniques to improve resource allocation based on RAM and CPU utilization. The research work in this project showed great potential for the system through a number of experiments. However, it has been recommended that further research is to be conducted to make the system more suitable to be deployed in datacenters.

Thus, this study builds on enhancing the previously mentioned algorithms in order to achieve the main goal of this research; a suitable broker was created that distributes the VMs and the tasks efficiently with minimum power consumption; to avoid CO2 emissions in the environment. This study included a literature review, which indicated that there is still a need to use different methods and taking different factors to ensure saving energy, which show significant improvements in Green Cloud Computing.

Therefore, it has been concluded that further steps have been taken to identify and analyse in depth the energy consumption factors with their evaluation assessment; the literature review provided further support to the literature review findings related to the

lack of research done on the energy consumption caused by RAM. The main findings that have been concluded from the analysis of the energy consumption factors in Cloud Computing are that there are many factors to be taken into consideration rather than the CPU and RAM utilization in the Cloud, and all these factors, with their specification, require further research.

Hence, the solution presented to solve the earlier shortcomings is an enhanced algorithm to ensure reducing energy consumptions, in addition of evaluating our work throughout the broker side simulated, which was very useful in the last phase in this research project.

A simulation technique was carried out to measure the energy consumption in different scenarios. The main outcomes showed that there is an impact for the RAM size on power consumption. In addition, the outcomes of this study showed that taking the RAM size into consideration has improved the results when measuring the energy consumption.

In summary, the overall information was presented in this research work related to the critical analysis and previous studies in Cloud Computing, in order to afford opportunity for researchers to improve the Green Cloud Computing as well as to help those who have the potential to implement this work in the future. Furthermore, the findings can be beneficial for the success of this research, as well as being a milestone on the way to further progress.

5.2. FUTURE WORK

Further work need to be conducted; we suggest few ideas to be studied in the future:

- 1. Reducing energy consumption taking into consideration the quality of service.
- 2. More factors to be studied to increase the amount of energy saved.

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APPENDIX

1- Type 1 – CPU

	CPU		RA	M		Task		Tim e	Usag e	Curren t	Total Of Power use	Power		OS	
CPUS (GHz)	CPU C (#)	CTD S (MB)	FSBS (MHz)	RAM S (GB)	Gbi t	Data (MB)	CRUO (MHz)	S	%	ı	Power * Time	I*V	OCCU R (MHz)	RLOR (MB)	OSRU (MB)
2	1	2	1600	1	0.5	50	1600	0.31	3.00	3.00	36.56	116.9 9	400	200	650
2	1	2	1600	2	0.5	50	1600	0.31	1.67	3.00	22.09	70.69	400	200	650
2	1	2	1600	3	0.5	50	1600	0.31	1.22	3.00	17.62	56.39	400	200	650
2	1	2	1600	4	0.5	50	1600	0.31	1.00	3.00	15.65	50.09	400	200	650
2	1	2	1600	5	0.5	50	1600	0.31	0.87	2.60	14.69	46.99	400	200	650
2	1	2	1600	6	0.5	50	1600	0.31	0.78	2.33	14.22	45.49	400	200	650
2	1	2	1600	7	0.5	50	1600	0.31	0.78	2.33	14.75	47.19	400	200	650
2	1	2	1600	8	0.5	50	1600	0.31	0.78	2.33	15.28	48.89	400	200	650
2.2	1	2	1600	1	0.5	50	1600	0.31	2.73	3.00	33.49	107.1 8	400	200	650
2.2	1	2	1600	2	0.5	50	1600	0.31	1.52	3.00	20.39	65.24	400	200	650
2.2	1	2	1600	3	0.5	50	1600	0.31	1.11	3.00	16.37	52.39	400	200	650
2.2	1	2	1600	4	0.5	50	1600	0.31	0.91	2.73	14.63	46.82	400	200	650
2.2	1	2	1600	5	0.5	50	1600	0.31	0.79	2.36	13.80	44.16	400	200	650
2.2	1	2	1600	6	0.5	50	1600	0.31	0.71	2.12	13.42	42.95	400	200	650

			4600	_	0.5		4.500	0.04	0.74	0.40	40.05	44.65	400	200	650
2.2	1	2	1600	7	0.5	50	1600	0.31	0.71	2.12	13.95	44.65	400	200	650
2.2	1	2	1600	8	0.5	50	1600	0.31	0.71	2.12	14.48	46.35	400	200	650
2.5	1	2	1600	1	0.5	50	1600	0.31	2.40	3.00	29.81	95.39	400	200	650
2.5	1	2	1600	2	0.5	50	1600	0.31	1.33	3.00	18.34	58.69	400	200	650
2.5	1	2	1600	3	0.5	50	1600	0.31	0.98	2.93	14.87	47.59	400	200	650
2.5	1	2	1600	4	0.5	50	1600	0.31	0.80	2.40	13.40	42.89	400	200	650
2.5	1	2	1600	5	0.5	50	1600	0.31	0.69	2.08	12.74	40.75	400	200	650
2.5	1	2	1600	6	0.5	50	1600	0.31	0.62	1.87	12.47	39.89	400	200	650
2.5	1	2	1600	7	0.5	50	1600	0.31	0.62	1.87	13.00	41.59	400	200	650
2.5	1	2	1600	8	0.5	50	1600	0.31	0.62	1.87	13.53	43.29	400	200	650
3	1	2	1600	1	0.5	50	1600	0.31	2.00	3.00	25.31	80.99	400	200	650
3	1	2	1600	2	0.5	50	1600	0.31	1.11	3.00	15.84	50.69	400	200	650
3	1	2	1600	3	0.5	50	1600	0.31	0.81	2.44	13.04	41.73	400	200	650
3	1	2	1600	4	0.5	50	1600	0.31	0.67	2.00	11.90	38.09	400	200	650
3	1	2	1600	5	0.5	50	1600	0.31	0.58	1.73	11.44	36.59	400	200	650
3	1	2	1600	6	0.5	50	1600	0.31	0.52	1.56	11.30	36.16	400	200	650
3	1	2	1600	7	0.5	50	1600	0.31	0.52	1.56	11.83	37.86	400	200	650
3	1	2	1600	8	0.5	50	1600	0.31	0.52	1.56	12.36	39.56	400	200	650
2	2	2	1600	1	0.5	50	1600	0.31	1.50	3.00	19.69	62.99	400	200	650
2	2	2	1600	2	0.5	50	1600	0.31	0.83	2.50	12.72	40.69	400	200	650
2	2	2	1600	3	0.5	50	1600	0.31	0.43	1.30	9.81	31.39	400	200	650
2	2	2	1600	4	0.5	50	1600	0.31	0.39	1.17	9.84	31.49	400	200	650
5	2	2	1600	5	0.5	50	1600	0.31	0.43	1.30	9.81	31.39	400	200	650
2	2	2	1600	6	0.5	50	1600	0.31	0.36	1.07	10.02	32.05	400	200	650
2	2	2	1600	7	0.5	50	1600	0.31	0.33	1.00	10.28	32.89	400	200	650
2	2	2	1600	8	0.5	50	1600	0.31	0.61	1.83	10.75	34.39	400	200	650
2.2	2	2	1600	1	0.5	50	1600	0.31	1.36	3.00	18.15	58.09	400	200	650
2.2	2	2	1600	2	0.5	50	1600	0.31	0.76	2.27	11.86	37.97	400	200	650

2.2	2	2	1600	3	0.5	50	1600	0.31	0.39	1.18	9.37	29.98	400	200	650
2.2	2	2	1600	4	0.5	50	1600	0.31	0.35	1.06	9.44	30.22	400	200	650
2.2	2	2	1600	5	0.5	50	1600	0.31	0.35	1.06	9.44	30.22	400	200	650
2.2	2	2	1600	6	0.5	50	1600	0.31	0.45	1.36	9.52	30.46	400	200	650
2.2	2	2	1600	7	0.5	50	1600	0.31	0.32	0.97	9.65	30.88	400	200	650
2.2	2	2	1600	8	0.5	50	1600	0.31	0.56	1.67	10.12	32.39	400	200	650
2.5	2	2	1600	1	0.5	50	1600	0.31	1.20	3.00	16.31	52.19	400	200	650
2.5	2	2	1600	2	0.5	50	1600	0.31	0.67	2.00	10.84	34.69	400	200	650
2.5	2	2	1600	3	0.5	50	1600	0.31	0.35	1.04	8.84	28.27	400	200	650
2.5	2	2	1600	4	0.5	50	1600	0.31	0.40	1.20	8.90	28.49	400	200	650
2.5	2	2	1600	5	0.5	50	1600	0.31	0.31	0.93	8.97	28.69	400	200	650
2.5	2	2	1600	6	0.5	50	1600	0.31	0.29	0.86	9.21	29.48	400	200	650
2.5	2	2	1600	7	0.5	50	1600	0.31	0.49	1.47	9.37	29.99	400	200	650
2.5	2	2	1600	8	0.5	50	1600	0.31	0.27	0.80	9.53	30.49	400	200	650
3	2	2	1600	1	0.5	50	1600	0.31	1.00	3.00	14.06	44.99	400	200	650
3	2	2	1600	2	0.5	50	1600	0.31	0.56	1.67	9.59	30.69	400	200	650
3	2	2	1600	3	0.5	50	1600	0.31	0.33	1.00	8.15	26.09	400	200	650
3	2	2	1600	4	0.5	50	1600	0.31	0.29	0.87	8.19	26.19	400	200	650
3	2	2	1600	5	0.5	50	1600	0.31	0.41	1.22	8.46	27.06	400	200	650
3	2	2	1600	6	0.5	50	1600	0.31	0.26	0.78	8.38	26.83	400	200	650
3	2	2	1600	7	0.5	50	1600	0.31	0.24	0.71	8.68	27.77	400	200	650
3	2	2	1600	8	0.5	50	1600	0.31	0.22	0.67	9.03	28.89	400	200	650
2	3	2	1600	1	0.5	50	1600	0.31	1.00	3.00	14.06	44.99	400	200	650
2	3	2	1600	2	0.5	50	1600	0.31	0.56	1.67	9.59	30.69	400	200	650
2	3	2	1600	3	0.5	50	1600	0.31	0.33	1.00	8.15	26.09	400	200	650
2	3	2	1600	4	0.5	50	1600	0.31	0.29	0.87	8.19	26.19	400	200	650
2	3	2	1600	5	0.5	50	1600	0.31	0.41	1.22	8.46	27.06	400	200	650
2	3	2	1600	6	0.5	50	1600	0.31	0.26	0.78	8.38	26.83	400	200	650

_	2	_	1600	7	٥٠	F 0	1.000	0.24	0.24	0.74	0.60	27.77	400	200	CEO
2	3	2	1600	7	0.5	50	1600	0.31	0.24	0.71	8.68	27.77	400	200	650
2	3	2	1600	8	0.5	50	1600	0.31	0.22	0.67	9.03	28.89	400	200	650
2.2	3	2	1600	1	0.5	50	1600	0.31	0.91	2.73	13.04	41.72	400	200	650
2.2	3	2	1600	2	0.5	50	1600	0.31	0.51	1.52	9.02	28.88	400	200	650
2.2	3	2	1600	3	0.5	50	1600	0.31	0.30	0.91	7.81	25.00	400	200	650
2.2	3	2	1600	4	0.5	50	1600	0.31	0.26	0.79	7.89	25.25	400	200	650
2.2	3	2	1600	5	0.5	50	1600	0.31	0.37	1.11	8.04	25.73	400	200	650
2.2	3	2	1600	6	0.5	50	1600	0.31	0.24	0.71	8.12	25.98	400	200	650
2.2	3	2	1600	7	0.5	50	1600	0.31	0.22	0.65	8.43	26.99	400	200	650
2.2	3	2	1600	8	0.5	50	1600	0.31	0.20	0.61	8.80	28.17	400	200	650
2.5	3	2	1600	1	0.5	50	1600	0.31	0.80	2.40	11.81	37.79	400	200	650
2.5	3	2	1600	2	0.5	50	1600	0.31	0.44	1.33	8.34	26.69	400	200	650
2.5	3	2	1600	3	0.5	50	1600	0.31	0.27	0.80	7.40	23.69	400	200	650
2.5	3	2	1600	4	0.5	50	1600	0.31	0.33	0.98	7.54	24.13	400	200	650
2.5	3	2	1600	5	0.5	50	1600	0.31	0.23	0.69	7.54	24.11	400	200	650
2.5	3	2	1600	6	0.5	50	1600	0.31	0.21	0.62	7.80	24.96	400	200	650
2.5	3	2	1600	7	0.5	50	1600	0.31	0.19	0.57	8.14	26.05	400	200	650
2.5	3	2	1600	8	0.5	50	1600	0.31	0.18	0.53	8.53	27.29	400	200	650
3	3	2	1600	1	0.5	50	1600	0.31	0.67	2.00	10.31	32.99	400	200	650
3	3	2	1600	2	0.5	50	1600	0.31	0.37	1.11	7.51	24.03	400	200	650
3	3	2	1600	3	0.5	50	1600	0.31	0.27	0.81	6.93	22.17	400	200	650
3	3	2	1600	4	0.5	50	1600	0.31	0.22	0.67	6.90	22.09	400	200	650
3	3	2	1600	5	0.5	50	1600	0.31	0.19	0.58	7.10	22.73	400	200	650
3	3	2	1600	6	0.5	50	1600	0.31	0.17	0.52	7.41	23.72	400	200	650
3	3	2	1600	7	0.5	50	1600	0.31	0.16	0.48	7.78	24.91	400	200	650
3	3	2	1600	8	0.5	50	1600	0.31	0.15	0.44	8.20	26.23	400	200	650
2	5	2	1600	1	0.5	50	1600	0.31	0.60	1.80	9.56	30.59	400	200	650
2	5	2	1600	2	0.5	50	1600	0.31	0.33	1.00	7.09	22.69	400	200	650
	•	_			0.0			0.01	0.00		7.00				

2 5 2 1600 4 0.5 50 1600 0.31 0.20 0.60 6.65 21.29 400 200 650 2 5 2 1600 5 0.5 50 1600 0.31 0.17 0.52 6.89 22.03 400 200 650 2 5 2 1600 6 0.5 50 1600 0.31 0.16 0.47 7.22 23.09 400 200 650 2 5 2 1600 7 0.5 50 1600 0.31 0.14 0.43 7.61 24.34 400 200 650 2.2 5 2 1600 1 0.5 50 1600 0.31 0.40 8.03 25.69 400 200 650 2.2 5 2 1600 2 0.5 50 1600 0.31 0.30 0.91 6.75 21.60 <td< th=""><th></th><th>_</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></td<>		_														
2 5 2 1600 5 0.5 50 1600 0.31 0.17 0.52 6.89 22.03 400 200 650 2 5 2 1600 6 0.5 50 1600 0.31 0.16 0.47 7.22 23.09 400 200 650 2 5 2 1600 7 0.5 50 1600 0.31 0.14 0.43 7.61 24.34 400 200 650 2 5 2 1600 8 0.5 50 1600 0.31 0.33 0.40 8.03 25.69 400 200 650 2.2 5 2 1600 2 0.5 50 1600 0.31 0.55 1.64 8.95 28.63 400 200 650 2.2 5 2 1600 3 0.5 50 1600 0.31 0.20 6.67 6.37	2	5	2	1600	3	0.5	50	1600	0.31	0.24	0.73	6.62	21.19	400	200	650
2 5 2 1600 6 0.5 50 1600 0.31 0.16 0.47 7.22 23.09 400 200 650 2 5 2 1600 7 0.5 50 1600 0.31 0.14 0.43 7.61 24.34 400 200 650 2 5 2 1600 8 0.5 50 1600 0.31 0.13 0.40 8.03 25.69 400 200 650 2.2 5 2 1600 1 0.5 50 1600 0.31 0.55 1.64 8.95 28.63 400 200 650 2.2 5 2 1600 2 0.5 50 1600 0.31 0.22 0.67 6.37 20.39 400 200 650 2.2 5 2 1600 4 0.5 50 1600 0.31 0.18 0.16 0.47 <t< td=""><td>2</td><td>5</td><td>2</td><td>1600</td><td>4</td><td>0.5</td><td>50</td><td>1600</td><td>0.31</td><td>0.20</td><td>0.60</td><td>6.65</td><td>21.29</td><td>400</td><td>200</td><td>650</td></t<>	2	5	2	1600	4	0.5	50	1600	0.31	0.20	0.60	6.65	21.29	400	200	650
2 5 2 1600 7 0.5 50 1600 0.31 0.14 0.43 7.61 24.34 400 200 650 2 5 2 1600 8 0.5 50 1600 0.31 0.13 0.40 8.03 25.69 400 200 650 2.2 5 2 1600 1 0.5 50 1600 0.31 0.55 1.64 8.95 28.63 400 200 650 2.2 5 2 1600 3 0.5 50 1600 0.31 0.22 0.67 6.37 20.39 400 200 650 2.2 5 2 1600 4 0.5 50 1600 0.31 0.18 0.55 6.45 20.64 400 200 650 2.2 5 2 1600 5 0.5 50 1600 0.31 0.14 0.42 7.06	2	5	2	1600	5	0.5	50	1600	0.31	0.17	0.52	6.89	22.03	400	200	650
2 5 2 1600 8 0.5 50 1600 0.31 0.13 0.40 8.03 25.69 400 200 650 2.2 5 2 1600 1 0.5 50 1600 0.31 0.55 1.64 8.95 28.63 400 200 650 2.2 5 2 1600 2 0.5 50 1600 0.31 0.30 0.91 6.75 21.60 400 200 650 2.2 5 2 1600 4 0.5 50 1600 0.31 0.18 0.55 6.45 20.64 400 200 650 2.2 5 2 1600 5 0.5 50 1600 0.31 0.16 0.47 6.71 21.47 400 200 650 2.2 5 2 1600 6 0.5 50 1600 0.31 0.14 0.42 7.06	2	5	2	1600	6	0.5	50	1600	0.31	0.16	0.47	7.22	23.09	400	200	650
2.2 5 2 1600 1 0.5 50 1600 0.31 0.55 1.64 8.95 28.63 400 200 650 2.2 5 2 1600 2 0.5 50 1600 0.31 0.30 0.91 6.75 21.60 400 200 650 2.2 5 2 1600 3 0.5 50 1600 0.31 0.22 0.67 6.37 20.39 400 200 650 2.2 5 2 1600 5 0.5 50 1600 0.31 0.18 0.55 6.45 20.64 400 200 650 2.2 5 2 1600 5 0.5 50 1600 0.31 0.16 0.47 6.71 21.47 400 200 650 2.2 5 2 1600 7 0.5 50 1600 0.31 0.14 0.42 7.06	2	5	2	1600	7	0.5	50	1600	0.31	0.14	0.43	7.61	24.34	400	200	650
2.2 5 2 1600 2 0.5 50 1600 0.31 0.30 0.91 6.75 21.60 400 200 650 2.2 5 2 1600 3 0.5 50 1600 0.31 0.22 0.67 6.37 20.39 400 200 650 2.2 5 2 1600 4 0.5 50 1600 0.31 0.18 0.55 6.45 20.64 400 200 650 2.2 5 2 1600 5 0.5 50 1600 0.31 0.16 0.47 6.71 21.47 400 200 650 2.2 5 2 1600 6 0.5 50 1600 0.31 0.14 0.42 7.06 22.59 400 200 650 2.2 5 2 1600 7 0.5 50 1600 0.31 0.13 0.39 7.46	2	5	2	1600	8	0.5	50	1600	0.31	0.13	0.40	8.03	25.69	400	200	650
2.2 5 2 1600 3 0.5 50 1600 0.31 0.22 0.67 6.37 20.39 400 200 650 2.2 5 2 1600 4 0.5 50 1600 0.31 0.18 0.55 6.45 20.64 400 200 650 2.2 5 2 1600 5 0.5 50 1600 0.31 0.16 0.47 6.71 21.47 400 200 650 2.2 5 2 1600 6 0.5 50 1600 0.31 0.14 0.42 7.06 22.59 400 200 650 2.2 5 2 1600 7 0.5 50 1600 0.31 0.12 0.36 7.89 25.26 400 200 650 2.5 5 2 1600 1 0.5 50 1600 0.31 0.27 0.80 6.34	2.2	5	2	1600	1	0.5	50	1600	0.31	0.55	1.64	8.95	28.63	400	200	650
2.2 5 2 1600 4 0.5 50 1600 0.31 0.18 0.55 6.45 20.64 400 200 650 2.2 5 2 1600 5 0.5 50 1600 0.31 0.16 0.47 6.71 21.47 400 200 650 2.2 5 2 1600 6 0.5 50 1600 0.31 0.14 0.42 7.06 22.59 400 200 650 2.2 5 2 1600 7 0.5 50 1600 0.31 0.13 0.39 7.46 23.87 400 200 650 2.2 5 2 1600 8 0.5 50 1600 0.31 0.12 0.36 7.89 25.26 400 200 650 2.5 5 2 1600 1 0.5 50 1600 0.31 0.27 0.80 6.34	2.2	5	2	1600	2	0.5	50	1600	0.31	0.30	0.91	6.75	21.60	400	200	650
2.2 5 2 1600 5 0.5 50 1600 0.31 0.16 0.47 6.71 21.47 400 200 650 2.2 5 2 1600 6 0.5 50 1600 0.31 0.14 0.42 7.06 22.59 400 200 650 2.2 5 2 1600 7 0.5 50 1600 0.31 0.13 0.39 7.46 23.87 400 200 650 2.2 5 2 1600 8 0.5 50 1600 0.31 0.12 0.36 7.89 25.26 400 200 650 2.5 5 2 1600 1 0.5 50 1600 0.31 0.48 1.44 8.21 26.27 400 200 650 2.5 5 2 1600 2 0.5 50 1600 0.31 0.27 0.80 6.34	2.2	5	2	1600	3	0.5	50	1600	0.31	0.22	0.67	6.37	20.39	400	200	650
2.2 5 2 1600 6 0.5 50 1600 0.31 0.14 0.42 7.06 22.59 400 200 650 2.2 5 2 1600 7 0.5 50 1600 0.31 0.13 0.39 7.46 23.87 400 200 650 2.2 5 2 1600 8 0.5 50 1600 0.31 0.12 0.36 7.89 25.26 400 200 650 2.5 5 2 1600 1 0.5 50 1600 0.31 0.48 1.44 8.21 26.27 400 200 650 2.5 5 2 1600 2 0.5 50 1600 0.31 0.27 0.80 6.34 20.29 400 200 650 2.5 5 2 1600 3 0.5 50 1600 0.31 0.16 0.48 6.20	2.2	5	2	1600	4	0.5	50	1600	0.31	0.18	0.55	6.45	20.64	400	200	650
2.2 5 2 1600 7 0.5 50 1600 0.31 0.13 0.39 7.46 23.87 400 200 650 2.2 5 2 1600 8 0.5 50 1600 0.31 0.12 0.36 7.89 25.26 400 200 650 2.5 5 2 1600 1 0.5 50 1600 0.31 0.48 1.44 8.21 26.27 400 200 650 2.5 5 2 1600 2 0.5 50 1600 0.31 0.27 0.80 6.34 20.29 400 200 650 2.5 5 2 1600 3 0.5 50 1600 0.31 0.20 0.59 6.07 19.43 400 200 650 2.5 5 2 1600 4 0.5 50 1600 0.31 0.16 0.48 6.20	2.2	5	2	1600	5	0.5	50	1600	0.31	0.16	0.47	6.71	21.47	400	200	650
2.2 5 2 1600 8 0.5 50 1600 0.31 0.12 0.36 7.89 25.26 400 200 650 2.5 5 2 1600 1 0.5 50 1600 0.31 0.48 1.44 8.21 26.27 400 200 650 2.5 5 2 1600 2 0.5 50 1600 0.31 0.27 0.80 6.34 20.29 400 200 650 2.5 5 2 1600 3 0.5 50 1600 0.31 0.20 0.59 6.07 19.43 400 200 650 2.5 5 2 1600 4 0.5 50 1600 0.31 0.16 0.48 6.20 19.85 400 200 650 2.5 5 2 1600 5 0.5 50 1600 0.31 0.14 0.42 6.50	2.2	5	2	1600	6	0.5	50	1600	0.31	0.14	0.42	7.06	22.59	400	200	650
2.5 5 2 1600 1 0.5 50 1600 0.31 0.48 1.44 8.21 26.27 400 200 650 2.5 5 2 1600 2 0.5 50 1600 0.31 0.27 0.80 6.34 20.29 400 200 650 2.5 5 2 1600 3 0.5 50 1600 0.31 0.20 0.59 6.07 19.43 400 200 650 2.5 5 2 1600 4 0.5 50 1600 0.31 0.16 0.48 6.20 19.85 400 200 650 2.5 5 2 1600 5 0.5 50 1600 0.31 0.14 0.42 6.50 20.79 400 200 650 2.5 5 2 1600 6 0.5 50 1600 0.31 0.12 0.37 6.87	2.2	5	2	1600	7	0.5	50	1600	0.31	0.13	0.39	7.46	23.87	400	200	650
2.5 5 2 1600 2 0.5 50 1600 0.31 0.27 0.80 6.34 20.29 400 200 650 2.5 5 2 1600 3 0.5 50 1600 0.31 0.20 0.59 6.07 19.43 400 200 650 2.5 5 2 1600 4 0.5 50 1600 0.31 0.16 0.48 6.20 19.85 400 200 650 2.5 5 2 1600 5 0.5 50 1600 0.31 0.14 0.42 6.50 20.79 400 200 650 2.5 5 2 1600 6 0.5 50 1600 0.31 0.12 0.37 6.87 21.97 400 200 650 2.5 5 2 1600 7 0.5 50 1600 0.31 0.11 0.34 7.28	2.2	5	2	1600	8	0.5	50	1600	0.31	0.12	0.36	7.89	25.26	400	200	650
2.5 5 2 1600 3 0.5 50 1600 0.31 0.20 0.59 6.07 19.43 400 200 650 2.5 5 2 1600 4 0.5 50 1600 0.31 0.16 0.48 6.20 19.85 400 200 650 2.5 5 2 1600 5 0.5 50 1600 0.31 0.14 0.42 6.50 20.79 400 200 650 2.5 5 2 1600 6 0.5 50 1600 0.31 0.12 0.37 6.87 21.97 400 200 650 2.5 5 2 1600 7 0.5 50 1600 0.31 0.11 0.34 7.28 23.31 400 200 650 2.5 5 2 1600 8 0.5 50 1600 0.31 0.11 0.32 7.73	2.5	5	2	1600	1	0.5	50	1600	0.31	0.48	1.44	8.21	26.27	400	200	650
2.5 5 2 1600 4 0.5 50 1600 0.31 0.16 0.48 6.20 19.85 400 200 650 2.5 5 2 1600 5 0.5 50 1600 0.31 0.14 0.42 6.50 20.79 400 200 650 2.5 5 2 1600 6 0.5 50 1600 0.31 0.12 0.37 6.87 21.97 400 200 650 2.5 5 2 1600 7 0.5 50 1600 0.31 0.11 0.34 7.28 23.31 400 200 650 2.5 5 2 1600 8 0.5 50 1600 0.31 0.11 0.32 7.73 24.73 400 200 650 3 5 2 1600 2 0.5 50 1600 0.31 0.40 1.20 7.31	2.5	5	2	1600	2	0.5	50	1600	0.31	0.27	0.80	6.34	20.29	400	200	650
2.5 5 2 1600 5 0.5 50 1600 0.31 0.14 0.42 6.50 20.79 400 200 650 2.5 5 2 1600 6 0.5 50 1600 0.31 0.12 0.37 6.87 21.97 400 200 650 2.5 5 2 1600 7 0.5 50 1600 0.31 0.11 0.34 7.28 23.31 400 200 650 2.5 5 2 1600 8 0.5 50 1600 0.31 0.11 0.32 7.73 24.73 400 200 650 3 5 2 1600 1 0.5 50 1600 0.31 0.40 1.20 7.31 23.39 400 200 650 3 5 2 1600 2 0.5 50 1600 0.31 0.22 0.67 5.84	2.5	5	2	1600	3	0.5	50	1600	0.31	0.20	0.59	6.07	19.43	400	200	650
2.5 5 2 1600 6 0.5 50 1600 0.31 0.12 0.37 6.87 21.97 400 200 650 2.5 5 2 1600 7 0.5 50 1600 0.31 0.11 0.34 7.28 23.31 400 200 650 2.5 5 2 1600 8 0.5 50 1600 0.31 0.11 0.32 7.73 24.73 400 200 650 3 5 2 1600 1 0.5 50 1600 0.31 0.40 1.20 7.31 23.39 400 200 650 3 5 2 1600 2 0.5 50 1600 0.31 0.22 0.67 5.84 18.69 400 200 650 3 5 2 1600 3 0.5 50 1600 0.31 0.16 0.49 5.71 <t< td=""><td>2.5</td><td>5</td><td>2</td><td>1600</td><td>4</td><td>0.5</td><td>50</td><td>1600</td><td>0.31</td><td>0.16</td><td>0.48</td><td>6.20</td><td>19.85</td><td>400</td><td>200</td><td>650</td></t<>	2.5	5	2	1600	4	0.5	50	1600	0.31	0.16	0.48	6.20	19.85	400	200	650
2.5 5 2 1600 7 0.5 50 1600 0.31 0.11 0.34 7.28 23.31 400 200 650 2.5 5 2 1600 8 0.5 50 1600 0.31 0.11 0.32 7.73 24.73 400 200 650 3 5 2 1600 1 0.5 50 1600 0.31 0.40 1.20 7.31 23.39 400 200 650 3 5 2 1600 2 0.5 50 1600 0.31 0.22 0.67 5.84 18.69 400 200 650 3 5 2 1600 3 0.5 50 1600 0.31 0.16 0.49 5.71 18.26 400 200 650 3 5 2 1600 4 0.5 50 1600 0.31 0.13 0.40 5.90	2.5	5	2	1600	5	0.5	50	1600	0.31	0.14	0.42	6.50	20.79	400	200	650
2.5 5 2 1600 8 0.5 50 1600 0.31 0.11 0.32 7.73 24.73 400 200 650 3 5 2 1600 1 0.5 50 1600 0.31 0.40 1.20 7.31 23.39 400 200 650 3 5 2 1600 2 0.5 50 1600 0.31 0.22 0.67 5.84 18.69 400 200 650 3 5 2 1600 3 0.5 50 1600 0.31 0.16 0.49 5.71 18.26 400 200 650 3 5 2 1600 4 0.5 50 1600 0.31 0.13 0.40 5.90 18.89 400 200 650	2.5	5	2	1600	6	0.5	50	1600	0.31	0.12	0.37	6.87	21.97	400	200	650
3 5 2 1600 1 0.5 50 1600 0.31 0.40 1.20 7.31 23.39 400 200 650 3 5 2 1600 2 0.5 50 1600 0.31 0.22 0.67 5.84 18.69 400 200 650 3 5 2 1600 3 0.5 50 1600 0.31 0.16 0.49 5.71 18.26 400 200 650 3 5 2 1600 4 0.5 50 1600 0.31 0.13 0.40 5.90 18.89 400 200 650	2.5	5	2	1600	7	0.5	50	1600	0.31	0.11	0.34	7.28	23.31	400	200	650
3 5 2 1600 2 0.5 50 1600 0.31 0.22 0.67 5.84 18.69 400 200 650 3 5 2 1600 3 0.5 50 1600 0.31 0.16 0.49 5.71 18.26 400 200 650 3 5 2 1600 4 0.5 50 1600 0.31 0.13 0.40 5.90 18.89 400 200 650	2.5	5	2	1600	8	0.5	50	1600	0.31	0.11	0.32	7.73	24.73	400	200	650
3 5 2 1600 3 0.5 50 1600 0.31 0.16 0.49 5.71 18.26 400 200 650 3 5 2 1600 4 0.5 50 1600 0.31 0.13 0.40 5.90 18.89 400 200 650	3	5	2	1600	1	0.5	50	1600	0.31	0.40	1.20	7.31	23.39	400	200	650
3 5 2 1600 4 0.5 50 1600 0.31 0.13 0.40 5.90 18.89 400 200 650	3	5	2	1600	2	0.5	50	1600	0.31	0.22	0.67	5.84	18.69	400	200	650
	3	5	2	1600	3	0.5	50	1600	0.31	0.16	0.49	5.71	18.26	400	200	650
3 5 2 1600 5 0.5 50 1600 0.31 0.12 0.35 6.24 19.95 400 200 650	3	5	2	1600	4	0.5	50	1600	0.31	0.13	0.40	5.90	18.89	400	200	650
0 0 1 100 0 00 100 000 000 000 000	3	5	2	1600	5	0.5	50	1600	0.31	0.12	0.35	6.24	19.95	400	200	650
3 5 2 1600 6 0.5 50 1600 0.31 0.10 0.31 6.63 21.23 400 200 650	3	5	2	1600	6	0.5	50	1600	0.31	0.10	0.31	6.63	21.23	400	200	650

3	5	2	1600	7	0.5	50	1600	0.31	0.10	0.29	7.07	22.62	400	200	650
3	5	2	1600	8	0.5	50	1600	0.31	0.09	0.27	7.53	24.09	400	200	650

2- Type 2 – CPU

	CPU		RA	M		Task		Time	Usage	Current	Total Of Power use	Power		OS	
CPUS (GHz)	CPUC (#)	CTDS (MB)	FSBS (MHz)	RAMS (GB)	Gbit	Data (MB)	CRUO (MHz)	S	%		Power * Time	I*V	OCCUR (MHz)	RLOR (MB)	OSRU (MB)
2	1	2	1600	1	0.1	512	800	0.13	1.67	3.00	8.75	70.00	400	200	650
2	1	2	1600	2	0.1	1024	800	0.06	1.67	3.00	4.91	78.59	400	200	650
2	1	2	1600	3	0.1	1536	800	0.06	1.22	3.00	4.28	68.44	400	200	650
2	1	2	1600	4	0.1	2048	800	0.06	1.00	3.00	4.14	66.29	400	200	650
2	1	2	1600	5	0.1	2560	800	0.06	0.87	2.60	4.21	67.34	400	200	650
2	1	2	1600	6	0.1	3072	800	0.06	0.78	2.33	4.37	69.99	400	200	650
2	1	2	1600	7	0.1	3584	800	0.06	0.78	2.33	4.74	75.84	400	200	650
2	1	2	1600	8	0.1	4096	800	0.06	0.78	2.33	5.11	81.69	400	200	650
2.2	1	2	1600	1	0.1	512	800	0.13	1.52	3.00	8.07	64.55	400	200	650
2.2	1	2	1600	2	0.1	1024	800	0.06	1.52	3.00	4.57	73.14	400	200	650
2.2	1	2	1600	3	0.1	1536	800	0.06	1.11	3.00	4.03	64.44	400	200	650
2.2	1	2	1600	4	0.1	2048	800	0.06	0.91	2.73	3.94	63.02	400	200	650
2.2	1	2	1600	5	0.1	2560	800	0.06	0.79	2.36	4.03	64.50	400	200	650
2.2	1	2	1600	6	0.1	3072	800	0.06	0.71	2.12	4.22	67.44	400	200	650
2.2	1	2	1600	7	0.1	3584	800	0.06	0.71	2.12	4.58	73.29	400	200	650
2.2	1	2	1600	8	0.1	4096	800	0.06	0.71	2.12	4.95	79.14	400	200	650
2.5	1	2	1600	1	0.1	512	800	0.13	1.33	3.00	7.25	58.00	400	200	650
2.5	1	2	1600	2	0.1	1024	800	0.06	1.33	3.00	4.16	66.59	400	200	650

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2.5	1	2	1600	3	0.1	1536	800	0.06	0.98	2.93	3.73	59.64	400	200	650
2.5	1	2	1600	4	0.1	2048	800	0.06	0.80	2.40	3.69	59.09	400	200	650
2.5	1	2	1600	5	0.1	2560	800	0.06	0.69	2.08	3.82	61.10	400	200	650
2.5	1	2	1600	6	0.1	3072	800	0.06	0.62	1.87	4.02	64.39	400	200	650
2.5	1	2	1600	7	0.1	3584	800	0.06	0.62	1.87	4.39	70.24	400	200	650
2.5	1	2	1600	8	0.1	4096	800	0.06	0.62	1.87	4.76	76.09	400	200	650
3	1	2	1600	1	0.1	512	800	0.13	1.11	3.00	6.25	50.00	400	200	650
3	1	2	1600	2	0.1	1024	800	0.06	1.11	3.00	3.66	58.59	400	200	650
3	1	2	1600	3	0.1	1536	800	0.06	0.81	2.44	3.36	53.77	400	200	650
3	1	2	1600	4	0.1	2048	800	0.06	0.67	2.00	3.39	54.29	400	200	650
3	1	2	1600	5	0.1	2560	800	0.06	0.58	1.73	3.56	56.94	400	200	650
3	1	2	1600	6	0.1	3072	800	0.06	0.52	1.56	3.79	60.66	400	200	650
3	1	2	1600	7	0.1	3584	800	0.06	0.52	1.56	4.16	66.51	400	200	650
3	1	2	1600	8	0.1	4096	800	0.06	0.52	1.56	4.52	72.36	400	200	650
2	2	2	1600	1	0.1	512	800	0.13	0.83	2.50	5.00	40.00	400	200	650
2	2	2	1600	2	0.1	1024	800	0.06	0.83	2.50	3.04	48.59	400	200	650
2	2	2	1600	3	0.1	1536	800	0.06	0.61	1.83	2.90	46.44	400	200	650
2	2	2	1600	4	0.1	2048	800	0.06	0.50	1.50	3.02	48.29	400	200	650
2	2	2	1600	5	0.1	2560	800	0.06	0.43	1.30	3.23	51.74	400	200	650
2	2	2	1600	6	0.1	3072	800	0.06	0.39	1.17	3.50	55.99	400	200	650
2	2	2	1600	7	0.1	3584	800	0.06	0.36	1.07	3.79	60.70	400	200	650
2	2	2	1600	8	0.1	4096	800	0.06	0.33	1.00	4.11	65.69	400	200	650
2.2	2	2	1600	1	0.1	512	800	0.13	0.76	2.27	4.66	37.27	400	200	650
2.2	2	2	1600	2	0.1	1024	800	0.06	0.76	2.27	2.87	45.86	400	200	650
2.2	2	2	1600	3	0.1	1536	800	0.06	0.56	1.67	2.78	44.44	400	200	650
2.2	2	2	1600	4	0.1	2048	800	0.06	0.45	1.36	2.92	46.65	400	200	650
2.2	2	2	1600	5	0.1	2560	800	0.06	0.39	1.18	3.15	50.32	400	200	650
2.2	2	2	1600	6	0.1	3072	800	0.06	0.35	1.06	3.42	54.72	400	200	650

			4.600	-	0.4	0504	000	0.06	0.00	0.07	0.70	50.50	400	200	650
2.2	2	2	1600	7	0.1	3584	800	0.06	0.32	0.97	3.72	59.53	400	200	650
2.2	2	2	1600	8	0.1	4096	800	0.06	0.30	0.91	4.04	64.60	400	200	650
2.5	2	2	1600	1	0.1	512	800	0.13	0.67	2.00	4.25	34.00	400	200	650
2.5	2	2	1600	2	0.1	1024	800	0.06	0.67	2.00	2.66	42.59	400	200	650
2.5	2	2	1600	3	0.1	1536	800	0.06	0.49	1.47	2.63	42.04	400	200	650
2.5	2	2	1600	4	0.1	2048	800	0.06	0.40	1.20	2.79	44.69	400	200	650
2.5	2	2	1600	5	0.1	2560	800	0.06	0.35	1.04	3.04	48.62	400	200	650
2.5	2	2	1600	6	0.1	3072	800	0.06	0.31	0.93	3.32	53.19	400	200	650
2.5	2	2	1600	7	0.1	3584	800	0.06	0.29	0.86	3.63	58.13	400	200	650
2.5	2	2	1600	8	0.1	4096	800	0.06	0.27	0.80	3.96	63.29	400	200	650
3	2	2	1600	1	0.1	512	800	0.13	0.56	1.67	3.75	30.00	400	200	650
3	2	2	1600	2	0.1	1536	800	0.06	0.41	1.22	2.44	39.11	400	200	650
3	2	2	1600	3	0.1	1024	800	0.06	0.56	1.67	2.41	38.59	400	200	650
3	2	2	1600	4	0.1	2048	800	0.06	0.33	1.00	2.64	42.29	400	200	650
3	2	2	1600	5	0.1	2560	800	0.06	0.29	0.87	2.91	46.54	400	200	650
3	2	2	1600	6	0.1	3072	800	0.06	0.26	0.78	3.21	51.32	400	200	650
3	2	2	1600	7	0.1	3584	800	0.06	0.24	0.71	3.53	56.41	400	200	650
3	2	2	1600	8	0.1	4096	800	0.06	0.22	0.67	3.86	61.69	400	200	650
2	3	2	1600	1	0.1	512	800	0.13	0.56	1.67	3.75	30.00	400	200	650
2	3	2	1600	2	0.1	1536	800	0.06	0.41	1.22	2.44	39.11	400	200	650
2	3	2	1600	3	0.1	1024	800	0.06	0.56	1.67	2.41	38.59	400	200	650
2	3	2	1600	4	0.1	2048	800	0.06	0.33	1.00	2.64	42.29	400	200	650
2	3	2	1600	5	0.1	2560	800	0.06	0.29	0.87	2.91	46.54	400	200	650
2	3	2	1600	6	0.1	3072	800	0.06	0.26	0.78	3.21	51.32	400	200	650
2	3	2	1600	7	0.1	3584	800	0.06	0.24	0.71	3.53	56.41	400	200	650
2	3	2	1600	8	0.1	4096	800	0.06	0.22	0.67	3.86	61.69	400	200	650
2.2	3	2	1600	1	0.1	512	800	0.13	0.51	1.52	3.52	28.18	400	200	650
2.2	3	2	1600	2	0.1	1536	800	0.06	0.37	1.11	2.36	37.77	400	200	650

2.2	3	2	1600	3	0.1	1024	800	0.06	0.51	1.52	2.30	36.77	400	200	650
2.2	3	2	1600	4	0.1	2048	800	0.06	0.30	0.91	2.57	41.20	400	200	650
2.2	3	2	1600	5	0.1	2560	800	0.06	0.26	0.79	2.85	45.59	400	200	650
2.2	3	2	1600	6	0.1	3072	800	0.06	0.24	0.71	3.15	50.47	400	200	650
2.2	3	2	1600	7	0.1	3584	800	0.06	0.22	0.65	3.48	55.63	400	200	650
2.2	3	2	1600	8	0.1	4096	800	0.06	0.20	0.61	3.81	60.96	400	200	650
2.5	3	2	1600	1	0.1	512	800	0.13	0.44	1.33	3.25	26.00	400	200	650
2.5	3	2	1600	2	0.1	1536	800	0.06	0.33	0.98	2.26	36.17	400	200	650
2.5	3	2	1600	3	0.1	1024	800	0.06	0.44	1.33	2.16	34.59	400	200	650
2.5	3	2	1600	4	0.1	2048	800	0.06	0.27	0.80	2.49	39.89	400	200	650
2.5	3	2	1600	5	0.1	2560	800	0.06	0.23	0.69	2.78	44.46	400	200	650
2.5	3	2	1600	6	0.1	3072	800	0.06	0.21	0.62	3.09	49.46	400	200	650
2.5	3	2	1600	7	0.1	3584	800	0.06	0.19	0.57	3.42	54.70	400	200	650
2.5	3	2	1600	8	0.1	4096	800	0.06	0.18	0.53	3.76	60.09	400	200	650
3	3	2	1600	1	0.1	512	800	0.13	0.37	1.11	2.92	23.33	400	200	650
3	3	2	1600	2	0.1	1536	800	0.06	0.27	0.81	2.14	34.22	400	200	650
3	3	2	1600	3	0.1	1024	800	0.06	0.37	1.11	2.00	31.92	400	200	650
3	3	2	1600	4	0.1	2048	800	0.06	0.22	0.67	2.39	38.29	400	200	650
3	3	2	1600	5	0.1	2560	800	0.06	0.19	0.58	2.69	43.07	400	200	650
3	3	2	1600	6	0.1	3072	800	0.06	0.17	0.52	3.01	48.21	400	200	650
3	3	2	1600	7	0.1	3584	800	0.06	0.16	0.48	3.35	53.55	400	200	650
3	3	2	1600	8	0.1	4096	800	0.06	0.15	0.44	3.69	59.02	400	200	650
2	5	2	1600	1	0.1	512	800	0.13	0.33	1.00	2.75	22.00	400	200	650
2	5	2	1600	2	0.1	1536	800	0.06	0.24	0.73	2.08	33.24	400	200	650
2	5	2	1600	3	0.1	1024	800	0.06	0.33	1.00	1.91	30.59	400	200	650
2	5	2	1600	4	0.1	2048	800	0.06	0.20	0.60	2.34	37.49	400	200	650
2	5	2	1600	5	0.1	2560	800	0.06	0.17	0.52	2.65	42.38	400	200	650
2	5	2	1600	6	0.1	3072	800	0.06	0.16	0.47	2.97	47.59	400	200	650

2	5	2	1600	7	0.1	3584	800	0.06	0.14	0.43	3.31	52.98	400	200	650
2	5	2	1600	8	0.1	4096	800	0.06	0.13	0.40	3.66	58.49	400	200	650
2.2	5	2	1600	1	0.1	512	800	0.13	0.30	0.91	2.61	20.91	400	200	650
2.2	5	2	1600	2	0.1	1536	800	0.06	0.22	0.67	2.03	32.44	400	200	650
2.2	5	2	1600	3	0.1	1024	800	0.06	0.30	0.91	1.84	29.50	400	200	650
2.2	5	2	1600	4	0.1	2048	800	0.06	0.18	0.55	2.30	36.84	400	200	650
2.2	5	2	1600	5	0.1	2560	800	0.06	0.16	0.47	2.61	41.81	400	200	650
2.2	5	2	1600	6	0.1	3072	800	0.06	0.14	0.42	2.94	47.08	400	200	650
2.2	5	2	1600	7	0.1	3584	800	0.06	0.13	0.39	3.28	52.51	400	200	650
2.2	5	2	1600	8	0.1	4096	800	0.06	0.12	0.36	3.63	58.05	400	200	650
2.5	5	2	1600	1	0.1	512	800	0.13	0.27	0.80	2.45	19.60	400	200	650
2.5	5	2	1600	2	0.1	1536	800	0.06	0.20	0.59	1.97	31.48	400	200	650
2.5	5	2	1600	3	0.1	1024	800	0.06	0.27	0.80	1.76	28.19	400	200	650
2.5	5	2	1600	4	0.1	2048	800	0.06	0.16	0.48	2.25	36.05	400	200	650
2.5	5	2	1600	5	0.1	2560	800	0.06	0.14	0.42	2.57	41.13	400	200	650
2.5	5	2	1600	6	0.1	3072	800	0.06	0.12	0.37	2.90	46.47	400	200	650
2.5	5	2	1600	7	0.1	3584	800	0.06	0.11	0.34	3.25	51.95	400	200	650
2.5	5	2	1600	8	0.1	4096	800	0.06	0.11	0.32	3.60	57.53	400	200	650
3	5	2	1600	1	0.1	512	800	0.13	0.22	0.67	2.25	18.00	400	200	650
3	5	2	1600	2	0.1	1536	800	0.06	0.16	0.49	1.89	30.31	400	200	650
3	5	2	1600	3	0.1	1024	800	0.06	0.22	0.67	1.66	26.59	400	200	650
3	5	2	1600	4	0.1	2048	800	0.06	0.13	0.40	2.19	35.09	400	200	650
3	5	2	1600	5	0.1	2560	800	0.06	0.12	0.35	2.52	40.30	400	200	650
3	5	2	1600	6	0.1	3072	800	0.06	0.10	0.31	2.86	45.72	400	200	650
3	5	2	1600	7	0.1	3584	800	0.06	0.10	0.29	3.20	51.27	400	200	650
3	5	2	1600	8	0.1	4096	800	0.06	0.09	0.27	3.56	56.89	400	200	650

3- Type 3 – CPU

	СРИ		RA	ιM		Task		Time	Usage	Current	Total Of Power use	Power		OS	
CPUS (GHz)	CPUC (#)	CTDS (MB)	FSBS (MHz)	RAMS (GB)	Gbit	Data (MB)	CRUO (MHz)	S	%	I	Power * Time	I*V	OCCUR (MHz)	RLOR (MB)	OSRU (MB)
2	1	2	1600	1	0.5	100	150	0.31	3.00	3.00	36.69	117.40	400	200	650
2	1	2	1600	2	0.5	1024	150	0.31	1.67	3.00	24.56	78.59	400	200	650
2	1	2	1600	3	0.5	2048	150	0.31	1.22	3.00	22.68	72.59	400	200	650
2	1	2	1600	4	0.5	3072	150	0.31	1.00	3.00	23.31	74.59	400	200	650
2	1	2	1600	5	0.5	4096	150	0.31	0.87	2.60	24.93	79.79	400	200	650
2	1	2	1600	6	0.5	5120	150	0.31	0.78	2.33	27.06	86.59	400	200	650
2	1	2	1600	7	0.5	6144	150	0.31	0.78	2.33	30.18	96.59	400	200	650
2	1	2	1600	8	0.5	7168	150	0.31	0.78	2.33	33.31	106.59	400	200	650
2.2	1	2	1600	1	0.5	100	150	0.31	2.73	3.00	33.62	107.58	400	200	650
2.2	1	2	1600	2	0.5	1024	150	0.31	1.52	3.00	22.85	73.14	400	200	650
2.2	1	2	1600	3	0.5	2048	150	0.31	1.11	3.00	21.43	68.59	400	200	650
2.2	1	2	1600	4	0.5	3072	150	0.31	0.91	2.73	22.29	71.32	400	200	650
2.2	1	2	1600	5	0.5	4096	150	0.31	0.79	2.36	24.05	76.95	400	200	650
2.2	1	2	1600	6	0.5	5120	150	0.31	0.71	2.12	26.26	84.04	400	200	650
2.2	1	2	1600	7	0.5	6144	150	0.31	0.71	2.12	29.39	94.04	400	200	650
2.2	1	2	1600	8	0.5	7168	150	0.31	0.71	2.12	32.51	104.04	400	200	650
2.5	1	2	1600	1	0.5	100	150	0.31	2.40	3.00	29.94	95.80	400	200	650
2.5	1	2	1600	2	0.5	1024	150	0.31	1.33	3.00	20.81	66.59	400	200	650
2.5	1	2	1600	3	0.5	2048	150	0.31	0.98	2.93	19.93	63.79	400	200	650

2.5 1 2 1600 4 0.5 3072 150 0.31 0.80 2.40 21.06 67.39 400 20 2.5 1 2 1600 5 0.5 4096 150 0.31 0.69 2.08 22.98 73.55 400 20 2.5 1 2 1600 6 0.5 5120 150 0.31 0.62 1.87 25.31 80.99 400 20 2.5 1 2 1600 7 0.5 6144 150 0.31 0.62 1.87 28.43 90.99 400 20 2.5 1 2 1600 8 0.5 7168 150 0.31 0.62 1.87 31.56 100.99 400 20	650 650 650 650 650
2.5 1 2 1600 6 0.5 5120 150 0.31 0.62 1.87 25.31 80.99 400 20 2.5 1 2 1600 7 0.5 6144 150 0.31 0.62 1.87 28.43 90.99 400 20	650 650 650
2.5 1 2 1600 7 0.5 6144 150 0.31 0.62 1.87 28.43 90.99 400 20	650
	650
25 1 2 1000 0 05 7100 150 0 21 0 62 1 97 21 56 100 00 400 20	
2.5 1 2 1600 8 0.5 7168 150 0.31 0.62 1.87 31.56 100.99 400 20	650
3 1 2 1600 1 0.5 100 150 0.31 2.00 3.00 25.44 81.40 400 20	
3 1 2 1600 2 0.5 1024 150 0.31 1.11 3.00 18.31 58.59 400 20	650
3 1 2 1600 3 0.5 2048 150 0.31 0.81 2.44 18.10 57.92 400 20	650
3 1 2 1600 4 0.5 3072 150 0.31 0.67 2.00 19.56 62.59 400 20	650
3 1 2 1600 5 0.5 4096 150 0.31 0.58 1.73 21.68 69.39 400 20	650
3 1 2 1600 6 0.5 5120 150 0.31 0.52 1.56 24.14 77.26 400 20	650
3 1 2 1600 7 0.5 6144 150 0.31 0.52 1.56 27.27 87.26 400 20	650
3 1 2 1600 8 0.5 7168 150 0.31 0.52 1.56 30.39 97.26 400 20	650
2 2 2 1600 1 0.5 100 150 0.31 1.50 3.00 19.81 63.40 400 20	650
2 2 2 1600 2 0.5 1024 150 0.31 0.83 2.50 15.18 48.59 400 20	650
2 2 2 1600 3 0.5 2048 150 0.31 0.61 1.83 15.81 50.59 400 20	650
2 2 2 1600 4 0.5 3072 150 0.31 0.50 1.50 17.68 56.59 400 20	650
2 2 1600 5 0.5 4096 150 0.31 0.43 1.30 20.06 64.19 400 20	650
2 2 2 1600 6 0.5 5120 150 0.31 0.39 1.17 22.68 72.59 400 20	650
2 2 2 1600 7 0.5 6144 150 0.31 0.36 1.07 25.45 81.45 400 20	650
2 2 2 1600 8 0.5 7168 150 0.31 0.33 1.00 28.31 90.59 400 20	650
2.2 2 1600 1 0.5 100 150 0.31 1.36 3.00 18.28 58.49 400 20	650
2.2 2 1600 2 0.5 1024 150 0.31 0.76 2.27 14.33 45.86 400 20	650
2.2 2 1600 3 0.5 2048 150 0.31 0.56 1.67 15.18 48.59 400 20	650
2.2 2 1600 4 0.5 3072 150 0.31 0.45 1.36 17.17 54.95 400 20	650
2.2 2 1600 5 0.5 4096 150 0.31 0.39 1.18 19.62 62.77 400 20	650
2.2 2 1600 6 0.5 5120 150 0.31 0.35 1.06 22.29 71.32 400 20	650
2.2 2 1600 7 0.5 6144 150 0.31 0.32 0.97 25.09 80.28 400 20	650

2.2	2	2	1600	8	0.5	7168	150	0.31	0.30	0.91	27.97	89.50	400	200	650
2.5	2		1600		0.5	100	150						400	200	
	_	2		1				0.31	1.20	3.00	16.44	52.60			650
2.5	2	2	1600	2	0.5	1024	150	0.31	0.67	2.00	13.31	42.59	400	200	650
2.5	2	2	1600	3	0.5	2048	150	0.31	0.49	1.47	14.43	46.19	400	200	650
2.5	2	2	1600	4	0.5	3072	150	0.31	0.40	1.20	16.56	52.99	400	200	650
2.5	2	2	1600	5	0.5	4096	150	0.31	0.35	1.04	19.08	61.07	400	200	650
2.5	2	2	1600	6	0.5	5120	150	0.31	0.31	0.93	21.81	69.79	400	200	650
2.5	2	2	1600	7	0.5	6144	150	0.31	0.29	0.86	24.65	78.88	400	200	650
2.5	2	2	1600	8	0.5	7168	150	0.31	0.27	0.80	27.56	88.19	400	200	650
3	2	2	1600	1	0.5	100	150	0.31	1.00	3.00	14.19	45.40	400	200	650
3	2	2	1600	2	0.5	1024	150	0.31	0.56	1.67	12.06	38.59	400	200	650
3	2	2	1600	3	0.5	2048	150	0.31	0.41	1.22	13.52	43.26	400	200	650
3	2	2	1600	4	0.5	3072	150	0.31	0.33	1.00	15.81	50.59	400	200	650
3	2	2	1600	5	0.5	4096	150	0.31	0.29	0.87	18.43	58.99	400	200	650
3	2	2	1600	6	0.5	5120	150	0.31	0.26	0.78	21.23	67.92	400	200	650
3	2	2	1600	7	0.5	6144	150	0.31	0.24	0.71	24.11	77.16	400	200	650
3	2	2	1600	8	0.5	7168	150	0.31	0.22	0.67	27.06	86.59	400	200	650
2	3	2	1600	1	0.5	100	150	0.31	1.00	3.00	14.19	45.40	400	200	650
2	3	2	1600	2	0.5	1024	150	0.31	0.56	1.67	12.06	38.59	400	200	650
2	3	2	1600	3	0.5	2048	150	0.31	0.41	1.22	13.52	43.26	400	200	650
2	3	2	1600	4	0.5	3072	150	0.31	0.33	1.00	15.81	50.59	400	200	650
2	3	2	1600	5	0.5	4096	150	0.31	0.29	0.87	18.43	58.99	400	200	650
2	3	2	1600	6	0.5	5120	150	0.31	0.26	0.78	21.23	67.92	400	200	650
2	3	2	1600	7	0.5	6144	150	0.31	0.24	0.71	24.11	77.16	400	200	650
2	3	2	1600	8	0.5	7168	150	0.31	0.22	0.67	27.06	86.59	400	200	650
2.2	3	2	1600	1	0.5	100	150	0.31	0.91	2.73	13.16	42.13	400	200	650
2.2	3	2	1600	2	0.5	1024	150	0.31	0.51	1.52	11.49	36.77	400	200	650
2.2	3	2	1600	3	0.5	2048	150	0.31	0.37	1.11	13.10	41.92	400	200	650

2.2	3	2	1600	4	0.5	3072	150	0.31	0.30	0.91	15.47	49.50	400	200	650
2.2	3	2	1600	5	0.5	4096	150	0.31	0.26	0.79	18.14	58.04	400	200	650
2.2	3	2	1600	6	0.5	5120	150	0.31	0.24	0.71	20.96	67.07	400	200	650
2.2	3	2	1600	7	0.5	6144	150	0.31	0.22	0.65	23.87	76.38	400	200	650
2.2	3	2	1600	8	0.5	7168	150	0.31	0.20	0.61	26.83	85.86	400	200	650
2.5	3	2	1600	1	0.5	100	150	0.31	0.80	2.40	11.94	38.20	400	200	650
2.5	3	2	1600	2	0.5	1024	150	0.31	0.44	1.33	10.81	34.59	400	200	650
2.5	3	2	1600	3	0.5	2048	150	0.31	0.33	0.98	12.60	40.32	400	200	650
2.5	3	2	1600	4	0.5	3072	150	0.31	0.27	0.80	15.06	48.19	400	200	650
2.5	3	2	1600	5	0.5	4096	150	0.31	0.23	0.69	17.78	56.91	400	200	650
2.5	3	2	1600	6	0.5	5120	150	0.31	0.21	0.62	20.64	66.06	400	200	650
2.5	3	2	1600	7	0.5	6144	150	0.31	0.19	0.57	23.58	75.45	400	200	650
2.5	3	2	1600	8	0.5	7168	150	0.31	0.18	0.53	26.56	84.99	400	200	650
3	3	2	1600	1	0.5	100	150	0.31	0.67	2.00	10.44	33.40	400	200	650
3	3	2	1600	2	0.5	1024	150	0.31	0.37	1.11	9.98	31.92	400	200	650
3	3	2	1600	3	0.5	2048	150	0.31	0.27	0.81	11.99	38.37	400	200	650
3	3	2	1600	4	0.5	3072	150	0.31	0.22	0.67	14.56	46.59	400	200	650
3	3	2	1600	5	0.5	4096	150	0.31	0.19	0.58	17.35	55.52	400	200	650
3	3	2	1600	6	0.5	5120	150	0.31	0.17	0.52	20.25	64.81	400	200	650
3	3	2	1600	7	0.5	6144	150	0.31	0.16	0.48	23.22	74.30	400	200	650
3	3	2	1600	8	0.5	7168	150	0.31	0.15	0.44	26.23	83.92	400	200	650
2	5	2	1600	1	0.5	100	150	0.31	0.60	1.80	9.69	31.00	400	200	650
2	5	2	1600	2	0.5	1024	150	0.31	0.33	1.00	9.56	30.59	400	200	650
2	5	2	1600	3	0.5	2048	150	0.31	0.24	0.73	11.68	37.39	400	200	650
2	5	2	1600	4	0.5	3072	150	0.31	0.20	0.60	14.31	45.79	400	200	650
2	5	2	1600	5	0.5	4096	150	0.31	0.17	0.52	17.13	54.83	400	200	650
2	5	2	1600	6	0.5	5120	150	0.31	0.16	0.47	20.06	64.19	400	200	650
2	5	2	1600	7	0.5	6144	150	0.31	0.14	0.43	23.04	73.73	400	200	650

2	5	2	1600	8	0.5	7168	150	0.31	0.13	0.40	26.06	83.39	400	200	650
2.2	5	2	1600	1	0.5	100	150	0.31	0.55	1.64	9.07	29.04	400	200	650
2.2	5	2	1600	2	0.5	1024	150	0.31	0.30	0.91	9.22	29.50	400	200	650
2.2	5	2	1600	3	0.5	2048	150	0.31	0.22	0.67	11.43	36.59	400	200	650
2.2	5	2	1600	4	0.5	3072	150	0.31	0.18	0.55	14.10	45.14	400	200	650
2.2	5	2	1600	5	0.5	4096	150	0.31	0.16	0.47	16.96	54.26	400	200	650
2.2	5	2	1600	6	0.5	5120	150	0.31	0.14	0.42	19.90	63.68	400	200	650
2.2	5	2	1600	7	0.5	6144	150	0.31	0.13	0.39	22.90	73.26	400	200	650
2.2	5	2	1600	8	0.5	7168	150	0.31	0.12	0.36	25.92	82.95	400	200	650
2.5	5	2	1600	1	0.5	100	150	0.31	0.48	1.44	8.34	26.68	400	200	650
2.5	5	2	1600	2	0.5	1024	150	0.31	0.27	0.80	8.81	28.19	400	200	650
2.5	5	2	1600	3	0.5	2048	150	0.31	0.20	0.59	11.13	35.63	400	200	650
2.5	5	2	1600	4	0.5	3072	150	0.31	0.16	0.48	13.86	44.35	400	200	650
2.5	5	2	1600	5	0.5	4096	150	0.31	0.14	0.42	16.74	53.58	400	200	650
2.5	5	2	1600	6	0.5	5120	150	0.31	0.12	0.37	19.71	63.07	400	200	650
2.5	5	2	1600	7	0.5	6144	150	0.31	0.11	0.34	22.72	72.70	400	200	650
2.5	5	2	1600	8	0.5	7168	150	0.31	0.11	0.32	25.76	82.43	400	200	650
3	5	2	1600	1	0.5	100	150	0.31	0.40	1.20	7.44	23.80	400	200	650
3	5	2	1600	2	0.5	1024	150	0.31	0.22	0.67	8.31	26.59	400	200	650
3	5	2	1600	3	0.5	2048	150	0.31	0.16	0.49	10.77	34.46	400	200	650
3	5	2	1600	4	0.5	3072	150	0.31	0.13	0.40	13.56	43.39	400	200	650
3	5	2	1600	5	0.5	4096	150	0.31	0.12	0.35	16.48	52.75	400	200	650
3	5	2	1600	6	0.5	5120	150	0.31	0.10	0.31	19.48	62.32	400	200	650
3	5	2	1600	7	0.5	6144	150	0.31	0.10	0.29	22.51	72.02	400	200	650
3	5	2	1600	8	0.5	7168	150	0.31	0.09	0.27	25.56	81.79	400	200	650

4- **Type 1 – RAM**

V M		CF	νU		RA	M		Task		Tim e	Usag e	Curren	Total Of Power use	Powe r		OS	
#	CPU S (GHz	CPU C (#)	CPU S * CPU C	CTDS (MB)	FSBS (MHz)	RAM S (GB)	Gbi t	Dat a (MB)	CRU O (MHz)	S	%	_	Power * Time	I*V	OCCU R (MHz)	RLO R (MB)	OSR U (MB)
1	2	1	2	2	1600	1	0.5	50	1600	0.31	3.00	3.00	36.56	116.9 9	400	200	650
2	2.2	1	2.2	2	1600	1	0.5	50	1600	0.31	2.73	3.00	33.49	107.1 8	400	200	650
3	2.5	1	2.5	2	1600	1	0.5	50	1600	0.31	2.40	3.00	29.81	95.39	400	200	650
4	3	1	3	2	1600	1	0.5	50	1600	0.31	2.00	3.00	25.31	80.99	400	200	650
5	2	2	4	2	1600	1	0.5	50	1600	0.31	1.50	3.00	19.69	62.99	400	200	650
6	2.2	2	4.4	2	1600	1	0.5	50	1600	0.31	1.36	3.00	18.15	58.09	400	200	650
7	2.5	2	5	2	1600	1	0.5	50	1600	0.31	1.20	3.00	16.31	52.19	400	200	650
8	3	2	6	2	1600	1	0.5	50	1600	0.31	1.00	3.00	14.06	44.99	400	200	650
9	2	3	6	2	1600	1	0.5	50	1600	0.31	1.00	3.00	14.06	44.99	400	200	650
10	2.2	3	6.6	2	1600	1	0.5	50	1600	0.31	0.91	2.73	13.04	41.72	400	200	650
11	2.5	3	7.5	2	1600	1	0.5	50	1600	0.31	0.80	2.40	11.81	37.79	400	200	650
12	3	3	9	2	1600	1	0.5	50	1600	0.31	0.67	2.00	10.31	32.99	400	200	650
13	2	5	10	2	1600	1	0.5	50	1600	0.31	0.60	1.80	9.56	30.59	400	200	650
14	2.2	5	11	2	1600	1	0.5	50	1600	0.31	0.55	1.64	8.95	28.63	400	200	650
15	2.5	5	12.5	2	1600	1	0.5	50	1600	0.31	0.48	1.44	8.21	26.27	400	200	650
16	3	5	15	2	1600	1	0.5	50	1600	0.31	0.40	1.20	7.31	23.39	400	200	650
1	2	1	2	2	1600	2	0.5	50	1600	0.31	1.67	3.00	22.09	70.69	400	200	650

	2.2		2.2		4.600	2	0.5	50	4600	0.24	4.50	2.00	20.20	CF 24	400	200	CEO
2	2.2	1	2.2	2	1600	2	0.5	50	1600	0.31	1.52	3.00	20.39	65.24	400	200	650
3	2.5	1	2.5	2	1600	2	0.5	50	1600	0.31	1.33	3.00	18.34	58.69	400	200	650
4	3	1	3	2	1600	2	0.5	50	1600	0.31	1.11	3.00	15.84	50.69	400	200	650
5	2	2	4	2	1600	2	0.5	50	1600	0.31	0.83	2.50	12.72	40.69	400	200	650
6	2.2	2	4.4	2	1600	2	0.5	50	1600	0.31	0.76	2.27	11.86	37.97	400	200	650
7	2.5	2	5	2	1600	2	0.5	50	1600	0.31	0.67	2.00	10.84	34.69	400	200	650
8	3	2	6	2	1600	2	0.5	50	1600	0.31	0.56	1.67	9.59	30.69	400	200	650
9	2	3	6	2	1600	2	0.5	50	1600	0.31	0.56	1.67	9.59	30.69	400	200	650
10	2.2	3	6.6	2	1600	2	0.5	50	1600	0.31	0.51	1.52	9.02	28.88	400	200	650
11	2.5	3	7.5	2	1600	2	0.5	50	1600	0.31	0.44	1.33	8.34	26.69	400	200	650
12	3	3	9	2	1600	2	0.5	50	1600	0.31	0.37	1.11	7.51	24.03	400	200	650
13	2	5	10	2	1600	2	0.5	50	1600	0.31	0.33	1.00	7.09	22.69	400	200	650
14	2.2	5	11	2	1600	2	0.5	50	1600	0.31	0.30	0.91	6.75	21.60	400	200	650
15	2.5	5	12.5	2	1600	2	0.5	50	1600	0.31	0.27	0.80	6.34	20.29	400	200	650
16	3	5	15	2	1600	2	0.5	50	1600	0.31	0.22	0.67	5.84	18.69	400	200	650
1	2	1	2	2	1600	3	0.5	50	1600	0.31	1.22	3.00	17.62	56.39	400	200	650
2	2.2	1	2.2	2	1600	3	0.5	50	1600	0.31	1.11	3.00	16.37	52.39	400	200	650
3	2.5	1	2.5	2	1600	3	0.5	50	1600	0.31	0.98	2.93	14.87	47.59	400	200	650
4	3	1	3	2	1600	3	0.5	50	1600	0.31	0.81	2.44	13.04	41.73	400	200	650
5	2	2	4	2	1600	3	0.5	50	1600	0.31	0.61	1.83	10.75	34.39	400	200	650
6	2.2	2	4.4	2	1600	3	0.5	50	1600	0.31	0.56	1.67	10.12	32.39	400	200	650
7	2.5	2	5	2	1600	3	0.5	50	1600	0.31	0.49	1.47	9.37	29.99	400	200	650
8	3	2	6	2	1600	3	0.5	50	1600	0.31	0.41	1.22	8.46	27.06	400	200	650
9	2	3	6	2	1600	3	0.5	50	1600	0.31	0.41	1.22	8.46	27.06	400	200	650
10	2.2	3	6.6	2	1600	3	0.5	50	1600	0.31	0.37	1.11	8.04	25.73	400	200	650
11	2.5	3	7.5	2	1600	3	0.5	50	1600	0.31	0.33	0.98	7.54	24.13	400	200	650
12	3	3	9	2	1600	3	0.5	50	1600	0.31	0.27	0.81	6.93	22.17	400	200	650
13	2	5	10	2	1600	3	0.5	50	1600	0.31	0.24	0.73	6.62	21.19	400	200	650

14	2.2	5	11	2	1600	3	0.5	50	1600	0.31	0.22	0.67	6.37	20.39	400	200	650
15	2.5	5	12.5	2	1600	3	0.5	50	1600	0.31	0.20	0.59	6.07	19.43	400	200	650
16	3	5	15	2	1600	3	0.5	50	1600	0.31	0.16	0.49	5.71	18.26	400	200	650
1	2	1	2	2	1600	4	0.5	50	1600	0.31	1.00	3.00	15.65	50.09	400	200	650
2	2.2	1	2.2	2	1600	4	0.5	50	1600	0.31	0.91	2.73	14.63	46.82	400	200	650
3	2.5	1	2.5	2	1600	4	0.5	50	1600	0.31	0.80	2.40	13.40	42.89	400	200	650
4	3	1	3	2	1600	4	0.5	50	1600	0.31	0.67	2.00	11.90	38.09	400	200	650
5	2	2	4	2	1600	4	0.5	50	1600	0.31	0.50	1.50	10.03	32.09	400	200	650
6	2.2	2	4.4	2	1600	4	0.5	50	1600	0.31	0.45	1.36	9.52	30.46	400	200	650
7	2.5	2	5	2	1600	4	0.5	50	1600	0.31	0.40	1.20	8.90	28.49	400	200	650
8	3	2	6	2	1600	4	0.5	50	1600	0.31	0.33	1.00	8.15	26.09	400	200	650
9	2	3	6	2	1600	4	0.5	50	1600	0.31	0.33	1.00	8.15	26.09	400	200	650
10	2.2	3	6.6	2	1600	4	0.5	50	1600	0.31	0.30	0.91	7.81	25.00	400	200	650
11	2.5	3	7.5	2	1600	4	0.5	50	1600	0.31	0.27	0.80	7.40	23.69	400	200	650
12	3	3	9	2	1600	4	0.5	50	1600	0.31	0.22	0.67	6.90	22.09	400	200	650
13	2	5	10	2	1600	4	0.5	50	1600	0.31	0.20	0.60	6.65	21.29	400	200	650
14	2.2	5	11	2	1600	4	0.5	50	1600	0.31	0.18	0.55	6.45	20.64	400	200	650
15	2.5	5	12.5	2	1600	4	0.5	50	1600	0.31	0.16	0.48	6.20	19.85	400	200	650
16	3	5	15	2	1600	4	0.5	50	1600	0.31	0.13	0.40	5.90	18.89	400	200	650
1	2	1	2	2	1600	5	0.5	50	1600	0.31	0.87	2.60	14.69	46.99	400	200	650
2	2.2	1	2.2	2	1600	5	0.5	50	1600	0.31	0.79	2.36	13.80	44.16	400	200	650
3	2.5	1	2.5	2	1600	5	0.5	50	1600	0.31	0.69	2.08	12.74	40.75	400	200	650
4	3	1	3	2	1600	5	0.5	50	1600	0.31	0.58	1.73	11.44	36.59	400	200	650
5	2	2	4	2	1600	5	0.5	50	1600	0.31	0.43	1.30	9.81	31.39	400	200	650
6	2.2	2	4.4	2	1600	5	0.5	50	1600	0.31	0.39	1.18	9.37	29.98	400	200	650
7	2.5	2	5	2	1600	5	0.5	50	1600	0.31	0.35	1.04	8.84	28.27	400	200	650
8	3	2	6	2	1600	5	0.5	50	1600	0.31	0.29	0.87	8.19	26.19	400	200	650
9	2	3	6	2	1600	5	0.5	50	1600	0.31	0.29	0.87	8.19	26.19	400	200	650

	2.2	3	c														
44 0			6.6	2	1600	5	0.5	50	1600	0.31	0.26	0.79	7.89	25.25	400	200	650
11 2	2.5	3	7.5	2	1600	5	0.5	50	1600	0.31	0.23	0.69	7.54	24.11	400	200	650
12	3	3	9	2	1600	5	0.5	50	1600	0.31	0.19	0.58	7.10	22.73	400	200	650
13 2	2	5	10	2	1600	5	0.5	50	1600	0.31	0.17	0.52	6.89	22.03	400	200	650
14 2	2.2	5	11	2	1600	5	0.5	50	1600	0.31	0.16	0.47	6.71	21.47	400	200	650
15 2	2.5	5	12.5	2	1600	5	0.5	50	1600	0.31	0.14	0.42	6.50	20.79	400	200	650
16	3	5	15	2	1600	5	0.5	50	1600	0.31	0.12	0.35	6.24	19.95	400	200	650
1 2	2	1	2	2	1600	6	0.5	50	1600	0.31	0.78	2.33	14.22	45.49	400	200	650
2 2	2.2	1	2.2	2	1600	6	0.5	50	1600	0.31	0.71	2.12	13.42	42.95	400	200	650
3 2	2.5	1	2.5	2	1600	6	0.5	50	1600	0.31	0.62	1.87	12.47	39.89	400	200	650
4	3	1	3	2	1600	6	0.5	50	1600	0.31	0.52	1.56	11.30	36.16	400	200	650
5 2	2	2	4	2	1600	6	0.5	50	1600	0.31	0.39	1.17	9.84	31.49	400	200	650
6 2	2.2	2	4.4	2	1600	6	0.5	50	1600	0.31	0.35	1.06	9.44	30.22	400	200	650
7 2	2.5	2	5	2	1600	6	0.5	50	1600	0.31	0.31	0.93	8.97	28.69	400	200	650
8	3	2	6	2	1600	6	0.5	50	1600	0.31	0.26	0.78	8.38	26.83	400	200	650
9 2	2	3	6	2	1600	6	0.5	50	1600	0.31	0.26	0.78	8.38	26.83	400	200	650
10 2	2.2	3	6.6	2	1600	6	0.5	50	1600	0.31	0.24	0.71	8.12	25.98	400	200	650
11 2	2.5	3	7.5	2	1600	6	0.5	50	1600	0.31	0.21	0.62	7.80	24.96	400	200	650
12	3	3	9	2	1600	6	0.5	50	1600	0.31	0.17	0.52	7.41	23.72	400	200	650
13	2	5	10	2	1600	6	0.5	50	1600	0.31	0.16	0.47	7.22	23.09	400	200	650
14 2	2.2	5	11	2	1600	6	0.5	50	1600	0.31	0.14	0.42	7.06	22.59	400	200	650
15 2	2.5	5	12.5	2	1600	6	0.5	50	1600	0.31	0.12	0.37	6.87	21.97	400	200	650
16	3	5	15	2	1600	6	0.5	50	1600	0.31	0.10	0.31	6.63	21.23	400	200	650
1 2	2	1	2	2	1600	7	0.5	50	1600	0.31	0.78	2.33	14.75	47.19	400	200	650
2 2	2.2	1	2.2	2	1600	7	0.5	50	1600	0.31	0.71	2.12	13.95	44.65	400	200	650
3 2	2.5	1	2.5	2	1600	7	0.5	50	1600	0.31	0.62	1.87	13.00	41.59	400	200	650
4 3	3	1	3	2	1600	7	0.5	50	1600	0.31	0.52	1.56	11.83	37.86	400	200	650
5 2	2	2	4	2	1600	7	0.5	50	1600	0.31	0.36	1.07	10.02	32.05	400	200	650

6	2.2	2	4.4	2	1600	7	0.5	50	1600	0.31	0.32	0.97	9.65	30.88	400	200	650
7	2.5	2	5	2	1600	7	0.5	50	1600	0.31	0.29	0.86	9.21	29.48	400	200	650
8	3	2	6	2	1600	7	0.5	50	1600	0.31	0.24	0.71	8.68	27.77	400	200	650
9	2	3	6	2	1600	7	0.5	50	1600	0.31	0.24	0.71	8.68	27.77	400	200	650
10	2.2	3	6.6	2	1600	7	0.5	50	1600	0.31	0.22	0.65	8.43	26.99	400	200	650
11	2.5	3	7.5	2	1600	7	0.5	50	1600	0.31	0.19	0.57	8.14	26.05	400	200	650
12	3	3	9	2	1600	7	0.5	50	1600	0.31	0.16	0.48	7.78	24.91	400	200	650
13	2	5	10	2	1600	7	0.5	50	1600	0.31	0.14	0.43	7.61	24.34	400	200	650
14	2.2	5	11	2	1600	7	0.5	50	1600	0.31	0.13	0.39	7.46	23.87	400	200	650
15	2.5	5	12.5	2	1600	7	0.5	50	1600	0.31	0.11	0.34	7.28	23.31	400	200	650
16	3	5	15	2	1600	7	0.5	50	1600	0.31	0.10	0.29	7.07	22.62	400	200	650
1	2	1	2	2	1600	8	0.5	50	1600	0.31	0.78	2.33	15.28	48.89	400	200	650
2	2.2	1	2.2	2	1600	8	0.5	50	1600	0.31	0.71	2.12	14.48	46.35	400	200	650
3	2.5	1	2.5	2	1600	8	0.5	50	1600	0.31	0.62	1.87	13.53	43.29	400	200	650
4	3	1	3	2	1600	8	0.5	50	1600	0.31	0.52	1.56	12.36	39.56	400	200	650
5	2	2	4	2	1600	8	0.5	50	1600	0.31	0.33	1.00	10.28	32.89	400	200	650
6	2.2	2	4.4	2	1600	8	0.5	50	1600	0.31	0.30	0.91	9.94	31.80	400	200	650
7	2.5	2	5	2	1600	8	0.5	50	1600	0.31	0.27	0.80	9.53	30.49	400	200	650
8	3	2	6	2	1600	8	0.5	50	1600	0.31	0.22	0.67	9.03	28.89	400	200	650
9	2	3	6	2	1600	8	0.5	50	1600	0.31	0.22	0.67	9.03	28.89	400	200	650
10	2.2	3	6.6	2	1600	8	0.5	50	1600	0.31	0.20	0.61	8.80	28.17	400	200	650
11	2.5	3	7.5	2	1600	8	0.5	50	1600	0.31	0.18	0.53	8.53	27.29	400	200	650
12	3	3	9	2	1600	8	0.5	50	1600	0.31	0.15	0.44	8.20	26.23	400	200	650
13	2	5	10	2	1600	8	0.5	50	1600	0.31	0.13	0.40	8.03	25.69	400	200	650
14	2.2	5	11	2	1600	8	0.5	50	1600	0.31	0.12	0.36	7.89	25.26	400	200	650
15	2.5	5	12.5	2	1600	8	0.5	50	1600	0.31	0.11	0.32	7.73	24.73	400	200	650
16	3	5	15	2	1600	8	0.5	50	1600	0.31	0.09	0.27	7.53	24.09	400	200	650

5- **Type 2 – RAM**

V M		СР	U		RA	M		Task		Tim e	Usag e	Curren t	Total Of Power use	Powe r		OS	
#	CPU S (GHz)	CPU C (#)	CPU S * CPU C	CTD S (MB	FSBS (MHz)	RAM S (GB)	Gbi t	Dat a (MB)	CRU O (MHz)	S	%	ı	Power * Time	I*V	OCCU R (MHz)	RLO R (MB)	OSR U (MB)
1	2	1	2	2	1600	1	0.1	512	800	0.13	1.67	3.00	8.75	70.00	400	200	650
2	2.2	1	2.2	2	1600	1	0.1	512	800	0.13	1.52	3.00	8.07	64.55	400	200	650
3	2.5	1	2.5	2	1600	1	0.1	512	800	0.13	1.33	3.00	7.25	58.00	400	200	650
4	3	1	3	2	1600	1	0.1	512	800	0.13	1.11	3.00	6.25	50.00	400	200	650
5	2	2	4	2	1600	1	0.1	512	800	0.13	0.83	2.50	5.00	40.00	400	200	650
6	2.2	2	4.4	2	1600	1	0.1	512	800	0.13	0.76	2.27	4.66	37.27	400	200	650
7	2.5	2	5	2	1600	1	0.1	512	800	0.13	0.67	2.00	4.25	34.00	400	200	650
8	3	2	6	2	1600	1	0.1	512	800	0.13	0.56	1.67	3.75	30.00	400	200	650
9	2	3	6	2	1600	1	0.1	512	800	0.13	0.56	1.67	3.75	30.00	400	200	650
10	2.2	3	6.6	2	1600	1	0.1	512	800	0.13	0.51	1.52	3.52	28.18	400	200	650
11	2.5	3	7.5	2	1600	1	0.1	512	800	0.13	0.44	1.33	3.25	26.00	400	200	650
12	3	3	9	2	1600	1	0.1	512	800	0.13	0.37	1.11	2.92	23.33	400	200	650
13	2	5	10	2	1600	1	0.1	512	800	0.13	0.33	1.00	2.75	22.00	400	200	650
14	2.2	5	11	2	1600	1	0.1	512	800	0.13	0.30	0.91	2.61	20.91	400	200	650
15	2.5	5	12.5	2	1600	1	0.1	512	800	0.13	0.27	0.80	2.45	19.60	400	200	650
16	3	5	15	2	1600	1	0.1	512	800	0.13	0.22	0.67	2.25	18.00	400	200	650
1	2	1	2	2	1600	2	0.1	102 4	800	0.06	1.67	3.00	4.91	78.59	400	200	650
2	2.2	1	2.2	2	1600	2	0.1	102	800	0.06	1.52	3.00	4.57	73.14	400	200	650

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3	2.5	1	2.5	2	1600	2	0.1	102 4	800	0.06	1.33	3.00	4.16	66.59	400	200	650
4	3	1	3	2	1600	2	0.1	102 4	800	0.06	1.11	3.00	3.66	58.59	400	200	650
5	2	2	4	2	1600	2	0.1	102 4	800	0.06	0.83	2.50	3.04	48.59	400	200	650
6	2.2	2	4.4	2	1600	2	0.1	102 4	800	0.06	0.76	2.27	2.87	45.86	400	200	650
7	2.5	2	5	2	1600	2	0.1	102 4	800	0.06	0.67	2.00	2.66	42.59	400	200	650
8	3	2	6	2	1600	2	0.1	102 4	800	0.06	0.56	1.67	2.41	38.59	400	200	650
9	2	3	6	2	1600	2	0.1	102 4	800	0.06	0.56	1.67	2.41	38.59	400	200	650
10	2.2	3	6.6	2	1600	2	0.1	102 4	800	0.06	0.51	1.52	2.30	36.77	400	200	650
11	2.5	3	7.5	2	1600	2	0.1	102 4	800	0.06	0.44	1.33	2.16	34.59	400	200	650
12	3	3	9	2	1600	2	0.1	102 4	800	0.06	0.37	1.11	2.00	31.92	400	200	650
13	2	5	10	2	1600	2	0.1	102 4	800	0.06	0.33	1.00	1.91	30.59	400	200	650
14	2.2	5	11	2	1600	2	0.1	102 4	800	0.06	0.30	0.91	1.84	29.50	400	200	650
15	2.5	5	12.5	2	1600	2	0.1	102 4	800	0.06	0.27	0.80	1.76	28.19	400	200	650
16	3	5	15	2	1600	2	0.1	102 4	800	0.06	0.22	0.67	1.66	26.59	400	200	650
1	2	1	2	2	1600	3	0.1	153 6	800	0.06	1.22	3.00	4.28	68.44	400	200	650
2	2.2	1	2.2	2	1600	3	0.1	153	800	0.06	1.11	3.00	4.03	64.44	400	200	650

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3	2.5	1	2.5	2	1600	3	0.1	153 6	800	0.06	0.98	2.93	3.73	59.64	400	200	650
4	3	1	3	2	1600	3	0.1	153 6	800	0.06	0.81	2.44	3.36	53.77	400	200	650
5	2	2	4	2	1600	3	0.1	153 6	800	0.06	0.61	1.83	2.90	46.44	400	200	650
6	2.2	2	4.4	2	1600	3	0.1	153 6	800	0.06	0.56	1.67	2.78	44.44	400	200	650
7_	2.5	2	5	2	1600	3	0.1	153 6	800	0.06	0.49	1.47	2.63	42.04	400	200	650
8	3	2	6	2	1600	3	0.1	153 6	800	0.06	0.41	1.22	2.44	39.11	400	200	650
9	2	3	6	2	1600	3	0.1	153 6	800	0.06	0.41	1.22	2.44	39.11	400	200	650
10	2.2	3	6.6	2	1600	3	0.1	153 6	800	0.06	0.37	1.11	2.36	37.77	400	200	650
11	2.5	3	7.5	2	1600	3	0.1	153 6	800	0.06	0.33	0.98	2.26	36.17	400	200	650
12	3	3	9	2	1600	3	0.1	153 6	800	0.06	0.27	0.81	2.14	34.22	400	200	650
13	2	5	10	2	1600	3	0.1	153 6	800	0.06	0.24	0.73	2.08	33.24	400	200	650
14	2.2	5	11	2	1600	3	0.1	153 6	800	0.06	0.22	0.67	2.03	32.44	400	200	650
15	2.5	5	12.5	2	1600	3	0.1	153 6	800	0.06	0.20	0.59	1.97	31.48	400	200	650
16	3	5	15	2	1600	3	0.1	153 6	800	0.06	0.16	0.49	1.89	30.31	400	200	650
1	2	1	2	2	1600	4	0.1	204 8	800	0.06	1.00	3.00	4.14	66.29	400	200	650
2	2.2	1	2.2	2	1600	4	0.1	204	800	0.06	0.91	2.73	3.94	63.02	400	200	650

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3	2.5	1	2.5	2	1600	4	0.1	204 8	800	0.06	0.80	2.40	3.69	59.09	400	200	650
4	3	1	3	2	1600	4	0.1	204 8	800	0.06	0.67	2.00	3.39	54.29	400	200	650
5	2	2	4	2	1600	4	0.1	204 8	800	0.06	0.50	1.50	3.02	48.29	400	200	650
6	2.2	2	4.4	2	1600	4	0.1	204 8	800	0.06	0.45	1.36	2.92	46.65	400	200	650
7	2.5	2	5	2	1600	4	0.1	204 8	800	0.06	0.40	1.20	2.79	44.69	400	200	650
8	3	2	6	2	1600	4	0.1	204 8	800	0.06	0.33	1.00	2.64	42.29	400	200	650
9	2	3	6	2	1600	4	0.1	204 8	800	0.06	0.33	1.00	2.64	42.29	400	200	650
10	2.2	3	6.6	2	1600	4	0.1	204 8	800	0.06	0.30	0.91	2.57	41.20	400	200	650
11	2.5	3	7.5	2	1600	4	0.1	204 8	800	0.06	0.27	0.80	2.49	39.89	400	200	650
12	3	3	9	2	1600	4	0.1	204 8	800	0.06	0.22	0.67	2.39	38.29	400	200	650
13	2	5	10	2	1600	4	0.1	204 8	800	0.06	0.20	0.60	2.34	37.49	400	200	650
14	2.2	5	11	2	1600	4	0.1	204 8	800	0.06	0.18	0.55	2.30	36.84	400	200	650
15	2.5	5	12.5	2	1600	4	0.1	204 8	800	0.06	0.16	0.48	2.25	36.05	400	200	650
16	3	5	15	2	1600	4	0.1	204 8	800	0.06	0.13	0.40	2.19	35.09	400	200	650
1	2	1	2	2	1600	5	0.1	256 0	800	0.06	0.87	2.60	4.21	67.34	400	200	650
2	2.2	1	2.2	2	1600	5	0.1	256	800	0.06	0.79	2.36	4.03	64.50	400	200	650

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3	2.5	1	2.5	2	1600	5	0.1	256 0	800	0.06	0.69	2.08	3.82	61.10	400	200	650
4	3	1	3	2	1600	5	0.1	256 0	800	0.06	0.58	1.73	3.56	56.94	400	200	650
5	2	2	4	2	1600	5	0.1	256 0	800	0.06	0.43	1.30	3.23	51.74	400	200	650
6	2.2	2	4.4	2	1600	5	0.1	256 0	800	0.06	0.39	1.18	3.15	50.32	400	200	650
7	2.5	2	5	2	1600	5	0.1	256 0	800	0.06	0.35	1.04	3.04	48.62	400	200	650
8	3	2	6	2	1600	5	0.1	256 0	800	0.06	0.29	0.87	2.91	46.54	400	200	650
9	2	3	6	2	1600	5	0.1	256 0	800	0.06	0.29	0.87	2.91	46.54	400	200	650
10	2.2	3	6.6	2	1600	5	0.1	256 0	800	0.06	0.26	0.79	2.85	45.59	400	200	650
11	2.5	3	7.5	2	1600	5	0.1	256 0	800	0.06	0.23	0.69	2.78	44.46	400	200	650
12	3	3	9	2	1600	5	0.1	256 0	800	0.06	0.19	0.58	2.69	43.07	400	200	650
13	2	5	10	2	1600	5	0.1	256 0	800	0.06	0.17	0.52	2.65	42.38	400	200	650
14	2.2	5	11	2	1600	5	0.1	256 0	800	0.06	0.16	0.47	2.61	41.81	400	200	650
15	2.5	5	12.5	2	1600	5	0.1	256 0	800	0.06	0.14	0.42	2.57	41.13	400	200	650
16	3	5	15	2	1600	5	0.1	256 0	800	0.06	0.12	0.35	2.52	40.30	400	200	650
1	2	1	2	2	1600	6	0.1	307 2	800	0.06	0.78	2.33	4.37	69.99	400	200	650
2	2.2	1	2.2	2	1600	6	0.1	307	800	0.06	0.71	2.12	4.22	67.44	400	200	650

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3	2.5	1	2.5	2	1600	6	0.1	307 2	800	0.06	0.62	1.87	4.02	64.39	400	200	650
4	3	1	3	2	1600	6	0.1	307 2	800	0.06	0.52	1.56	3.79	60.66	400	200	650
5	2	2	4	2	1600	6	0.1	307 2	800	0.06	0.39	1.17	3.50	55.99	400	200	650
6	2.2	2	4.4	2	1600	6	0.1	307 2	800	0.06	0.35	1.06	3.42	54.72	400	200	650
7	2.5	2	5	2	1600	6	0.1	307 2	800	0.06	0.31	0.93	3.32	53.19	400	200	650
8	3	2	6	2	1600	6	0.1	307 2	800	0.06	0.26	0.78	3.21	51.32	400	200	650
9	2	3	6	2	1600	6	0.1	307 2	800	0.06	0.26	0.78	3.21	51.32	400	200	650
10	2.2	3	6.6	2	1600	6	0.1	307 2	800	0.06	0.24	0.71	3.15	50.47	400	200	650
11	2.5	3	7.5	2	1600	6	0.1	307 2	800	0.06	0.21	0.62	3.09	49.46	400	200	650
12	3	3	9	2	1600	6	0.1	307 2	800	0.06	0.17	0.52	3.01	48.21	400	200	650
13	2	5	10	2	1600	6	0.1	307 2	800	0.06	0.16	0.47	2.97	47.59	400	200	650
14	2.2	5	11	2	1600	6	0.1	307 2	800	0.06	0.14	0.42	2.94	47.08	400	200	650
15	2.5	5	12.5	2	1600	6	0.1	307 2	800	0.06	0.12	0.37	2.90	46.47	400	200	650
16	3	5	15	2	1600	6	0.1	307 2	800	0.06	0.10	0.31	2.86	45.72	400	200	650
1	2	1	2	2	1600	7	0.1	358 4	800	0.06	0.78	2.33	4.74	75.84	400	200	650
2	2.2	1	2.2	2	1600	7	0.1	358	800	0.06	0.71	2.12	4.58	73.29	400	200	650

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3	2.5	1	2.5	2	1600	7	0.1	358 4	800	0.06	0.62	1.87	4.39	70.24	400	200	650
4	3	1	3	2	1600	7	0.1	358 4	800	0.06	0.52	1.56	4.16	66.51	400	200	650
5	2	2	4	2	1600	7	0.1	358 4	800	0.06	0.36	1.07	3.79	60.70	400	200	650
6	2.2	2	4.4	2	1600	7	0.1	358 4	800	0.06	0.32	0.97	3.72	59.53	400	200	650
7	2.5	2	5	2	1600	7	0.1	358 4	800	0.06	0.29	0.86	3.63	58.13	400	200	650
8	3	2	6	2	1600	7	0.1	358 4	800	0.06	0.24	0.71	3.53	56.41	400	200	650
9	2	3	6	2	1600	7	0.1	358 4	800	0.06	0.24	0.71	3.53	56.41	400	200	650
10	2.2	3	6.6	2	1600	7	0.1	358 4	800	0.06	0.22	0.65	3.48	55.63	400	200	650
11	2.5	3	7.5	2	1600	7	0.1	358 4	800	0.06	0.19	0.57	3.42	54.70	400	200	650
12	3	3	9	2	1600	7	0.1	358 4	800	0.06	0.16	0.48	3.35	53.55	400	200	650
13	2	5	10	2	1600	7	0.1	358 4	800	0.06	0.14	0.43	3.31	52.98	400	200	650
14	2.2	5	11	2	1600	7	0.1	358 4	800	0.06	0.13	0.39	3.28	52.51	400	200	650
15	2.5	5	12.5	2	1600	7	0.1	358 4	800	0.06	0.11	0.34	3.25	51.95	400	200	650
16	3	5	15	2	1600	7	0.1	358 4	800	0.06	0.10	0.29	3.20	51.27	400	200	650
1	2	1	2	2	1600	8	0.1	409 6	800	0.06	0.78	2.33	5.11	81.69	400	200	650
2	2.2	1	2.2	2	1600	8	0.1	409	800	0.06	0.71	2.12	4.95	79.14	400	200	650

								6									
3	2.5	1	2.5	2	1600	8	0.1	409 6	800	0.06	0.62	1.87	4.76	76.09	400	200	650
4	3	1	3	2	1600	8	0.1	409 6	800	0.06	0.52	1.56	4.52	72.36	400	200	650
5	2	2	4	2	1600	8	0.1	409 6	800	0.06	0.33	1.00	4.11	65.69	400	200	650
6	2.2	2	4.4	2	1600	8	0.1	409 6	800	0.06	0.30	0.91	4.04	64.60	400	200	650
7	2.5	2	5	2	1600	8	0.1	409 6	800	0.06	0.27	0.80	3.96	63.29	400	200	650
8	3	2	6	2	1600	8	0.1	409 6	800	0.06	0.22	0.67	3.86	61.69	400	200	650
9	2	3	6	2	1600	8	0.1	409 6	800	0.06	0.22	0.67	3.86	61.69	400	200	650
10	2.2	3	6.6	2	1600	8	0.1	409 6	800	0.06	0.20	0.61	3.81	60.96	400	200	650
11	2.5	3	7.5	2	1600	8	0.1	409 6	800	0.06	0.18	0.53	3.76	60.09	400	200	650
12	3	3	9	2	1600	8	0.1	409 6	800	0.06	0.15	0.44	3.69	59.02	400	200	650
13	2	5	10	2	1600	8	0.1	409 6	800	0.06	0.13	0.40	3.66	58.49	400	200	650
14	2.2	5	11	2	1600	8	0.1	409 6	800	0.06	0.12	0.36	3.63	58.05	400	200	650
15	2.5	5	12.5	2	1600	8	0.1	409 6	800	0.06	0.11	0.32	3.60	57.53	400	200	650
16	3	5	15	2	1600	8	0.1	409 6	800	0.06	0.09	0.27	3.56	56.89	400	200	650

6- Type 3 – RAM

VM		СР	U		RA	M		Task		Time	Usage	Current	Total Of Power use	Power		OS	
#	CPUS (GHz)	CPUC (#)	CPUS * CPUC	CTDS (MB)	FSBS (MHz)	RAMS (GB)	Gbit	Data (MB)	CRUO (MHz)	S	%	_	Power * Time	I*V	OCCUR (MHz)	RLOR (MB)	OSRU (MB)
1	2	1	2	2	1600	1	0.5	100	150	0.31	3.00	3.00	36.69	117.40	400	200	650
2	2.2	1	2.2	2	1600	1	0.5	100	150	0.31	2.73	3.00	33.62	107.58	400	200	650
3	2.5	1	2.5	2	1600	1	0.5	100	150	0.31	2.40	3.00	29.94	95.80	400	200	650
4	3	1	3	2	1600	1	0.5	100	150	0.31	2.00	3.00	25.44	81.40	400	200	650
5	2	2	4	2	1600	1	0.5	100	150	0.31	1.50	3.00	19.81	63.40	400	200	650
6	2.2	2	4.4	2	1600	1	0.5	100	150	0.31	1.36	3.00	18.28	58.49	400	200	650
7	2.5	2	5	2	1600	1	0.5	100	150	0.31	1.20	3.00	16.44	52.60	400	200	650
8	3	2	6	2	1600	1	0.5	100	150	0.31	1.00	3.00	14.19	45.40	400	200	650
9	2	3	6	2	1600	1	0.5	100	150	0.31	1.00	3.00	14.19	45.40	400	200	650
10	2.2	3	6.6	2	1600	1	0.5	100	150	0.31	0.91	2.73	13.16	42.13	400	200	650
11	2.5	3	7.5	2	1600	1	0.5	100	150	0.31	0.80	2.40	11.94	38.20	400	200	650
12	3	3	9	2	1600	1	0.5	100	150	0.31	0.67	2.00	10.44	33.40	400	200	650
13	2	5	10	2	1600	1	0.5	100	150	0.31	0.60	1.80	9.69	31.00	400	200	650
14	2.2	5	11	2	1600	1	0.5	100	150	0.31	0.55	1.64	9.07	29.04	400	200	650
15	2.5	5	12.5	2	1600	1	0.5	100	150	0.31	0.48	1.44	8.34	26.68	400	200	650
16	3	5	15	2	1600	1	0.5	100	150	0.31	0.40	1.20	7.44	23.80	400	200	650
1	2	1	2	2	1600	2	0.5	1024	150	0.31	1.67	3.00	24.56	78.59	400	200	650
2	2.2	1	2.2	2	1600	2	0.5	1024	150	0.31	1.52	3.00	22.85	73.14	400	200	650
3	2.5	1	2.5	2	1600	2	0.5	1024	150	0.31	1.33	3.00	20.81	66.59	400	200	650
4	3	1	3	2	1600	2	0.5	1024	150	0.31	1.11	3.00	18.31	58.59	400	200	650

5	2	2	4	2	1600	2	0.5	1024	150	0.31	0.83	2.50	15.18	48.59	400	200	650
6	2.2	2	4.4	2	1600	2	0.5	1024	150	0.31	0.76	2.27	14.33	45.86	400	200	650
7	2.5	2	5	2	1600	2	0.5	1024	150	0.31	0.67	2.00	13.31	42.59	400	200	650
8	3	2	6	2	1600	2	0.5	1024	150	0.31	0.56	1.67	12.06	38.59	400	200	650
9	2	3	6	2	1600	2	0.5	1024	150	0.31	0.56	1.67	12.06	38.59	400	200	650
10	2.2	3	6.6	2	1600	2	0.5	1024	150	0.31	0.51	1.52	11.49	36.77	400	200	650
11	2.5	3	7.5	2	1600	2	0.5	1024	150	0.31	0.44	1.33	10.81	34.59	400	200	650
12	3	3	9	2	1600	2	0.5	1024	150	0.31	0.37	1.11	9.98	31.92	400	200	650
13	2	5	10	2	1600	2	0.5	1024	150	0.31	0.33	1.00	9.56	30.59	400	200	650
14	2.2	5	11	2	1600	2	0.5	1024	150	0.31	0.30	0.91	9.22	29.50	400	200	650
15	2.5	5	12.5	2	1600	2	0.5	1024	150	0.31	0.27	0.80	8.81	28.19	400	200	650
16	3	5	15	2	1600	2	0.5	1024	150	0.31	0.22	0.67	8.31	26.59	400	200	650
1	2	1	2	2	1600	3	0.5	2048	150	0.31	1.22	3.00	22.68	72.59	400	200	650
2	2.2	1	2.2	2	1600	3	0.5	2048	150	0.31	1.11	3.00	21.43	68.59	400	200	650
3	2.5	1	2.5	2	1600	3	0.5	2048	150	0.31	0.98	2.93	19.93	63.79	400	200	650
4	3	1	3	2	1600	3	0.5	2048	150	0.31	0.81	2.44	18.10	57.92	400	200	650
5	2	2	4	2	1600	3	0.5	2048	150	0.31	0.61	1.83	15.81	50.59	400	200	650
6	2.2	2	4.4	2	1600	3	0.5	2048	150	0.31	0.56	1.67	15.18	48.59	400	200	650
7	2.5	2	5	2	1600	3	0.5	2048	150	0.31	0.49	1.47	14.43	46.19	400	200	650
8	3	2	6	2	1600	3	0.5	2048	150	0.31	0.41	1.22	13.52	43.26	400	200	650
9	2	3	6	2	1600	3	0.5	2048	150	0.31	0.41	1.22	13.52	43.26	400	200	650
10	2.2	3	6.6	2	1600	3	0.5	2048	150	0.31	0.37	1.11	13.10	41.92	400	200	650
11	2.5	3	7.5	2	1600	3	0.5	2048	150	0.31	0.33	0.98	12.60	40.32	400	200	650
12	3	3	9	2	1600	3	0.5	2048	150	0.31	0.27	0.81	11.99	38.37	400	200	650
13	2	5	10	2	1600	3	0.5	2048	150	0.31	0.24	0.73	11.68	37.39	400	200	650
14	2.2	5	11	2	1600	3	0.5	2048	150	0.31	0.22	0.67	11.43	36.59	400	200	650
15	2.5	5	12.5	2	1600	3	0.5	2048	150	0.31	0.20	0.59	11.13	35.63	400	200	650
16	3	5	15	2	1600	3	0.5	2048	150	0.31	0.16	0.49	10.77	34.46	400	200	650

1					1000	4	0.5	2072	150	0.21	1.00	2.00	22.24	74.50	400	200	CEO
1	2	1	2	2	1600	4		3072	150	0.31	1.00	3.00	23.31	74.59	400	200	650
2	2.2	1	2.2	2	1600	4	0.5	3072	150	0.31	0.91	2.73	22.29	71.32	400	200	650
3	2.5	1	2.5	2	1600	4	0.5	3072	150	0.31	0.80	2.40	21.06	67.39	400	200	650
4	3	1	3	2	1600	4	0.5	3072	150	0.31	0.67	2.00	19.56	62.59	400	200	650
5	2	2	4	2	1600	4	0.5	3072	150	0.31	0.50	1.50	17.68	56.59	400	200	650
6	2.2	2	4.4	2	1600	4	0.5	3072	150	0.31	0.45	1.36	17.17	54.95	400	200	650
7	2.5	2	5	2	1600	4	0.5	3072	150	0.31	0.40	1.20	16.56	52.99	400	200	650
8	3	2	6	2	1600	4	0.5	3072	150	0.31	0.33	1.00	15.81	50.59	400	200	650
9	2	3	6	2	1600	4	0.5	3072	150	0.31	0.33	1.00	15.81	50.59	400	200	650
10	2.2	3	6.6	2	1600	4	0.5	3072	150	0.31	0.30	0.91	15.47	49.50	400	200	650
11	2.5	3	7.5	2	1600	4	0.5	3072	150	0.31	0.27	0.80	15.06	48.19	400	200	650
12	3	3	9	2	1600	4	0.5	3072	150	0.31	0.22	0.67	14.56	46.59	400	200	650
13	2	5	10	2	1600	4	0.5	3072	150	0.31	0.20	0.60	14.31	45.79	400	200	650
14	2.2	5	11	2	1600	4	0.5	3072	150	0.31	0.18	0.55	14.10	45.14	400	200	650
15	2.5	5	12.5	2	1600	4	0.5	3072	150	0.31	0.16	0.48	13.86	44.35	400	200	650
16	3	5	15	2	1600	4	0.5	3072	150	0.31	0.13	0.40	13.56	43.39	400	200	650
1	2	1	2	2	1600	5	0.5	4096	150	0.31	0.87	2.60	24.93	79.79	400	200	650
2	2.2	1	2.2	2	1600	5	0.5	4096	150	0.31	0.79	2.36	24.05	76.95	400	200	650
3	2.5	1	2.5	2	1600	5	0.5	4096	150	0.31	0.69	2.08	22.98	73.55	400	200	650
4	3	1	3	2	1600	5	0.5	4096	150	0.31	0.58	1.73	21.68	69.39	400	200	650
5	2	2	4	2	1600	5	0.5	4096	150	0.31	0.43	1.30	20.06	64.19	400	200	650
6	2.2	2	4.4	2	1600	5	0.5	4096	150	0.31	0.39	1.18	19.62	62.77	400	200	650
7	2.5	2	5	2	1600	5	0.5	4096	150	0.31	0.35	1.04	19.08	61.07	400	200	650
8	3	2	6	2	1600	5	0.5	4096	150	0.31	0.29	0.87	18.43	58.99	400	200	650
9	2	3	6	2	1600	5	0.5	4096	150	0.31	0.29	0.87	18.43	58.99	400	200	650
10	2.2	3	6.6	2	1600	5	0.5	4096	150	0.31	0.26	0.79	18.14	58.04	400	200	650
11	2.5	3	7.5	2	1600	5	0.5	4096	150	0.31	0.23	0.69	17.78	56.91	400	200	650
12	3	3	9	2	1600	5	0.5	4096	150	0.31	0.19	0.58	17.35	55.52	400	200	650

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13	2	5	10	2	1600	5	0.5	4096	150	0.31	0.17	0.52	17.13	54.83	400	200	650
14	2.2	5	11	2	1600	5	0.5	4096	150	0.31	0.16	0.47	16.96	54.26	400	200	650
15	2.5	5	12.5	2	1600	5	0.5	4096	150	0.31	0.14	0.42	16.74	53.58	400	200	650
16	3	5	15	2	1600	5	0.5	4096	150	0.31	0.12	0.35	16.48	52.75	400	200	650
1	2	1	2	2	1600	6	0.5	5120	150	0.31	0.78	2.33	27.06	86.59	400	200	650
2	2.2	1	2.2	2	1600	6	0.5	5120	150	0.31	0.71	2.12	26.26	84.04	400	200	650
3	2.5	1	2.5	2	1600	6	0.5	5120	150	0.31	0.62	1.87	25.31	80.99	400	200	650
4	3	1	3	2	1600	6	0.5	5120	150	0.31	0.52	1.56	24.14	77.26	400	200	650
5	2	2	4	2	1600	6	0.5	5120	150	0.31	0.39	1.17	22.68	72.59	400	200	650
6	2.2	2	4.4	2	1600	6	0.5	5120	150	0.31	0.35	1.06	22.29	71.32	400	200	650
7	2.5	2	5	2	1600	6	0.5	5120	150	0.31	0.31	0.93	21.81	69.79	400	200	650
8	3	2	6	2	1600	6	0.5	5120	150	0.31	0.26	0.78	21.23	67.92	400	200	650
9	2	3	6	2	1600	6	0.5	5120	150	0.31	0.26	0.78	21.23	67.92	400	200	650
10	2.2	3	6.6	2	1600	6	0.5	5120	150	0.31	0.24	0.71	20.96	67.07	400	200	650
11	2.5	3	7.5	2	1600	6	0.5	5120	150	0.31	0.21	0.62	20.64	66.06	400	200	650
12	3	3	9	2	1600	6	0.5	5120	150	0.31	0.17	0.52	20.25	64.81	400	200	650
13	2	5	10	2	1600	6	0.5	5120	150	0.31	0.16	0.47	20.06	64.19	400	200	650
14	2.2	5	11	2	1600	6	0.5	5120	150	0.31	0.14	0.42	19.90	63.68	400	200	650
15	2.5	5	12.5	2	1600	6	0.5	5120	150	0.31	0.12	0.37	19.71	63.07	400	200	650
16	3	5	15	2	1600	6	0.5	5120	150	0.31	0.10	0.31	19.48	62.32	400	200	650
1	2	1	2	2	1600	7	0.5	6144	150	0.31	0.78	2.33	30.18	96.59	400	200	650
2	2.2	1	2.2	2	1600	7	0.5	6144	150	0.31	0.71	2.12	29.39	94.04	400	200	650
3	2.5	1	2.5	2	1600	7	0.5	6144	150	0.31	0.62	1.87	28.43	90.99	400	200	650
4	3	1	3	2	1600	7	0.5	6144	150	0.31	0.52	1.56	27.27	87.26	400	200	650
5	2	2	4	2	1600	7	0.5	6144	150	0.31	0.36	1.07	25.45	81.45	400	200	650
6	2.2	2	4.4	2	1600	7	0.5	6144	150	0.31	0.32	0.97	25.09	80.28	400	200	650
7	2.5	2	5	2	1600	7	0.5	6144	150	0.31	0.29	0.86	24.65	78.88	400	200	650
8	3	2	6	2	1600	7	0.5	6144	150	0.31	0.24	0.71	24.11	77.16	400	200	650

9	2	3	6	2	1600	7	0.5	6144	150	0.31	0.24	0.71	24.11	77.16	400	200	650
10	2.2	3	6.6	2	1600	7	0.5	6144	150	0.31	0.22	0.65	23.87	76.38	400	200	650
11	2.5	3	7.5	2	1600	7	0.5	6144	150	0.31	0.19	0.57	23.58	75.45	400	200	650
12	3	3	9	2	1600	7	0.5	6144	150	0.31	0.16	0.48	23.22	74.30	400	200	650
13	2	5	10	2	1600	7	0.5	6144	150	0.31	0.14	0.43	23.04	73.73	400	200	650
14	2.2	5	11	2	1600	7	0.5	6144	150	0.31	0.13	0.39	22.90	73.26	400	200	650
15	2.5	5	12.5	2	1600	7	0.5	6144	150	0.31	0.11	0.34	22.72	72.70	400	200	650
16	3	5	15	2	1600	7	0.5	6144	150	0.31	0.10	0.29	22.51	72.02	400	200	650
1	2	1	2	2	1600	8	0.5	7168	150	0.31	0.78	2.33	33.31	106.59	400	200	650
2	2.2	1	2.2	2	1600	8	0.5	7168	150	0.31	0.71	2.12	32.51	104.04	400	200	650
3	2.5	1	2.5	2	1600	8	0.5	7168	150	0.31	0.62	1.87	31.56	100.99	400	200	650
4	3	1	3	2	1600	8	0.5	7168	150	0.31	0.52	1.56	30.39	97.26	400	200	650
5	2	2	4	2	1600	8	0.5	7168	150	0.31	0.33	1.00	28.31	90.59	400	200	650
6	2.2	2	4.4	2	1600	8	0.5	7168	150	0.31	0.30	0.91	27.97	89.50	400	200	650
7	2.5	2	5	2	1600	8	0.5	7168	150	0.31	0.27	0.80	27.56	88.19	400	200	650
8	3	2	6	2	1600	8	0.5	7168	150	0.31	0.22	0.67	27.06	86.59	400	200	650
9	2	3	6	2	1600	8	0.5	7168	150	0.31	0.22	0.67	27.06	86.59	400	200	650
10	2.2	3	6.6	2	1600	8	0.5	7168	150	0.31	0.20	0.61	26.83	85.86	400	200	650
11	2.5	3	7.5	2	1600	8	0.5	7168	150	0.31	0.18	0.53	26.56	84.99	400	200	650
12	3	3	9	2	1600	8	0.5	7168	150	0.31	0.15	0.44	26.23	83.92	400	200	650
13	2	5	10	2	1600	8	0.5	7168	150	0.31	0.13	0.40	26.06	83.39	400	200	650
14	2.2	5	11	2	1600	8	0.5	7168	150	0.31	0.12	0.36	25.92	82.95	400	200	650
15	2.5	5	12.5	2	1600	8	0.5	7168	150	0.31	0.11	0.32	25.76	82.43	400	200	650
16	3	5	15	2	1600	8	0.5	7168	150	0.31	0.09	0.27	25.56	81.79	400	200	650

7- Hardware Simulation

RAM with High Level Load and the CPU Low Level Load

Lov	w Level Lo	ad
1 GB	2 GB	3 GB
2.0	1.80	1.80
2.4	1.80	1.70
2.4	1.70	1.80
2.3	1.90	1.60
2.3	2.00	1.60
2.0	2.00	1.80
2.4	2.20	1.70
1.9	1.90	1.90
2.0	1.90	1.80
2.4	1.80	1.80
2.0	1.80	1.80
2.6	1.60	1.60
2.4	1.60	1.60
2.4	1.60	1.50
2.3	1.50	1.50
2.0	1.50	1.60
2.0	1.40	1.60
1.9	1.40	1.60
1.9	1.60	1.50

CPU with High Level Load and the RAM with Low Level Load

1 GB	2 GB	3 GB
2.30	2.00	1.90
2.30	2.00	1.80
2.40	2.30	1.90
2.40	2.20	2.00
2.40	2.00	2.00
2.40	2.00	1.90
2.30	2.00	1.90
2.20	2.00	2.00
2.00	2.00	2.00
2.30	2.00	2.00
2.40	1.80	1.90
2.40	1.80	1.80
2.40	1.60	1.70
2.40	1.70	1.70
2.30	1.60	1.70
2.30	1.70	1.80
2.30	1.80	1.90
2.40	1.90	1.90
2.40	1.90	1.90

RAM and CPU Low Level Load

1 GB	2 GB	3 GB
1.00	1.00	0.90
1.00	1.00	1.00
1.00	0.90	0.90
0.90	0.90	1.00
1.00	1.00	1.00
1.00	1.00	0.90
1.00	1.00	0.90
0.90	1.00	1.00
1.00	1.00	1.00
1.00	1.00	0.90
1.00	1.00	1.00
1.00	1.00	1.00
1.00	0.90	1.00
1.00	1.00	0.90
1.00	1.00	1.00
0.90	1.00	0.90
1.00	1.00	1.00
1.00	1.00	1.00
1.00	0.90	0.90

RAM and CPU High Level Load

1 GB	2 GB	3 GB			
2.80	2.50	2.20			
2.80	2.40	2.30			
2.80	2.40	2.30			
2.80	2.40	2.30			
2.80	2.40	2.30			
2.70	2.30	2.20			
2.80	2.30	2.20			
2.70	2.30	2.20			
2.70	2.50	2.20			
2.70	2.50	2.30			
2.70	2.50	2.20			
2.60	2.50	2.20			
2.60	2.40	2.20			
2.60	2.40	2.30			
2.70	2.40	2.30			
2.70	2.40	2.30			
2.70	2.30	2.30			
2.70	2.30	2.30			
2.80	2.30	2.30			

2.3	1.80	1.70
2.4	1.90	1.80
2.4	1.80	1.80
2.4	1.80	1.70
2.4	1.70	1.60
2.4	1.90	1.80
2.0	2.00	1.60
2.0	1.70	1.50
2.4	1.60	1.50
2.4	1.60	1.70

2.30	1.90	1.80
2.30	1.90	2.00
2.30	1.90	2.00
2.30	2.00	2.00
2.30	2.00	1.80
2.20	1.90	2.00
2.30	2.00	2.00
2.30	1.80	1.90
2.40	1.90	2.00
2.20	2.00	1.90

1.00	1.00	1.00
0.90	1.00	1.00
1.00	0.90	0.90
0.90	1.00	1.00
1.00	1.00	1.00
1.00	0.90	0.90
1.00	1.00	0.90
0.90	0.90	1.00
1.00	1.00	1.00
0.90	1.00	0.90

İ	i	i i
2.80	2.30	2.20
2.80	2.30	2.20
2.80	2.40	2.20
2.80	2.40	2.20
2.80	2.40	2.30
2.80	2.40	2.30
2.80	2.30	2.20
2.80	2.30	2.20
2.70	2.30	2.30
2.70	2.30	2.20

8- The difference in power consumption between both algorithms; the old resource allocation algorithm and the enhanced resource allocation algorithm.

	Enha	anced			Old				Difference			
PT1	PT2	PT3	AV	PT1	PT2	PT3	AV					
36.56	8.75	36.69	27.33	35.96	8.52	35.96	26.81	0.61	0.23	0.73	0.52	
22.09	4.91	24.56	17.19	23.15	7.30	23.15	17.87	-1.06	-2.39	1.41	-0.68	
17.62	4.28	22.68	14.86	20.35	8.07	20.35	16.26	-2.73	-3.79	2.33	-1.40	
15.65	4.14	23.31	14.37	20.05	9.34	20.05	16.48	-4.39	-5.20	3.26	-2.11	
14.69	4.21	24.93	14.61	20.75	10.82	20.75	17.44	-6.06	-6.61	4.19	-2.83	
14.22	4.37	27.06	15.22	21.95	12.39	21.95	18.76	-7.73	-8.01	5.11	-3.54	

14.75	4.74	30.18	16.56	24.14	14.16	24.14	20.82	-9.39	-9.42	6.04	-4.26
15.28	5.11	33.31	17.90	26.34	15.93	26.34	22.87	-11.06	-10.83	6.97	-4.97
18.86	5.06	27.84	17.25	24.09	10.82	24.09	19.66	-5.23	-5.75	3.76	-2.41
33.49	8.07	19.81	20.46	32.89	7.91	32.89	24.56	0.61	0.16	- 13.07	-4.10
20.39	4.57	15.18	13.38	21.45	6.96	21.45	16.62	-1.06	-2.39	-6.26	-3.24
14.48	4.03	15.81	11.44	19.10	7.82	19.10	15.34	-4.62	-3.79	-3.29	-3.90
14.63	3.94	17.68	12.08	19.03	9.14	19.03	15.73	-4.39	-5.20	-1.34	-3.65
13.80	4.03	20.06	12.63	19.86	10.64	19.86	16.79	-6.06	-6.61	0.20	-4.16
13.42	4.22	22.68	13.44	21.15	12.23	21.15	18.18	-7.73	-8.01	1.53	-4.74
13.95	4.58	25.45	14.66	23.35	14.00	23.35	20.23	-9.39	-9.42	2.10	-5.57
16.37	4.95	28.31	16.54	25.55	15.78	25.55	22.29	-9.18	-10.83	2.76	-5.75
17.57	4.80	20.62	14.33	22.80	10.56	22.80	18.72	-5.23	-5.76	-2.17	-4.39
29.81	7.25	14.19	17.08	29.21	7.17	29.21	21.86	0.61	0.08	- 15.02	-4.78
18.34	4.16	12.06	11.52	19.40	6.55	19.40	15.12	-1.06	-2.39	-7.34	-3.60
13.53	3.73	13.52	10.26	17.60	7.52	17.60	14.24	-4.07	-3.79	-4.08	-3.98
13.40	3.69	15.81	10.97	17.80	8.89	17.80	14.83	-4.39	-5.20	-1.99	-3.86
12.74	3.82	18.43	11.66	18.80	10.43	18.80	16.01	-6.06	-6.61	-0.36	-4.34
12.47	4.02	21.23	12.57	20.20	12.04	20.20	17.48	-7.73	-8.01	1.03	-4.90
13.00	4.39	24.11	13.83	22.39	13.81	22.39	19.53	-9.39	-9.42	1.72	-5.70
14.48	4.76	27.06	15.43	24.59	15.58	24.59	21.59	-10.11	-10.83	2.47	-6.16
15.97	4.48	18.30	12.92	21.25	10.25	21.25	17.58	-5.28	-5.77	-2.95	-4.67
25.31	6.25	9.69	13.75	24.71	6.27	24.71	18.56	0.61	-0.02	- 15.02	-4.81
15.84	3.66	9.56	9.69	16.90	6.05	16.90	13.28	-1.06	-2.39	-7.34	-3.60
11.83	3.36	11.68	8.96	15.77	7.15	15.77	12.90	-3.94	-3.79	-4.08	-3.94
11.90	3.39	14.31	9.87	16.30	8.59	16.30	13.73	-4.39	-5.20	-1.99	-3.86
11.44	3.56	17.13	10.71	17.50	10.17	17.50	15.05	-6.06	-6.61	-0.36	-4.34
11.30	3.79	20.06	11.72	19.03	11.81	19.03	16.62	-7.73	-8.01	1.03	-4.90

12.36	4.16	23.04	13.19	21.23	13.58	21.23	18.68	-8.87	-9.42	1.82	-5.49
13.06	4.52	26.06	14.55	23.42	15.35	23.42	20.73	-10.36	-10.83	2.63	-6.19
14.13	4.09	16.44	11.55	19.36	9.87	19.36	16.19	-5.23	-5.78	-2.91	-4.64
19.69	5.00	33.62	19.44	19.08	5.15	19.08	14.44	0.61	-0.15	14.54	5.00
12.72	3.04	22.85	12.87	13.78	5.42	13.78	10.99	-1.06	-2.39	9.08	1.88
9.81	3.32	21.43	11.52	13.48	6.70	13.48	11.22	-3.67	-3.38	7.96	0.31
9.84	3.02	22.29	11.72	14.42	8.22	14.42	12.36	-4.58	-5.20	7.86	-0.64
9.81	2.90	24.05	12.25	15.87	9.84	15.87	13.86	-6.06	-6.94	8.18	-1.61
10.02	3.50	26.26	13.26	17.57	11.51	17.57	15.55	-7.55	-8.01	8.69	-2.29
10.28	3.79	29.39	14.49	19.41	13.22	19.41	17.35	-9.13	-9.42	9.98	-2.86
10.75	4.11	32.51	15.79	21.34	14.93	21.34	19.21	-10.59	-10.83	11.17	-3.42
11.61	3.58	26.55	13.92	16.87	9.37	16.87	14.37	-5.26	-5.79	9.68	-0.45
18.15	4.66	18.28	13.70	17.55	4.84	17.55	13.31	0.61	-0.18	0.73	0.38
11.86	2.87	14.33	9.69	12.93	5.25	12.93	10.37	-1.06	-2.39	1.41	-0.68
9.37	2.78	15.18	9.11	12.85	6.57	12.85	10.76	-3.48	-3.79	2.33	-1.65
9.44	2.92	17.17	9.84	13.91	8.12	13.91	11.98	-4.47	-5.20	3.26	-2.14
9.44	3.15	19.62	10.74	15.43	9.75	15.43	13.54	-5.98	-6.61	4.19	-2.80
9.52	3.42	22.29	11.74	17.17	11.43	17.17	15.26	-7.65	-8.01	5.11	-3.52
9.65	3.72	25.09	12.82	19.05	13.14	19.05	17.08	-9.39	-9.42	6.04	-4.26
10.12	4.04	27.97	14.04	21.00	14.87	21.00	18.96	-10.88	-10.83	6.97	-4.91
10.95	3.44	19.99	11.46	16.24	9.25	16.24	13.91	-5.29	-5.80	3.76	-2.45
16.31	4.25	13.16	11.24	15.71	4.47	15.71	11.96	0.61	-0.22	-2.54	-0.72
10.84	2.66	11.49	8.33	11.90	5.05	11.90	9.62	-1.06	-2.39	-0.41	-1.29
8.84	2.63	13.10	8.19	12.10	6.42	12.10	10.21	-3.27	-3.79	1.00	-2.02
8.90	2.79	15.47	9.06	13.30	7.99	13.30	11.53	-4.39	-5.20	2.17	-2.48
8.97	3.04	18.14	10.05	14.90	9.65	14.90	13.15	-5.93	-6.61	3.24	-3.10
9.21	3.32	20.96	11.17	16.70	11.34	16.70	14.91	-7.48	-8.01	4.27	-3.74
9.37	3.63	23.87	12.29	18.61	13.05	18.61	16.76	-9.23	-9.42	5.26	-4.46
9.53	3.96	26.83	13.44	20.59	14.78	20.59	18.66	-11.06	-10.83	6.24	-5.22

10.25	3.29	17.88	10.47	15.48	9.10	15.48	13.35	-5.23	-5.81	2.40	-2.88
14.06	3.75	9.07	8.96	13.46	4.02	13.46	10.31	0.61	-0.27	-4.38	-1.35
9.59	2.44	9.22	7.08	10.65	4.80	10.65	8.70	-1.06	-2.35	-1.44	-1.62
8.15	2.41	11.43	7.33	11.18	6.24	11.18	9.54	-3.03	-3.83	0.25	-2.20
8.19	2.64	14.10	8.31	12.55	7.84	12.55	10.98	-4.36	-5.20	1.56	-2.67
8.46	2.91	16.96	9.44	14.25	9.52	14.25	12.67	-5.79	-6.61	2.71	-3.23
8.38	3.21	19.90	10.50	16.11	11.22	16.11	14.48	-7.73	-8.01	3.79	-3.98
8.68	3.53	22.90	11.70	18.07	12.95	18.07	16.36	-9.39	-9.42	4.82	-4.66
9.03	3.86	25.92	12.94	20.09	14.68	20.09	18.29	-11.06	-10.83	5.83	-5.35
9.32	3.09	16.19	9.53	14.55	8.91	14.55	12.67	-5.23	-5.82	1.64	-3.13
14.06	3.75	29.94	15.92	13.46	4.02	13.46	10.31	0.61	-0.27	16.48	5.60
9.59	2.44	20.81	10.95	10.65	4.80	10.65	8.70	-1.06	-2.35	10.16	2.25
8.15	3.21	19.93	10.43	11.18	6.24	11.18	9.54	-3.03	-3.03	8.75	0.90
8.19	2.64	21.06	10.63	12.55	7.84	12.55	10.98	-4.36	-5.20	8.51	-0.35
8.46	2.41	22.98	11.28	14.25	9.52	14.25	12.67	-5.79	-7.11	8.74	-1.39
8.38	3.21	25.31	12.30	16.11	11.22	16.11	14.48	-7.73	-8.01	9.20	-2.18
8.68	3.53	28.43	13.55	18.07	12.95	18.07	16.36	-9.39	-9.42	10.36	-2.82
9.03	3.86	31.56	14.81	20.09	14.68	20.09	18.29	-11.06	-10.83	11.47	-3.47
9.32	3.13	25.00	12.48	14.55	8.91	14.55	12.67	-5.23	-5.78	10.46	-0.18
13.04	3.52	16.44	11.00	12.43	3.82	12.43	9.56	0.61	-0.30	4.00	1.44
9.02	2.36	13.31	8.23	10.09	4.68	10.09	8.28	-1.06	-2.32	3.22	-0.05
7.81	2.30	14.43	8.18	10.77	6.15	10.77	9.23	-2.95	-3.86	3.67	-1.05
7.89	2.57	16.56	9.01	12.21	7.78	12.21	10.73	-4.32	-5.20	4.35	-1.72
8.04	2.85	19.08	9.99	13.95	9.46	13.95	12.45	-5.91	-6.61	5.13	-2.46
8.12	3.15	21.81	11.03	15.85	11.17	15.85	14.29	-7.73	-8.01	5.96	-3.26
8.43	3.48	24.65	12.19	17.83	12.90	17.83	16.19	-9.39	-9.42	6.82	-4.00
8.80	3.81	27.56	13.39	19.86	14.64	19.86	18.12	-11.06	-10.83	7.70	-4.73
8.90	3.01	19.23	10.38	14.12	8.82	14.12	12.36	-5.23	-5.82	5.11	-1.98
11.81	3.25	11.94	9.00	11.21	3.57	11.21	8.66	0.61	-0.32	0.73	0.34

8.34	2.26	10.81	7.14	9.40	4.55	9.40	7.78	-1.06	-2.29	1.41	-0.65
7.40	2.16	12.60	7.39	10.27	6.05	10.27	8.86	-2.86	-3.89	2.33	-1.47
7.54	2.49	15.06	8.36	11.80	7.69	11.80	10.43	-4.26	-5.20	3.26	-2.07
7.54	2.78	17.78	9.37	13.60	9.39	13.60	12.19	-6.06	-6.61	4.19	-2.83
7.80	3.09	20.64	10.51	15.53	11.11	15.53	14.05	-7.73	-8.01	5.11	-3.54
8.14	3.42	23.58	11.71	17.54	12.84	17.54	15.97	-9.39	-9.42	6.04	-4.26
8.53	3.76	26.56	12.95	19.59	14.58	19.59	17.92	-11.06	-10.83	6.97	-4.97
8.39	2.90	17.37	9.55	13.62	8.72	13.62	11.99	-5.23	-5.82	3.76	-2.43
10.31	2.92	8.34	7.19	9.71	3.27	9.71	7.56	0.61	-0.36	-1.37	-0.37
7.51	2.14	8.81	6.15	8.57	4.38	8.57	7.17	-1.06	-2.24	0.24	-1.02
6.93	2.00	11.13	6.69	9.66	5.93	9.66	8.42	-2.73	-3.94	1.48	-1.73
6.90	2.39	13.86	7.72	11.30	7.59	11.30	10.06	-4.39	-5.20	2.56	-2.34
7.10	2.69	16.74	8.85	13.16	9.30	13.16	11.88	-6.06	-6.61	3.58	-3.03
7.41	3.01	19.71	10.04	15.14	11.03	15.14	13.77	-7.73	-8.01	4.57	-3.72
7.78	3.35	22.72	11.28	17.18	12.77	17.18	15.71	-9.39	-9.42	5.54	-4.43
8.20	3.69	25.76	12.55	19.26	14.52	19.26	17.68	-11.06	-10.83	6.50	-5.13
7.77	2.77	15.88	8.81	13.00	8.60	13.00	11.53	-5.23	-5.83	2.89	-2.72
9.56	2.75	25.44	12.58	8.96	3.12	8.96	7.01	0.61	-0.37	16.48	5.57
7.09	1.91	18.31	9.10	8.15	4.30	8.15	6.87	-1.06	-2.39	10.16	2.24
6.62	2.65	18.10	9.12	9.35	5.87	9.35	8.19	-2.73	-3.22	8.75	0.93
6.65	2.34	19.56	9.52	11.05	7.54	11.05	9.88	-4.39	-5.20	8.51	-0.36
6.89	2.65	21.68	10.41	12.95	9.26	12.95	11.72	-6.06	-6.61	8.74	-1.31
7.22	2.97	24.14	11.44	14.95	10.99	14.95	13.63	-7.73	-8.01	9.20	-2.18
7.61	3.31	27.27	12.73	17.00	12.73	17.00	15.58	-9.39	-9.42	10.27	-2.85
8.03	3.66	30.39	14.03	19.09	14.48	19.09	17.56	-11.06	-10.83	11.30	-3.53
7.46	2.78	23.11	11.12	12.69	8.54	12.69	11.30	-5.23	-5.76	10.43	-0.19
8.95	2.61	14.19	8.58	8.34	3.00	8.34	6.56	0.61	-0.39	5.85	2.02
6.75	2.03	12.06	6.95	7.81	4.23	7.81	6.62	-1.06	-2.20	4.25	0.33
6.37	1.84	13.52	7.24	9.10	5.82	9.10	8.01	-2.73	-3.98	4.42	-0.76

6.45	2.30	15.81	8.19	10.84	7.50	10.84	9.73	-4.39	-5.20	4.96	-1.54
6.71	2.61	18.43	9.25	12.77	9.22	12.77	11.59	-6.06	-6.61	5.66	-2.33
7.06	2.94	21.23	10.41	14.79	10.96	14.79	13.51	-7.73	-8.01	6.44	-3.10
7.46	3.28	24.11	11.62	16.85	12.70	16.85	15.47	-9.39	-9.42	7.26	-3.85
7.89	3.63	27.06	12.86	18.95	14.46	18.95	17.46	-11.06	-10.83	8.10	-4.60
7.21	2.66	18.30	9.39	12.43	8.49	12.43	11.12	-5.23	-5.83	5.87	-1.73
8.21	2.45	10.44	7.03	7.61	2.85	7.61	6.02	0.61	-0.40	2.83	1.01
6.34	1.97	9.98	6.10	7.40	4.15	7.40	6.32	-1.06	-2.18	2.57	-0.22
6.07	1.76	11.99	6.61	8.80	5.76	8.80	7.79	-2.73	-4.00	3.19	-1.18
6.20	2.25	14.56	7.67	10.60	7.45	10.60	9.55	-4.39	-5.20	3.96	-1.88
6.50	2.57	17.35	8.81	12.56	9.18	12.56	11.43	-6.06	-6.61	4.79	-2.62
6.87	2.90	20.25	10.01	14.60	10.92	14.60	13.37	-7.73	-8.01	5.66	-3.36
7.28	3.25	23.22	11.25	16.68	12.67	16.68	15.34	-9.39	-9.42	6.54	-4.09
7.73	3.60	26.23	12.52	18.79	14.42	18.79	17.34	-11.06	-10.83	7.43	-4.82
6.90	2.59	16.75	8.75	12.13	8.43	12.13	10.89	-5.23	-5.83	4.62	-2.15
7.31	2.25	7.44	5.67	6.71	2.67	6.71	5.36	0.61	-0.42	0.73	0.30
5.84	1.89	8.31	5.35	6.90	4.05	6.90	5.95	-1.06	-2.15	1.41	-0.60
5.71	1.66	10.77	6.05	8.43	5.69	8.43	7.52	-2.73	-4.03	2.33	-1.47
5.90	2.19	13.56	7.22	10.30	7.39	10.30	9.33	-4.39	-5.20	3.26	-2.11
6.24	2.52	16.48	8.41	12.30	9.13	12.30	11.24	-6.06	-6.61	4.19	-2.83
6.63	2.86	19.48	9.66	14.36	10.87	14.36	13.20	-7.73	-8.01	5.11	-3.54
7.07	3.20	22.51	10.93	16.46	12.63	16.46	15.19	-9.39	-9.42	6.04	-4.26
7.53	3.56	25.56	12.21	18.59	14.38	18.59	17.19	-11.06	-10.83	6.97	-4.97
6.53	2.52	15.51	8.19	11.76	8.35	11.76	10.62	-5.23	-5.83	3.76	-2.44