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POWER CONSUMPTION MANAGEMENT SYSTEM (PCMS) IN WIRED NETWORKS USING ADAPTIVE GENETIC ALGORITHM

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Power consumption in both wired and wireless networks is becoming an increasingly important concern across the world. Most scholars have concentrated on wireless, so we have taken wired networks as our main focus. In particular, wired network operators had an increased network concern to meet the decrease in traffic levels from which service quality (QoS) is achieved and maximize power consumption. To achieve the QOS and power consumption in a wired network, we provided comprehensive Power Consumption Management (PCMS) research modules that provide current and future access networks. The results of PCMS are being tested out with the genetic algorithm gives us the best-optimized module.

KEYWORDS: wired network, power consumption management (PCM), power consumption, QoS, Genetic algorithm.

I. INTRODUCTION

Digital communication networks provide a step forward to reduce energy consumption, yet this potential decline is partly offset by the power used by computer networks [1]. Perhaps a portion of both the energy savings in networks may result in a lower cost of financial and electricity savings. Upcoming computer systems must have power-conscious traffic control and routing techniques, alongside effective infrastructure management level, only to provide sufficient QoS rates at the lowest energy levels available. With both the Internet Protocol Convergence (IP) model, where most communication modes, such as mobile communications, are increasingly activated by comparable packets services, the importance of energy consumption package networks increases. Because Internet networks rely on network connections and connections, that electric energy used to power and cool the infrastructure creates a vital use for energy-saving solutions to be researched on networks.

1.1 Earlier work on wired utility networks

Power reduction techniques for network wires did not get a lot of coverage. One can find some early works in [2][3]. Paper [4] defines the variability owing to the steadily increasing price of electricity and claims that currently distributed networks should be able to make significant economic benefits from this variation. Some methods that enable the identification of inactiveness phases in Ethernet networks are proposed in [5]. They take advantage of these periods to achieve energy efficiency improvements with less impact on loss or delay. Papers [2] analyze the energy spectrum of currently connected devices and suggest reducing power usage despite impacting performance. 3] Researchers suggest redeploying staff to decrease the number of activated switching that join the network. Eventually, in this context paper [6], strategies and techniques widely used to operate energy-efficient computer equipment and network equipment are examined.

Our paper begins from either the assumption that if you know (a) Traffic handled by only a wired network, (b) Quality of the service (QoS) traffic flow specifications, (c) Power and energy requirements of overload server detection with which nodes and links were eligible to storage and the forward traffic (D) under load server detection, by which a set of nodes and internodes connections and routes can be rationally selected.
Even though a huge amount of work was conducted about power management in wireless devices, wired networks have still not obtained any focus on this topic. As stated before, this work is

based on the optimization of dynamic energies in the context of network routers, tracking current flows and predicting future network flows to achieve QoS and lower power consumption. This can be accomplished with the parameters described below.

• Its layout and deployment of the Power Consumption Management System (PCMS) within our network is planned and evaluated.

• Genetic Algorithm (GA) is used to formalize complex network management for power optimization and growth.

The remainder of the paper is structured as follows. In Section 2, related work are discussed. The proposed PCMS model is presented in Section 3. Section 4 provides for the genetic algorithm. Finally, it suggests a conclusion in Section 5.

2. RELATED WORK

In recent years numerous studies have been carried out in the area, including energy consumption and resource usage for power consumption modules. Analyses are either based on less generating equipment [6] or the optimizations of resource allocation [7].

An Updated Particle Swarm Optimization (MPSO)-algorithm for VM Consolidation and Migration Work was presented in the research in [6]. It finds the multi-resource threshold and the distance from the Euclidean as the optimum factor; the lower the factor, the better VM placement. This requires the processor and disk to have a fixed threshold. Nevertheless, the cloud world is a dynamic environment, and both dynamic thresholds and set parameters cannot behave.

Beloglazov and Buyya[8] identified various forms of optimized on-line and off algorithms of VM migration and the consolidation problem. We have also suggested a novel sensitive heuristic available energy usage solution and effective aggregation of dynamic VMs, whose top and bottom thresholds were periodically set given the latest use of resources, thus creating a trade-off between performance and energy use.

We have introduced a dynamic consolidation system for servers[7] that aims to preserve server usage between both the top and bottom thresholds for CPU utilization. This algorithm is Modified Best Fit Decreasing (MBFD) for the Virtual machine-placement issue to reduce energy and decrease the number of SLA violations. 9] Research on complex upper-and reduced-threshold algorithms with the approach.

In [10], a virtual machine migration based on the Firefly algorithm was implemented with energy-aware. Their formulation of problems and their energy model is based on [11]. This approach considers CPU-intensive and memory-intensive, two different types of workloads. It moves loaded VMs from a heavy-energy node to an efficient node with both the least-energy consumption, where the parameters are based on the fireflies algorithm.

In [12], the authors approach the battery modelling life using three methods; the three models are being used to predict the acid battery capacity lifespan and find ways to extend it with quantitative outcomes.

3. PROPOSED METHODOLOGY

3.1 POWER CONSUMPTION MANAGEMENT SYSTEM (PCMS) MODEL

In such a section, they describe an access network power analysis and consider the energy consumption of various wired technologies. There are currently several multiple network technologies in use, and more are under development. Hence, the key goal is to build a sensible approach for just the software-based Power Consumption Management System (PCMS) architecture for wired network connections, rendering and executing important decisions to reduce network power consumption and QoS constraints.

Working of PCMS

A PCMS will operate over the top of the IP address network and take the following steps constantly: –

a) monitor current network traffic streams that regulate node status and network power consumption.

b) Choose a network layout that offers a suitable or good rate of QoS for current and planned movements of reduced energy consumption.
C) Enable dynamic series changes in connections and routers, and redirect traffic to reach low power at appropriate QoS speeds.
The designed based PCMS program is split into two detection modules
1. overload server detection
2. under load server detection

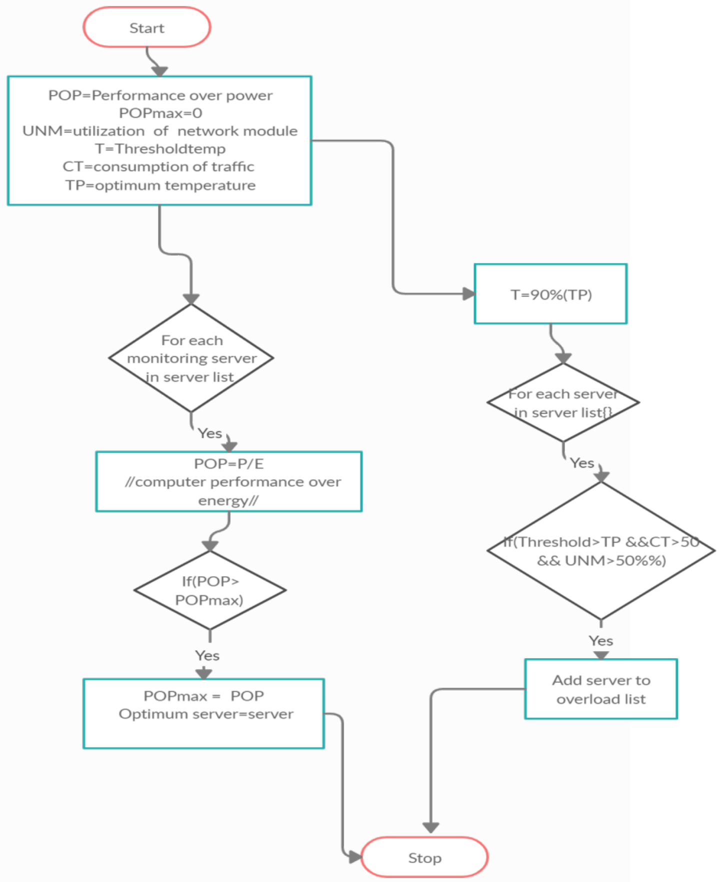
1. OVERLOAD SERVER DETECTION:

ALGORITHM

1. Input: monitoring server list
2. Output: overload list of traffics
3. Performance over power =POP
4. POP_{max}=0;
5. Traffic over load list
6. For(each monitoring server in server list)
7. POP=PERFORMACE/ENERGY //computer performance over energy
8. If(POP> POP_{max})
9. POP_{max} = POP
10. Optimum servers=server
11. End if
12. End for
13. $Threshold_{temp}$=90% consumption of temperature optimum
14. For(each list of server in a server list)
15. If (Threshold> $Threshold_{temp}$ && consumption of traffic ≥ 50% && utilization of network module ≥ 50%)
16. Server is added to the overload list
17. End if
18. End for
19. Revert overload list
20. Stop

FLOW CHART FOR OVER LOAD SERVER DETCTION

Here in the server list for each monitoring system in overload server detection; we will measure the energy output for each server list. Quality over power is measured and if it is higher than the maximum power then the server is optimized and then the threshold value for each server is tested to achieve the limit of 50 per cent utilization.



2. UNDER LOAD SERVER DETECTION

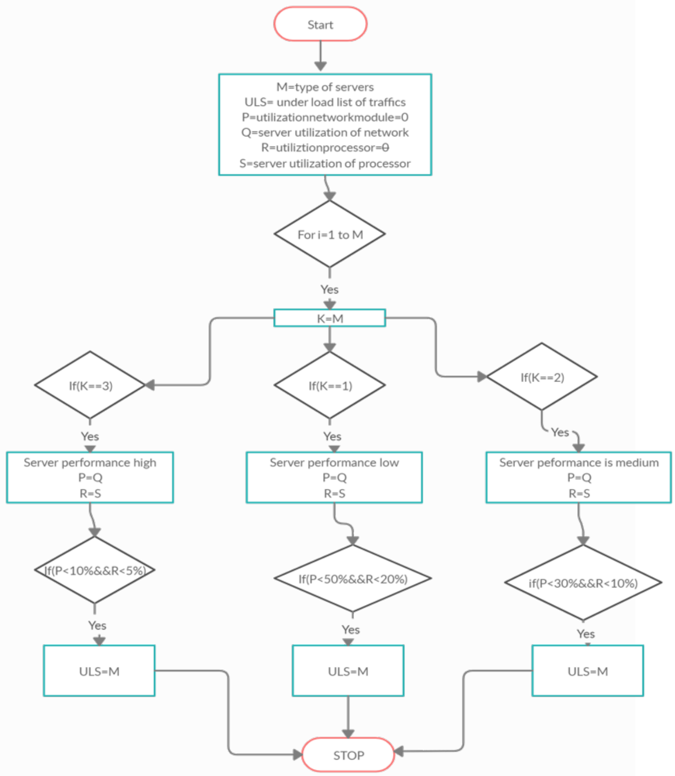
ALGORITHM

1. Input: monitoring server list
2. Output: under load list of traffics
3. Initialization: $utilization_{networkmodule}$ =P; get server utilization of network module=Q; $utiliztion_{processor}$=R; get server utilization of processor=S

4. Server categorization=$\text{utilization}_{\text{networkmodule}}$=0, $\text{utiliztion}_{\text{processor}}$=0
5. No of types of servers=M
6. For (i=1 to M)
7. K=type of server
8. If(K=1) then // Server =low performance
9. P=Q;
10. R=S;
11. If (P<=50% && R<=20%)
12. type k of under load server =traffic server
13. End if
14. End if
15. If (k=2) then // Server performance is medium
16. $\text{utilization}_{\text{networkmodule}}$=get server utilization of network module
17. $\text{utiliztion}_{\text{processor}}$ =get server utilization of processor
18. If ($\text{utilization}_{\text{networkmodule}}$<30% && $\text{utiliztion}_{\text{processor}}$<10%)
19. type k of under load server =traffic server
20. End if
21. End if
22. If (k=3) then // Server= high performance
23. P=Q;
24. R=S;
25. If (P<=10% && R <=5%)
26. type k of under load server =traffic server
27. End if
28. End if
29. Return under load server
30. Stop

FLOW CHART FOR UNDER LOAD SERVER DETCTION

Detecting servers under load should pick servers that have the processor's lowest usage. This differentiates the low-used servers from either the minimal-performance servers at first, instead of moderate, and eventually high-performance servers at last. In a medium performance server, less heat is produced than a low-performance server and more heat than a high-performance server. It has lower server performance and higher server performance than low server performance. When wired networks are combined into low-performance servers in contrast with high-performance servers, their total energy consumption comes even close together. In addition, the heat problem drastically reduces with high-performance servers.



In theory, the problem we present in the wired case can be conceived as just a network topology optimization question. The price to reduce is power consumption, and the limitation to still be fulfilled, is QoS. Our research looks at a dynamic approach to energy efficiency in packet wired networks; network traffic load ensures improvements in traffic paths with power management to fulfil the QoS needs. The PCMS module attempts to switch from low-performance servers to high-performance servers, and almost all low-performance servers are converted to sleep mode. The results are taken from PCMS to optimize the extreme threshold values. We proposed a genetic algorithm that counts the (QoS) and traffic server classification determined from the PCMS results above.

4. GENETIC ALGORITHM

Genetic algorithms are primarily used to solve various problems of optimization that exist in real-life applications. A genetic algorithms basic idea is to mimic the natural selection in nature to find a good choice for results from a PCMS. Genetic algorithms look for the best combination across different components, which will result in low power consumption. The fundamental processes used in the genetic algorithms as per our PCMS are

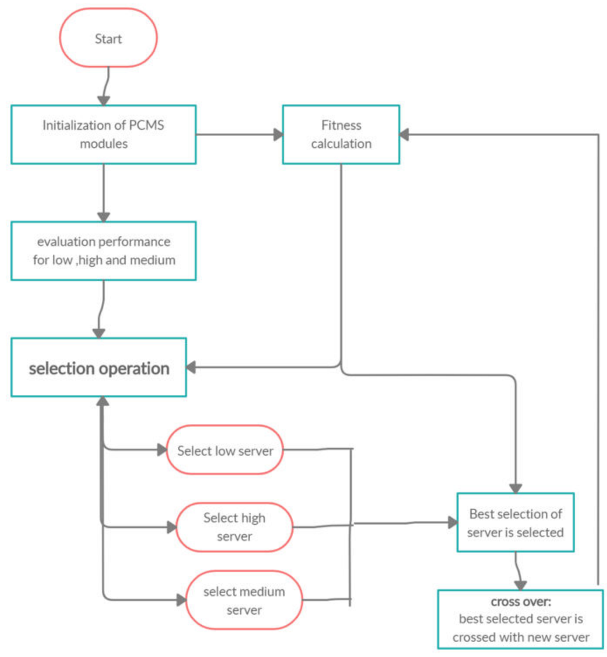
1. Initialization, in which an initial population is generated dynamically, the data of our PCMS modules are considered for overload and detection under the load server.

2. Evaluation that each member of both the population is evaluated and the individuals ' fitness is evaluated based on how well they meet the desired needs. On the basis of the threshold results generated from the modules algorithm as stated above, the overload list of traffics and the under load list of traffic are evaluated in our PCMS modules. So, here a low, moderate, and medium server output is measured, and in the next step, the best among the three is chosen.

3. Selection so that those who are selected suit the required requirements. The best set of server results is selected here.

4. The new individuals are formed through the integration of the best aspects of different individuals. As a result of this, the development of individuals is supposed to be closer to the desired needs. The next step is crossover after selection. Here, the new single server list is crossed with the server's best-selected fitness option results. From the second stage, the process is repeated until a termination state is reached.

FLOW CHART FOR THE PROCESS OF GENETIC ALGORITHM



Many energy management studies have been conducted, but many do not recognize multiple resource impacts. They often seek to minimize energy consumption before altering the temperature and the form of the server. This has inspired us to develop a genetic algorithm that takes into consideration multiple resources to reduce energy consumption. Throughout this paper network module, the efficiency of servers and thresholds is considered, and it is attempted to optimize their uses by specifying each parameter to achieve QoS and less power consumption.

- **Traffic variation**

In wired network traffic changes over time according to a typical daily pattern, indicating that sleep mode may be implemented dynamically to follow the pattern of traffic. This involves the use of sleep mode on long-term scales but also the possibility of switching off transmission facilities. This involves the latency implemented to recovery from a state of sleep mode and how to respond to sudden fluctuations in the load. Those things are outside of this paper's reach.

Let traffic variations 1, 2, 3… m... M, respectively, represent the highest detection to lowest detection.

λ_{TR} = the total traffic arriving rate and λ_{MR} = the arriving rate of traffic network m.

$$\lambda_{TR} = \lambda_{1+} \lambda_{2+} \lambda_{3+\dots} + \lambda_m + \cdots . \lambda_{MR} - -$$

N = total number of network modules, Γ=maximum allowable number of traffic. The reservations of network modules for large traffic are based on the detection of traffic variations. The remaining (N-Γ) numbers of network modules are equally shared by all the traffic variations. The value of Γ should not be very high in order to maintain the higher power utilization. The number of reserved traffic variations for only the traffic of 1, 2… and m is:

$$Y_m(t) = \frac{\lambda_m}{\lambda_{TR}} \tau \text{------- (2)}$$

Alternatively, the term Γ can be expressed as:

$$\tau = \sum_{i=1}^{MR} Y_i(t) \text{------ (3)}$$

Along with (N- Γ) traffic variations, the number of accessible network modules among Γ, for the m^{th} class traffic variation is:

$$z_m(t) = \left\lfloor \sum_{i=1}^{MR} Y_i(t) \right\rfloor - - - - - (4)$$

The total number of accessible modules for the traffic variation m is:

$$T_m = N - \tau + z_m(t) \text{------ (5)}$$

- **Traffic distribution**

Our system takes the amount of traffic exchanged in a network as its input, which we presume is distributed equally among all nodes. If an actual traffic matrix indicates unbalanced traffic demands, e.g., a peering point that gathers most of the network traffic, a uniform matrix is a conservative example, as many devices need to be at full capacity. This insight was also verified in earlier work.

Call distribution window, which is used for traffic variation rate estimation of traffic module m.

The average time interval for mth-class traffic between the two successive calls is estimated as last (n+1) number of traffic arrivals

$$\Delta t^m = \frac{1}{n} \sum_{i=1}^{1} \Delta t_i^m \text{------ (6)}$$

Now taking the expectation with respect to m we have

$$E[\Delta t_i^m] = E\left[\frac{1}{n} \sum_{i=1}^{n} \Delta t_i^m\right] = \Delta t^m - - - -(7)$$

The average traffic arrival rate (λm) of m-th module traffic considering the last (n+1) number of traffic arrivals is calculated as:

$$\frac{1}{\lambda_m} = \Delta t^m = \frac{1}{n} \sum_{i=1}^{n} \Delta t_i^m \text{------ (8)}$$

As m tD is an impartial estimation, λm is also an impartial estimation. Hence, λm in is used to estimate the traffic arrival rate of traffic distribution m.

$$N_m = \left[N - \frac{\sum_{j=1}^{m-1} \frac{1}{\sum_{i=1}^{n} \Delta t_i^j}}{\sum_{j=1}^{M} \frac{1}{\sum_{i=1}^{n} \Delta t_i^j}} \right] \text{--------- (9)}$$

- **Energy Consumption s**

A reasonably powerful transmitter is required on RS485 and other similar media to signal the line. RS485 powered from a 3.2V source, for example, would spend energy on line where the transmitter load is around 60 ohms.

We'll use a transmission speed of 125kbaud in the calculations below. It then takes 8us to submit one bit. For data transmission at this rate, it will be for one bit of energy consumed:

$$\Delta EC = \frac{u^2}{r} . \Delta t \text{----- (10)}$$

Here EC is energy, u is a friction of supply, r is traffic resistance, and t is time. If we assume a strong transmitter capable of connecting the traffic load to supply without additional resistance, then: Extraordinary and costly RS485-compatible transceiver MAX3475 takes 50[µA] of current, which is very low compared with the above.

$$\Delta EC = \frac{3.2[v]^2}{60[\Omega]} . 8[\mu s] = 1.36[\mu i] \text{----- (11)}$$

For example, if the system with the most energy-efficient transceiver has 1 million nodes, and 64 nodes are mounted in each branch of the buses, then the system has around 15625 active transmitters N at each moment. The consumption of energy per annum becomes:

$$\sum EC = N . \frac{\Delta EC}{\Delta t} . t_y =$$

$$15625 . \frac{1.36[\mu J]}{8[\mu S]} . (60[s] . 60[min] . 24[h] . 366[da$$

$$\ldots \ldots .83997[MI] = 23.3[MWH] \text{----(12)}$$

- **Performance analysis:**

Economic analysis provides a strong guarantee of worst case outcomes. A PCMS strategy has to perform well on all inputs (idle times) that even an adversary might generate. Such an exclusionary situation can seem sombre, and it is consistent with the classic algorithm analysis that measures techniques with respect for their worst-case assets, usually running time or memory needs. Throughout this segment, we will analyze algorithms utilizing trend analysis, but it will also discuss output on inputs developed by the probability distribution.

5. Simulation Results

5.1 Simulation Model and Parameters

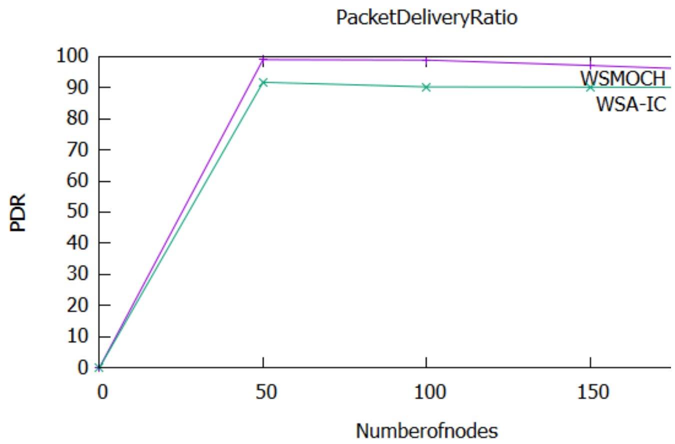
In this paperwork, we simulate a heterogeneous wired network using Network Simulator-3, version 3.25, by configuring a network with different energy models and network properties such as physical and channel models. To determine the efficiency of the proposed Power Consumption Management Optimization(PCMO), we configure the experiment by varying network topology by varying the number of nodes. In this experiment, we defined the various energy rates and channel rates to the sensors to balance the overall performance. This simulation employed different network topographies by representing the network size from 50 nodes to 200 nodes.
In this experiment, we design a heterogeneous cluster network topology by configuring the PCMO protocol module in NS3. The PCMO protocol optimizes the route and defines a routing packet to identifies the optimal ways. We compare

our experimental study with Whale Swarm Algorithm with Iterative Counter (WSA-IC) [13] The simulation settings and parameters are summarized in the table.

Parameter	Value
Network Area	100m × 100m
Nodes number	50,100, 150, 200 nodes
Channel	YansWifi
Phy	YansWifiPhy
Routing algorithm	PCMO
Mobility Model	Constant Position
IP Address	IP4
MAC	QoSwifiMAC
Socket	UDP Socket Factory
Initial energy	0.5 J
BS location	(50,50)
Packet size	4000 bits
Simulation Time	50s

Results and Discussion

Fig.5.1 represents the total number of packets transmitted to the receiver based on the number of nodes, and the above simulation results determine the packet delivery ratio of WSMOCH is increased when less number of nodes are presented in the network and slightly dropped with the respective number of nodes changed while comparing with WSMOCH protocol the performance is somewhat better to compare to WSA-IC



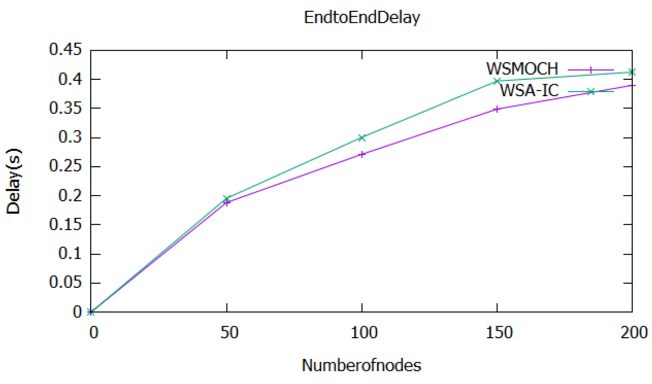


Fig.5.2 End-to-End Delay vs Number of nodes

Fig.5.2 Presents the end-to-end delay to reach the base station based on the number of nodes, and the above simulation results determine the delay of WSMOCH is increased with respective of number of nodes, and the performance is slightly better to compare to WSA-IC for different number of nodes

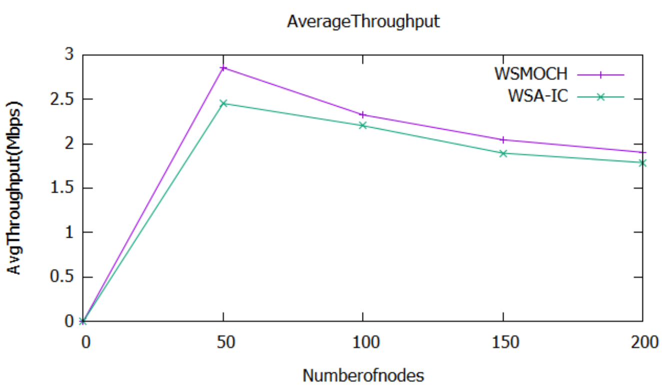


Fig 5.3: Average Throughput vs Number of nodes

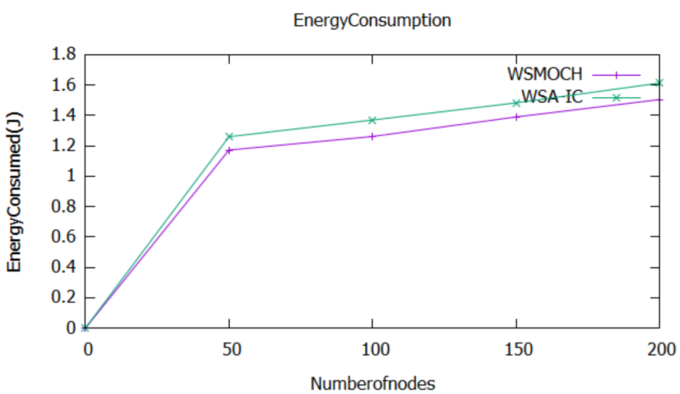


Fig 5.4: Energy consumption vs Number of Nodes

Fig. 5.3 and Fig. 5.4 represents the average throughput and energy consumption of both models performance by varying number of nodes. Hence, the energy consumption and throughput of VMOV is better than ACO-OFDM.

CONCLUSION

Wired network power consumption represents an important research challenge. There has been much research on raising the average power usage of these wired networks. So we proposed a PCMS module, which is aimed at reducing power consumption by considering the PCMS modules. This PCMS module gives us low, high, medium server usages from which QoS is achieved and to lessen the power consumption, the results of PCMS modules is being done with genetic algorithm. This genetic algorithm optimizes the power consumption performance by defining the traffic variation, distribution factors, and energy efficiency.

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