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A Proposed Power Saving Scheme for Distributed Systems by Powering On/Off Computers Remotely

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Abstract— Computers connected in distributed systems need to keep on for all time. These computers are either processing information of distributed application or running any service(s) to be provided in distributed system. But at all time all computers are not doing computations or remain idle. Similarly, service(s) providing by computers may not be accessing by any other computer(s) for certain period. So, it is not necessary to keep computers on during their idle period or period in which their service(s) is/are not being accessed. It can save tremendous amount of power. We present an approach to save power in distributed systems by dynamically powering on/off computers remotely.

Keywords— Distributed Systems, Power Save, Powering On/Off, Wake-On-Lan, Mac Address

I. INTRODUCTION

A distributed system consists of multiple computers that communicate through a computer network. The computers interact with each other in order to achieve a common goal. A distributed system may have a common goal, such as solving a large computational problem. Alternatively, each computer may have its own user with individual needs, and the purpose of the distributed system is to coordinate the use of shared resources or provide communication services to the users. Figure 1 shows two possible scenarios of distributed system.

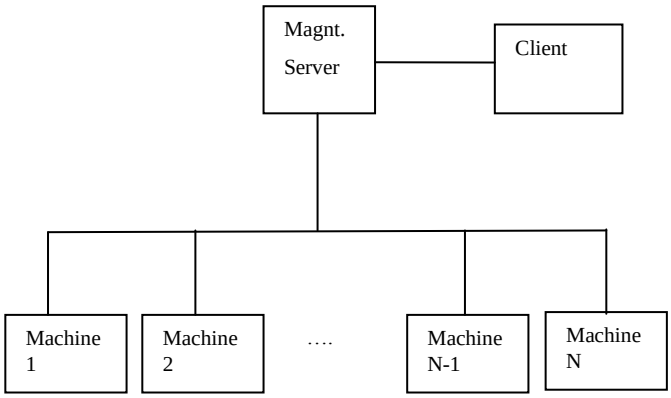

Fig. 1(a) Scenario 1 of distributed computing

Figure 1(a) depicts first scenario in which there is one server and number of clients. All the computers in this distributed system are doing computation to solve same problem. Server accepts requests from clients. It then distributes work load among machines of distributed system to get process the accepted request, accept the result from all machines, combine the results and deliver it to clients. It is the responsibility of server to balance the load of computers in distributed system. All the computing machines and the server need to be kept power on to serve continuous requests from the clients.

Other scenario is depicted in figure 1(b). In this scenario, there are number servers providing one particular service, one management server and number of clients. Clients send requests to management server for accessing certain service. Management server then redirects that request to service providing server and gives access to client if it is authenticated. All the servers in this system need to be kept power on to provide uninterrupted service to client.

But, it is not necessary that request will be continuously coming to the server from clients or there will be sufficient work with server to get distributed among all the computers connected with it (scenario 1). It is also possible that certain kind of servers is not requested for long time (scenario 2). Therefore in both the cases it is not necessary to keep power on computers all the time. They are unnecessarily consuming power. This power can be saved by powering off computers with less work or idle and powering on them again whenever they required. It can be done if computers can be

powered on or off remotely. We present how it can be achieved and propose power saving scheme for distributed system powering on/off computers remotely.

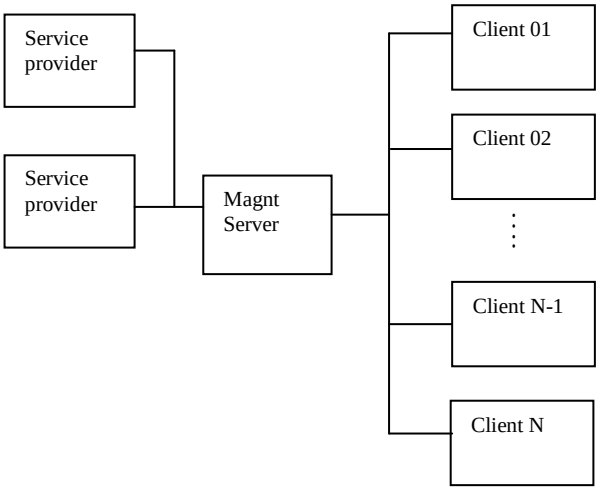

Fig. 1(b) Scenario 2 of distributed computing

II. PAGE LAYOUT POWERING COMPUTERS ON/OFF REMOTELY

Power off computers can be powered on remotely by Wake on LAN (WOL) feature. It is the ability to power on remote computers through special network packets. Wake on LAN (WOL) is an Ethernet computer networking standard that allows a shut-down computer to be turned on remotely. A remote computer must meet certain requirements so Wake-On-LAN can work. The motherboard and network adapter of the remote computer both support WOL technology, and connect a 3-pin power cable from network adapter to motherboard WOL connector. The overall steps or configuration required to power on remote computers are as follows:

1) Wake-On-LAN option in motherboard BIOS setup of remote computer must be enabled.
2) Get MAC address of NIC adaptor of remote computer.
3) Generate special message packet called as magic packet using MAC address of remote computer.
4) Broadcast this magic packet to all NICs of network using broadcast address of network. UDP is used to send this packet.

Magic packet contains 6 bytes of all 255 (FF FF FF FF FF FF in hexadecimal) followed by 16 times MAC address of remote computer. Figure 2 shows the format of magic packet.

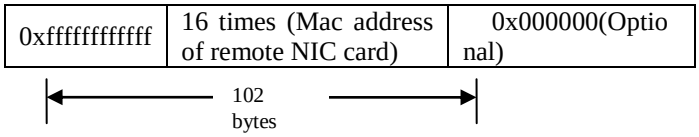

Fig. 2. Magic packet format

Similarly, to power off machine remotely, it is required to send "poweroff" command by sender machine to remote machine. Remote machine should be running program to listen commands from other machine and execute it. Therefore after receiving "poweroff" command , remote machine will start executing it and get power off. It is also possible to power on/off remote computers outside LAN by port forwarding.

III. OUR PROPOSED SCHEME

As per our scheme server of distributed system will work as per figure 3 along with its normal activities. Flowchart shown in figure 3(a) represents the working of server in scenario 1. It will get a task to be processed and check whether that task can be processed completely by itself. Otherwise, it will divide the task into subtasks and see those tasks can be distributed to currently connected and powered on machines or not. If not then it power on required number of machines and distribute the work accordingly. Server will also check periodically that which pcs are idle in its distributed pool and power off those idle pcs. Similarly, flowchart of figure 3(b) represents the working of server in scenario 2. It will receive request for service for client. It will then check whether the machine providing that service is power on or not. If no, then server will power on such machine. Server will also periodically get active request count from each service provider. It will power off service provider machines which doesn't have any active request pending.

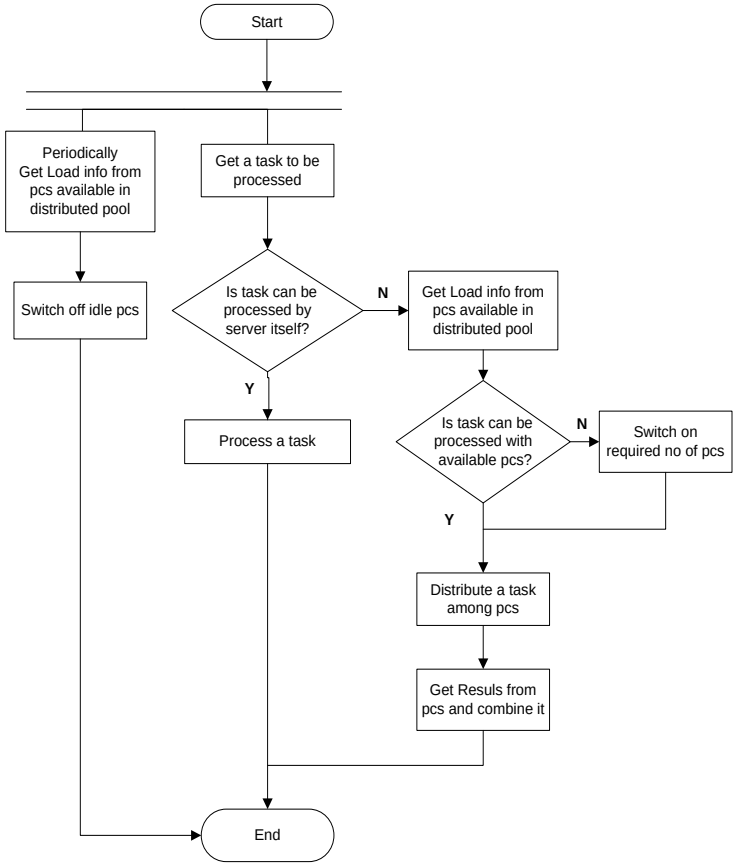

Fig. 3(a) Flowchart showing one of the activities of server in scenario 1as per scheme

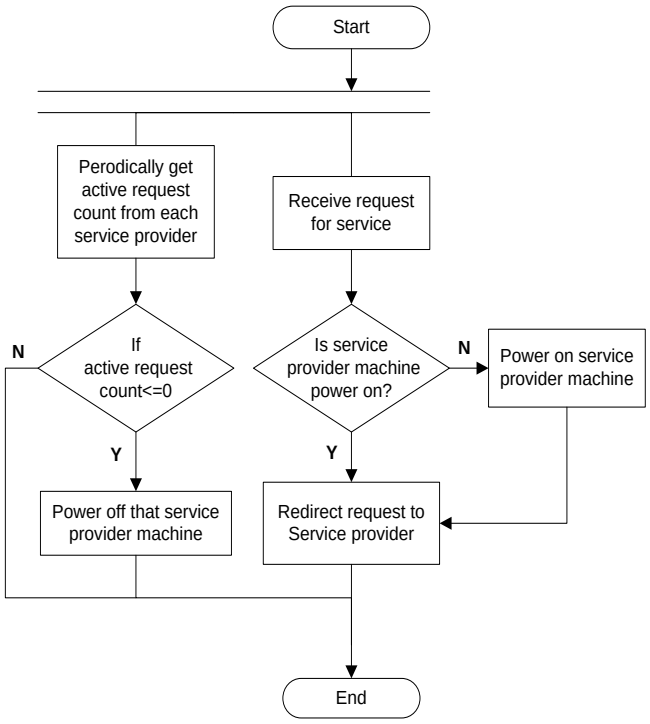

Fig. 3(b) Flowchart showing one of the activities of server in scenario 2 as per scheme

IV. **RESULT**

We implemented the steps for powering on/off computers remotely. Computers were being powered on/off successfully. We have written socket based client server programs for testing purpose. Server program listens message from client while client program sends "poweroff" command as a message to server. After receiving the message, server program executes this command on its machine and gets power off.

V. CONCLUSIONS AND FUTURE WORK

We conclude that powering computers on/off remotely can save tremendous power in such kind of distributed computing scenarios as well as in the systems where it is required to control computers remotely. It becomes disadvantageous in a distributed system if there is a frequent power on/off. In future we are going to implement server process which will automatically power on/off computers based on their CPU load.

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