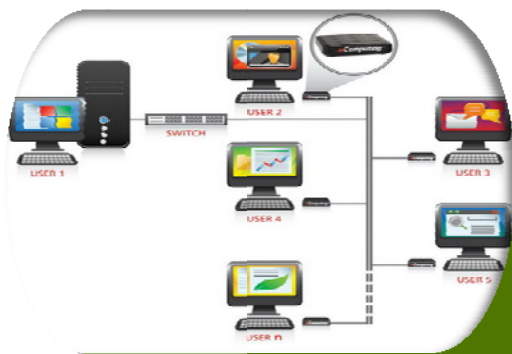


Desktop Virtualization based Shared Network Solution, it's Energy Saving Potential and Adaptability in Office Environment

Report



Energy Management Centre Kerala

Thiruvananthapuram
www.keralaenergy.gov.in



**DESKTOP VIRTUALISATION BASED SHARED NETWORK
SOLUTION, IT'S ENERGY SAVING POTENTIAL AND
ADAPTABILITY IN OFFICE ENVIORNMENT**

Report

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About Energy Management Centre-Kerala

Energy Management Centre – Kerala (EMC) an autonomous organization under the Department of Power, Government of Kerala, established in February 1996 in Thiruvananthapuram (Trivandrum), Kerala is first of its kind in the state level to promote energy efficiency and conservation programmes. EMC has a functional framework devoted to comprehensive and multi-disciplinary institutional objectives and orientation encompassing all aspects of energy, with a focus on energy-environment-development interactions aiming to remould and instrumentalise energy sector as a catalyst in promoting a sustainable development.

The guiding philosophy and school of thought of the EMC is “achieving sustainable development through enhancing total energy efficiency and application of renewable energy and environment friendly energy systems in all sectors of the economy”.

The Energy Management Centre, Kerala is also promoting Small Hydro Power developments in the State. The United Nations Industrial Development Organization (UNIDO) opened its first Regional Centre for Small Hydro Power in Energy Management Centre in April 2003. The SHP Cell of Department of Power, Government of Kerala is also functioning in EMC.

Government of Kerala has notified Energy Management Centre – Kerala as the State Designated Agency (SDA) on December 2003 to co-ordinate regulate and enforce the provisions of the Energy Conservation Act, 2001 within the State of Kerala.

EMC is working very closely with Bureau of Energy Efficiency, Government of India and all the stake holders in initiating and implementing energy efficiency measures in the State. EMC has been bestowed with the best SDA award in 2008 by Government of India.



Executive summary

A computer network is a collection of computers and devices connected together by communications channels that facilitates users to share hardware, files, data, and information, and software with other users. In Modern world almost all the organizations have computer networking systems that facilitates users to share hardware, files, data, and information, and software with other users. A typical Desktop computer in a network on an average utilizes 5- 25% of the CPU capacity and the remaining processing power is wasted. Moreover, it is a complex setup and requires specialized skills for maintenance. Hence Energy Management Centre-Kerala (EMC), as a part of its SDA activity (State Designated Agency to implement Energy Conservation Act, 2001 in the State) took an initiative to study about energy efficient networking systems currently available in market . It has been found that a company named “N computing” provides a solution for the above mentioned wastage and taps 75% - 95% of the unused processing power which can be shared with more users. The hardware cost can also be reduced by 40 to 55%. As part of the study two models of NComputing solution were used (models given below)

1. N-Computing X550 (5 user virtualization kit), which includes a PCI card, five XD2 access device and desktop virtualization software
2. N-Computing L230 (5 user virtualization kit), which includes, five access device and desktop virtualization software

A test lab was set up in EMC. The study extended upto one month and it has been observed that considerable amount of energy savings is possible with Ncomputing solutions. Apart from the merits the demerits of N computing include lack of USB port, monitor flickering, irregular font display etc which are detailed in the report. This network solution can be used in government organizations, Non Profit Organisations, Non Governmental Organisations, Educational Institutions, Banking sectors, call centers where computers are used for standard applications like MS-word, excel, PowerPoint , and not for CPU intensive applications like Multimedia , Graphic , 3D CAD, video games. The details of the study are as follows



Introduction to Computer Network

A computer network is a collection of computers and devices connected together by communication channels that facilitates users to share hardware, files, data, and information, and software with other users. The major components of a normal network consist of a Server/Host system, Client/user systems, Communication channels, switches and routers. A network server is a computer designed to process requests and deliver data to other (client) computers over a local network. Network servers are configured with higher processing, memory and storage capacity and holds resources that are accessed over the network by clients. A server can support a numerous number of Clients or users. The computer that requests the information from a network is usually referred to as the client. Communication channels may be wired or wireless. Wired technologies include twisted pair, coaxial and optical fiber connections and wireless technologies include bluetooth, communications satellites, and wireless LANs etc. With the server - client model, each client have separate CPU, monitors, mouse, keyboard and other hardwares connected. In this model clients are still used to run local applications in addition to server based applications. One of the main disadvantages of this model is that on an average it utilizes only 5- 25% of the CPU capacity and the remaining processing power is wasted. Moreover, it is a complex setup and requires specialized skills for maintenance. N computing is a solution for the above mentioned disadvantage.



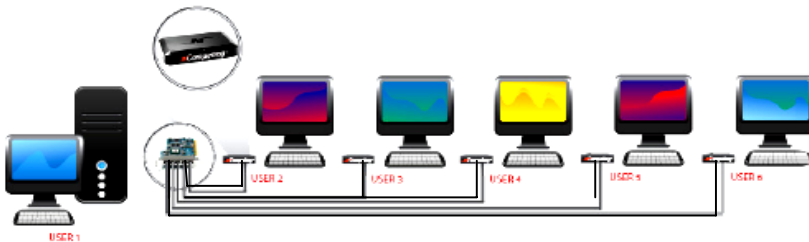
N computing shared computing Solution

N-computing product uses the unused hardware and software resources of a computer by employing virtual computing environment that enables a standard PC which acts as a server to be shared by multiple user/client terminals. The server PC uses a standard PC configuration with required memory, processing power and storage space depending upon the number of terminals and applications/storage requirements. CPUs are not needed in every user terminals. The user terminals are connected through a special N-Computing interface device and it has ports for connecting monitor, keyboard, mouse, speakers and USB devices. Virtual environment is created using **vSpace** Software Application.

vSpace software, which is Desktop virtualization software used with N-computing shared network solution, is installed in host system to create workspace in the server host computer for the users so that they can share the hardware and software of the host system and feels like working in a standalone computer and can run their own applications. Normally in a standalone computer only 5%-25% of the CPU capacity is utilized. Thus by using virtualization we can share the hardware and software installed in a PC and can utilize about 75 %-95% the power that is wasted otherwise.

Case Study 1:

A test lab with N-Computing X550 (5 user virtualization kit), which includes a PCI card, five XD2 access device and virtualization Software which enables five users to share a single host system, was set up with a test period of 1 week.

N-computing system configuration with XD2 access device .**I. The test conditions for XD2 access device are as follows:****1. Configuration of host system:**

- *Microsoft windows XP professional Version 2002, Service Pack3.*
- *Intel®Core™ 2 Duo CPU E4600@2.40GHz.*
- *2GB RAM @667MHz.*
- *Display Adapter: Intel® 82945G Express Chipset Family.*
- *160 GB sata hard disk.*
- *450 W SMPS*
- *15" LG LCD Monitor (30 Watts)*

2. Client system

- *XD2 access device.*



Connections (left to right):

- *Speaker Jack*
- *PS/2 Keyboard Port*
- *PS/2 Mouse Port*
- *VGA Monitor Port*
- *RJ-45 Connection (to host via Cat 5e cable)*



-
- *15" Monitor.*
 - *Keyboard PS2.*
 - *Mouse PS2.*
3. *Cat 5e network cable within 5mts range.*
 4. *UPS power with 230V pure sine wave*
 5. *vSpace virtualization software installed in host system*

Methodology for testing

One standard computer and 5 terminals without CPU unit in Energy Management Centre were used for installing the N computing devices and vSpace virtualization software.

Using one Standard PC as host/server system, with configuration as given above, a PCI interface card, which connects host system and the access device at the users end, is first installed in the host/server system. Five access devices were used to create working environment for five users. Each access device is connected with monitors, keyboard, Mouse, speakers and to PCI interface card installed in the host /server system via Cat 5e network cable through RJ-45 Connection port. The PCI interface card has five RJ-45 connection port. The users were situated within a range of 2 to 10 meters from the host/server system.

After the hardware installation, vSpace software was installed in the host / server system. The vSpace software is a virtualization software which creates individual workspace for the users in the server system and utilizes about 95% of the processing power that is unused by a single standalone PC otherwise. For testing purpose 5 user profiles were created in the host system using the vSpace virtualization software so that users could feel as working just as in a standalone PC and can run their own applications. The users are connected to the server through Access device X-series access device at user end, which connects to the PCI card at server end.



Test result

Merits

- 1. Five users can share one computer simultaneously and offers lower cost for setting up and running a small network.
- 2. Offers energy savings.

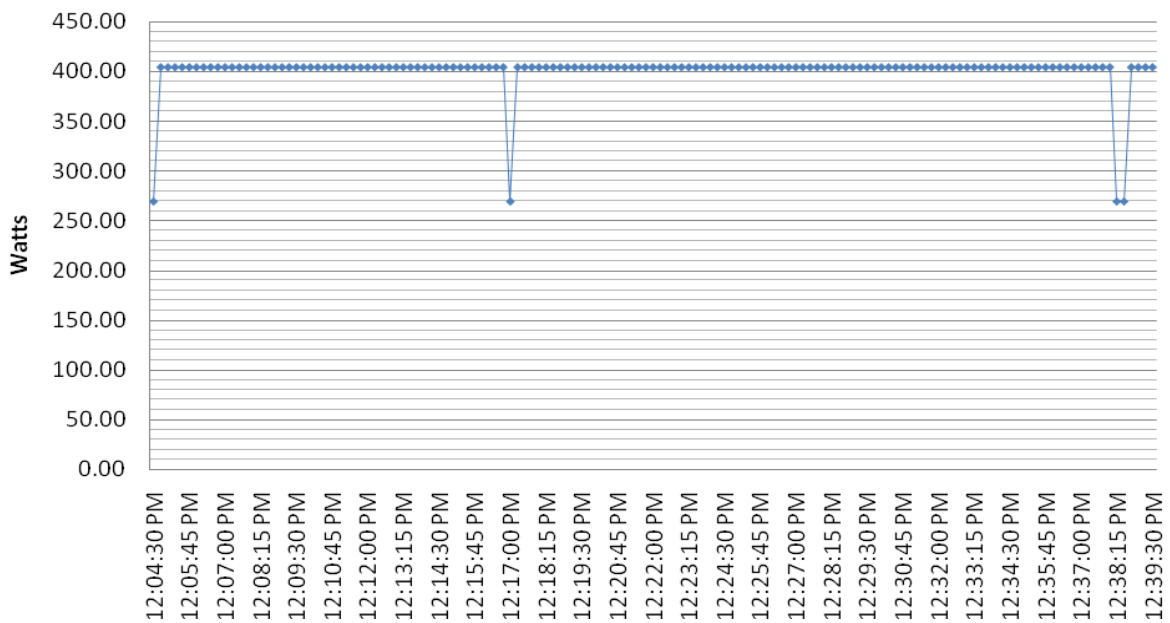
With N computing it is found that 50-70% of energy can be saved.

With N computing, 5 users, total power = 134.87 W

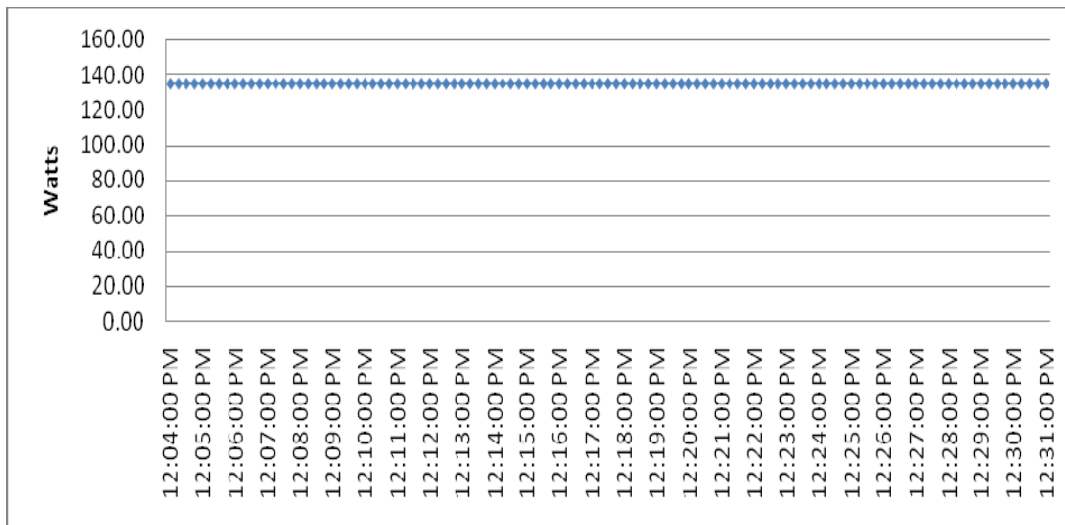
Without N computing, 5 users, total power = 404.60 W

$$\text{Power savings \%} = ((404.60-134.87)/404.60)*100$$

=66 % savings



Graph 1. Power consumption pattern of Six computers with out N computing



Graph 2. Power consumption pattern of Six computers with N computing

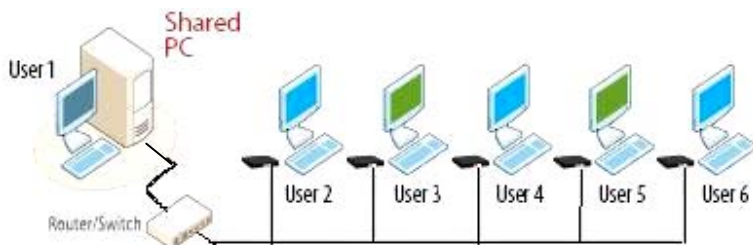
3. No external power adapters are required: Power to the access devices is provided by the PCI card through the Cat 5e from the host system.
4. It has been found that N-computing is working normally when Microsoft Word, Excel, Adobe Reader, Internet Explorer and Mozilla Firefox are loaded simultaneously by all users.
5. Reduction in e-waste as it has eliminated the requirement of CPU units at all the terminals.
6. Less power consumption equates to less heat generated per computing seat so less load on Air Conditioning.
7. When upgraded to Ncomputing terminals more users can work with the same capacity of UPS.
8. Less maintenance cost: Since Ncomputing eliminates the use of CPU units in the terminals, the maintenance cost and time is less compared to standard PC networks. It also reduces the software license costs as it requires only one copy of software packages and operating system which is shared by all the users.



-
9. Multimedia performance is good with video/audio clarity.
 10. vSpace Desktop Virtualization Software is supported by both windows and Linux.
 11. Better Virus and Malicious software control as there is no provision for USB in user terminals.
 12. Better security and control as data can transferred from Host System only.

Demerits

1. 17" and 19" Monitors generates flickering.
2. Interference in power when other devices are powered on or devices like speakers are plugged in.
3. It's difficult to use CD/DVDs and USB devices at the user terminals as there is no provision for them.
4. USB mouse when connected to the system using USB/PS2 convertor is not working.
5. Fonts display is slightly unbalanced.
6. Terminal Access devices need to be connected to the host system through PCI card interface card only and there is no provision for connecting the terminals to an Ethernet switch or Router.
7. Another Demerit is that the users should be situated within 5 meters from the host System.

Case Study 2:**N-computing system configuration with L230 access device****II. The test conditions for L230 access device are as follows:****1. Configuration of host system:**

- *Microsoft windows XP professional Version 2002, Service Pack3.*
- *Intel®Core™ 2 Duo CPU E4600@2.40GHz.*
- *2GB RAM @1.20GHz.*
- *Display Adapter: Intel® 82945G Express Chipset Family.*
- *160 GB sata hard disk.*
- *450 W SMPS*
- *15" LG LCD Monitor*

2. Client system

- *L230 access device.*



L230 back - Connections (left to right):

- 1. Ethernet*
- 2. Monitor*
- 3. 5 V DC IN*
- 4. On/off switch*



L230 side - Connections (left to right):

1. *USB.*
 2. *Microphone jack.*
 3. *Speaker jack.*
 4. *PS/2 Keyboard.*
 5. *PS/2 Mouse.*
-
3. *Cat 5e network cable within mtrs range*
 4. *UPS power with 230V pure sine wave.*
 5. *vSpace virtualization software installed in host system*

Methodology for testing (Users located within 200 mtrs range)

One standard PC system and 5 CPU less terminals in Energy Management Centre were used for installing the N computing devices and vSpace virtualization software.

Using One Standard PC as host/server system, with configuration as given above, Five Access devices were connected to the host /server system via 100 mbps switched Ethernet network to create working environment for six users. Each Access device was connected with a monitor, keyboard, Mouse, speakers and to the host /server system via the existing Ethernet Local Area Network of EMC. The users were situated within a range of 5 to 180 meters from the host/server system at separate buildings and rooms.

After the hardware installation, vSpace software is installed in the host / server system. The vSpace software is virtualization software which creates individual workspace for the users in the server system and utilizes about 95% of the power that is wasted by a single Standalone PC otherwise. For testing purpose 5 users were created using the vSpace virtualization



software so that users could feel as working just as in a standalone PC and can run their own applications.

Test result

Merits

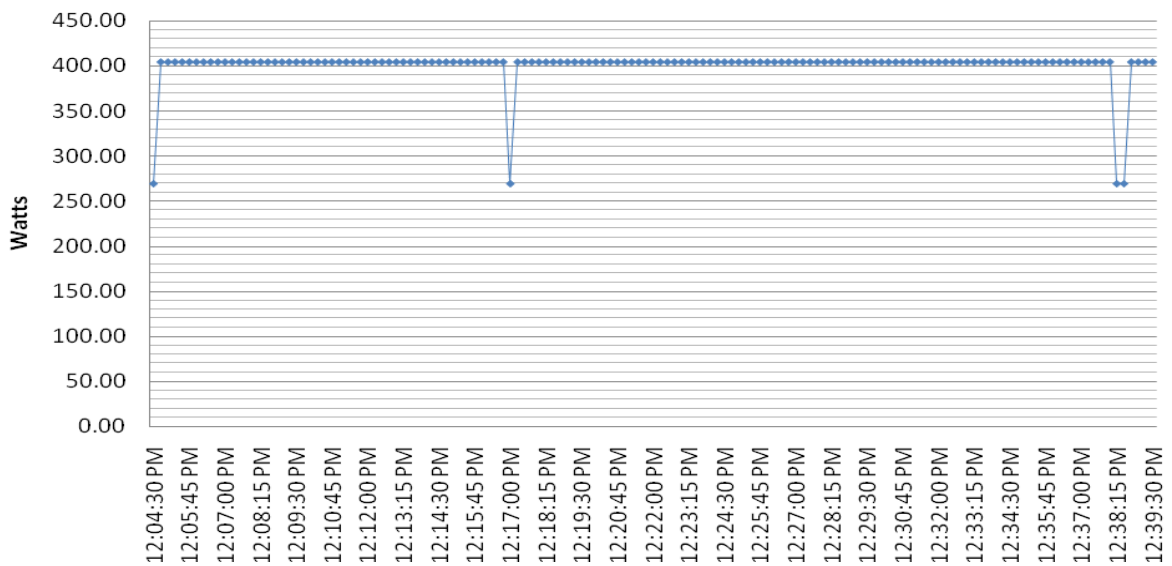
1. L 230 access device doesn't require PCI card interface for connecting to the host. It is connoted to the host system through Router/Switch.
2. Since it uses Ethernet to connect, it is suitable for networks in large organizations.
3. L230 access device supports USB devices at terminals.
4. Five or more users can share one computer simultaneously and has lower costs for setting a network compared to the standard PC network.
5. Users can share all applications like internet, Documentations, Word Processing, multimedia playback etc. and could work just like working in a standard PC.
6. Offers energy savings: With N-computing it is found that 50-70% of energy can be saved.

With N computing, 5 users, total power = 134.87 W

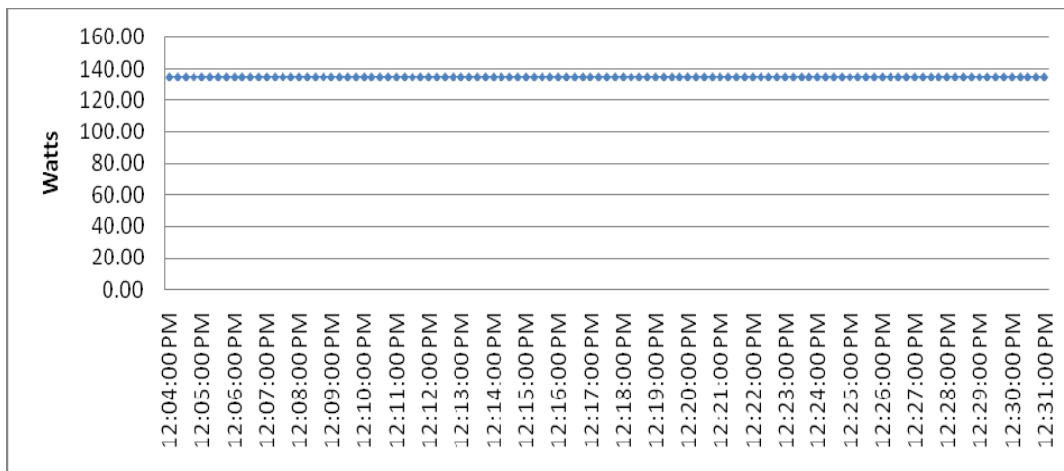
Without N computing, 5 users, total power = 404.60 W

Power savings % = $((404.60-134.87)/404.60)*100$

= 66 % savings



Graph 3. Power consumption pattern of Six computers with out N computing



Graph 4. Power consumption pattern of Six computers with N computing

- 7. It has been found that N-computing is working normally when Microsoft Word, Excel, Adobe Reader, Internet Explorer and Mozilla Firefox etc. are loaded by all users.
- 8. Comparative Reduction in E waste as it can reduce usage of CPU by all users.



-
9. Less power consumption equates to less heat generated per computing seat so Less A/C Needed.
 10. When upgraded to Ncomputing terminals more users can work with the same capacity of UPS.
 11. Less maintenance cost .Computers have many common parts that fail or need maintenance and also the maintenance time is less since it uses only one standalone PC. It is also reduces the software cost as it requires only one copy for all the users.
 12. Vspace Desktop Virtualization Software is supported by both windows and linux.

Demerits

1. 17" and 19" Monitor flickering.
2. Font display is irregular.
3. Requires 5 V DC external Power supply.
4. Video acceleration is low.
5. It's difficult to use CD/DVDs at the user terminals as there is no provision for them.

Cost analysis of a standard Personal computer and N computing solution

The following tables give the comparison of cost of a standard Personal computer(Here after given as standard PC) and two models of N-computing solution ,ie NComputing X550 desktop virtualization kit and NComputing L230 desktop virtualization kit.

**a. Standard PC vs NComputing X550 desktop virtualization kit**

SI No	Name of the Device	Price per unit (avg)	* Price for 5 units
1.	Standard PC	Rs 22,000 approx	5 x Rs 22,000 (approx) = Rs 1,10,000
2.	** NComputing X550 desktop virtualization kit	Rs 22,000 approx	Rs 22,000 approx
3.	Terminals (Monitor+Keyboard+mouse)	Rs 6000	5 x Rs 6000 =Rs 30000
4.	Total savings for hardware in Rs		Rs 1,11,000 – (Rs 22,000+Rs 30000) = Rs 59,000
5.	Saving %		= (59,000)/ 1,10,000 = 53.63%

Table 1.**b. Standard PC vs NComputing L230 desktop virtualization kit**

SI No	Name of the Device	Price per unit	* Price for 5 units
1.	Standard Personal computer	Rs 22,000 approx	5 x Rs 22,000 (approx) = Rs 1,10,000
2.	NComputing L230 desktop virtualization kit	Rs 6,750 approx	5 x Rs 6,750 (approx) = Rs 33,750 #
3.	Terminals (Monitor+Keyboard+mouse)	Rs 6000	5 x Rs 6000 =Rs 30000
4.	Total savings for hardware in Rs		Rs 1,11,000 – (Rs 33,750+Rs 30,000) =Rs 47,250
5.	Saving %		= (47,250)/ 1,10,000 = 42.9%

Table 2.

* Price for 5 units has been considered as the test conducted was for 5 Users

** NComputing X550 desktop virtualization kit contains 5 devices + a PCI Card

An Ethernet switch consisting of Rs 1500 may be required if there is no LAN in place.



Conclusion and Recommendations:

N computing shared computing solution utilizes 95% of the unused power of a standalone PC and saves 60% energy used otherwise and also reduces the hardware cost by 40 % - 55%. So it is recommended that Ncomputing solution can be used in Government offices, Non Profit Organizations, Non Governmental Organizations, Education Centres, Akshaya Computer training centres, Public Library, Educational Institutions, Banking sectors, Call centers etc.