How to Green Windows Update?

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Abstract

The most important challenges facing the earth in the future are energy, water, environment and food security, Green IT contributes in significant role in finding solutions because it consume energy more efficient and reduce pollution in water, air and soil in addition to improving economy because Green IT is manage energy sources by reducing energy consumption with good performance.

Most of energy consumed around the world depends on non-renewable energy and part of this energy consumed to update technologies

In this paper ,we will study one of the most important tools in Microsoft, which is used in order to help users to get updates of Microsoft's products, which is called windows server update services (WSUS), which is helping to reduce energy consumption, we will study this tool and then try to make it more green by reducing the send / receive between Microsoft Update (MU) and WSUS, which will reduce energy consumption, and we will propose algorithm and compared the energy consumption in the current design with energy consumption in the proposed design.

This design will open the way for future work in order to make sending updates in MU less energy consumption by apply conditional sending and that will help to improve the performance of MU added to improve the network performance with more efficient consumption of energy

Keywords: *Green IT, Green computing, Microsoft update, WSUS, Green WSUS*

1. Introduction

The competition for the best is the human desire since the ancient times, and with the evolution of life, the competition became for the (sustainability and best), to achieve equilibrium between costs and benefits, in some cases, costs are more than benefits and other times there will be benefits but the side effects are greater like environmental side effects or health, economic.. etc., and at sometimes can be useful if we change a part or after the period of time.

Determining of the history of concept of sustainability couldn't be done, but in the middle of century ago, and after the second world war there was a total depends on non-renewable energy (coal, oil, natural gas), which are limited sources and have environmental side effects when they being used like causing global warming and rain acidic (H2co3) and pollution of the atmosphere.

After that in 1992 the program was launched Energy star. The US Environmental Protection Agency (EPA) introduced ENERGY STAR as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. Computers and monitors were the first labeled products[1] and this program depends on urge companies to produce devices with less energy consume in order to reduce cost and therefore reduce greenhouse gases and In 2010 energy star program "save more than 240 billion kilowatt-hours (kWh)-about 5 percent of US electricity demand" [6]

In the period that apply energy star , the Swedish organization TCO Development launched the TCO Certification program to promote low magnetic and electrical emissions from CRT-based computer displays; this program was later expanded to include criteria on energy consumption, ergonomics [5].

The study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems—such as monitors, printers, storage devices, and networking and communications systems — efficiently and effectively with minimal or no impact on the environment [8]

Green IT is the use of technology in more environmentally friendly and how can manage energy consumption efficiently with good performance. Green IT use economic reasons to get scientific benefits.

1.1. Why Green IT

The energy sources in the world mainly depends on a non-renewable energy, according to institute for energy

research, that 91.7% is for energy is non-renewable and that the percentage of 82.9% of the sources of energy are fossil fuels (coal, oil, natural gas) see fig (1) [2] , fossil fuels still provide 78% of U.S. energy use in 2035 [7], which is the main cause of global warming and rising temperatures and environmental pollution problems if burned and used and that the sources of it are limited.
The high prevalence in the use of technology (computers, networks, web, mobile phones, etc.) led to consumed energy and increase in environmental pollutions.

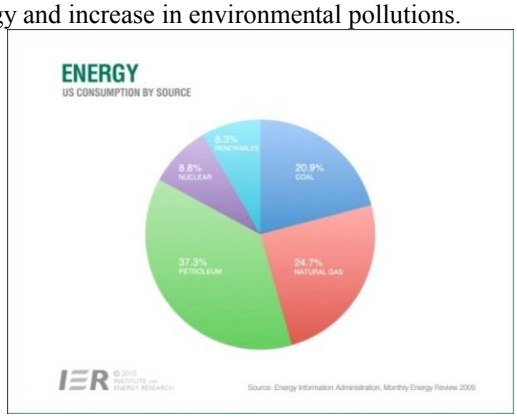


Fig (1) source energy information administration, monthly energy review2009

The most of the components that make up the information technologies are chemicals, some of them are heavy metals like toxic such as lead (in microprocessor, and CRT) and cadmium (in the CRT) and others, and that may cause infections in the environment and diseases of the nervous system if there is no dumping of its health, some materials are recyclable, such as steel (in the computer case) and aluminum (in CDs) to produce new products, in addition, there are materials used with the technology such as papers.
According to the Environmental Defense Fund, creating one ton of virgin, uncoated paper uses three tons of wood, over 19,000 gallons of water, and produces almost 2,300 pounds of solid waste [4], where the percentage of loss due to printing errors, or not necessary printing. or even CDs, they were a loss percentage due to worse use.
From above, it is clear the importance of using green technology because it will consume energy efficiently and this will improve economically and use product more environmentally friendly to reduce side effects on the environment.

1.2 Green computing

Green computing is efficiency energy consumed and awareness in using of technology, and in order to access to computing Green, it should choose the device that consumes energy efficiency and awareness in the use, for example, "Turn off your computer at night so it runs only eight hours a day-will reduce energy use by 810 kWh per year and net a Sixty seven percent (67%) annual savings "[5], The energy consumption is in every part of the computer but there are important parts of the work always consume energy, for example :

- CPU

Central Processing Unit is the most important part in computers, it executes the instructions, logical operations, arithmetic, etc. This unit is work for long period which it means it consumes more energy, and the energy consumption is related with operations in unit time, so we must choose the processor speed compared with the consumption of energy and cost & also we can use RAM (Random Access Memory) to temporarily store the program & this help CPU to complete execution in order to reduce energy consumption.

- Monitor

It is the part of computer that shows the data, images, video, & others. There are many kinds of monitors, the oldest type is CRT (Cathode Ray Tube), the principle of its work is the deviation of the beam output, it is cheaper than other types, but uses a lot of energy, but LCDs live longer, use less energy, and radiate much less heat [4].
LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, and faster switching [3].
Awareness in use reduce energy consume for example when we shut down monitors when we not use it or reduce use graphics that have high resolution & others lead reduce energy consumed

- Green network

Networks today, have a great role and high usage in life, it requires a lot of energy and therefore it consume high amount of energy and there are several principles to reduce consumption, for example:

- Virtualization : create virtual of the storage device or network resources in order to reduce the energy consumption when we use the data with different device & this method is widely use with servers
- Data sharing : It is one of the ways for exchange information through sharing or exchange of copies that are parts and submit them to the network through a number of users, such as Torrent
- Reducing send/receive between user & client, such as Ajax

1.3 Applications of Green IT

Water, air and soil are the basic elements of environment, every technology consumes energy could be one of the applications of Green IT. the flexibility, speed, and the great development of technologies, addition to the adoption of some technologies on levels and challenges such as games, and competition between companies and marketing approach such as competition between Apple and Android and other factors led to the high usage of technology today, and this mean large consumption of energy.

We can distinguish two concepts in the application of Green IT:
1. TI for Green: use technology or some of technologies to reduce total energy consumption, such as WSUS
2. Green for IT: Make technology more green such Green WSUS
Any technologies can become green when we know some important things such as:
• know the components of technology: this help to find where
energy consume & find suitable alternatives and solutions
that help to reduce energy consumption such as Ajax.
• Study hardware of technology: know properties of hardware components help to choose the hardware components which consume less energy like CRT and LCD monitors.
• Knowledge of algorithm technology: the use of efficient algorithms such as the division of task into small tasks in distributed systems

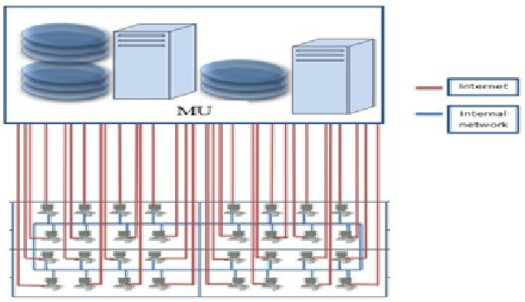
I. *WINDOWS UPDATE*

The companies which aim to sustainability always try to develop its products, this development needs to check the technology, discover errors or problems and find solutions. Microsoft is one of the more common and is characterized by continually develop its products and constantly tries to offer products commensurate with the need for the user, whereupon at first called test version (Beta) and this version will check from the company and users , through the use, the users discover a lot of problems, for example a problem in driver definition or a security problem and others, and user will send the problem to Microsoft company to find a solution , Microsoft will send solution to user for example add a specific file to the system in order to solve the problem.
After find the solution, Microsoft will add these solutions to a collection of the new copy.. after that when these solutions equal to a specific number they collect them in package and called the service pack version and sometimes there may be more than one service pack

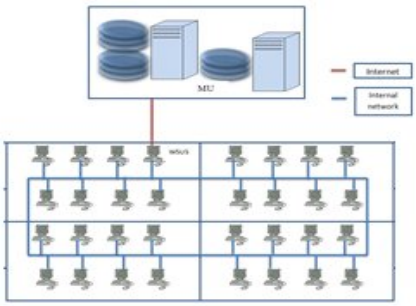
In order to facilitate the task and reduce costs to users, Microsoft will send user update and give user options to active update or not and give the user choices to select if he need to download update automatic or manual or download without install, from setting (Control Panel\All Control Panel Items\Windows Update\Change settings)

2.1. Windows Server Update Services
Windows Server Update Services (WSUS) is server used to download update from Microsoft update (MU) and then distributed to a group of computers that connected with it, It is central point between the Microsoft update and computers that are connected with it.

2.1.1 Why WSUS
Download update for each computer individually may be used in personal computers when the computer is a personal computer, but if organization or universities need to download update for all computers, there are many problems see fig (2), for example if we assume that an university have 200 computers and need to download update for all by every computer connect with Microsoft update & than download update and every update (50 MB) , this mean that university need (50 MB * 200 pc = 10000 MB) to download update and this leads to loss bandwidth and needs energy for (200 pc) to download update.
But if that University use WSUS, which will download the update in the server and then distributed it to computers, this helps that university to reduce bandwidth and energy consumed because instead of (200 computers) connect to (MU), only one computer connects & downloads update & then distributes it
The update without WSUS often during the work's times because it is difficult to update after work, and in work's period, the internet usage is very high, but with WSUS can download the update at times when low internet usage, and then distribute it at any time because distribution will be through organization's local area network and its fast than internet and consume energy less than update without WSUS because the time that transfer information in local area network is less than the time of update from Microsoft update for each computer. See fig (3)



Figs (2) download update without WSUS



Figs (3) download update with WSUS

The WSUS is central administration and this means that WSUS can distribute updates as needed, for example in un organization there are many departments like accounting, public relations , administration and others , and every department needs update that used in works for example the accounting department needs Microsoft's products that are used in accounting, and public relations department need update of program that used it in communication between the university and other organizations and it needs update for security program in order to communicate in secure channel with others. See fig (4)
Every organization consists of sections and these sections are sharing for the success the organization's aims and this needs for a centralized management to distribute tasks, in update without WSUS administer of organization cannot be central management and do not have details about what computers' needs only after knowing each device and this means if un organization have (200) computers ,it must have to check (200) times, but with WSUS by getting reports its possible to have full details about computers and what they need, and can send information by e-mail and so they facilitate the work of the central administration.

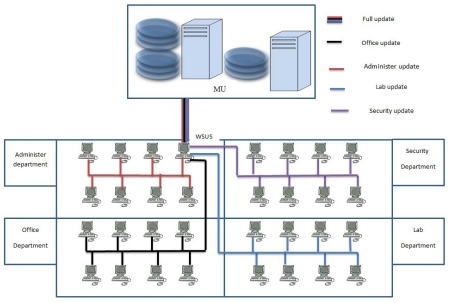


Fig (4) manage update distributed

WSUS provides remote control in order to multi location manager but the database only WSUS, see fig (5)

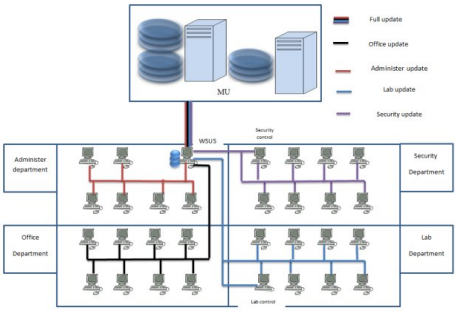


Fig (5) remote control in WSUS

2.1.2 WSUS design

WSUS is central server between MU and computers, and the connection can be:

- Simple WSUS design :

In this case, WSUS connect between MU and computers and when if download update, WSUS deploys it to computers, see fig (6)

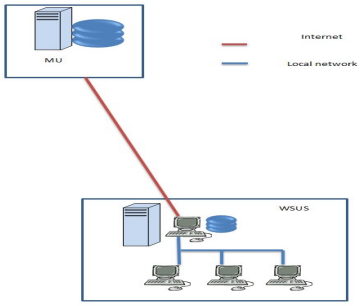


Fig (6) simple WSUS design

- Complex connection :

In this connection, WUSU that is connected to MU can deploys update to computers and other WSUS, During installation, WSUS asks from where download update ? From MU or from other WSUS? and this gives flexibility in the modernization process for organizations for many reasons such as Jitter in Internet or no desire to link all institutions, for example if un organization have two branches, first branch has main WSUS download update and then deploys it to the computers in the branch, and second branch has another WSUS connected with WSUS in the first branch, and data encryption by SSL ,see fig(7)

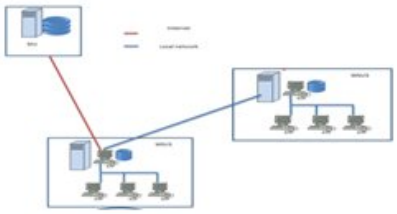


Fig (7) WSUS download update from other WSUS

2.2. WSUS is IT for Green

WSUS is technique used to reduce bandwidth consumption and efficient energy consumption with good performance, in the past, the total energy consumed equals the sum of the updates for all computers , If we assume that we have organization contain (k) of computers and every computer need (U) of update ,

The total energy consumed = total energy consumed in all updates

With WSUS, the total energy = energy of one line contains all update

We will take two scenarios:

1. All computer need the same update

In this scenario we assume organization have (100) computers , all computers need the same update (U)

Total energy (without WSUS) = 100 U

Total energy (WSUS) = U, see fig (8)

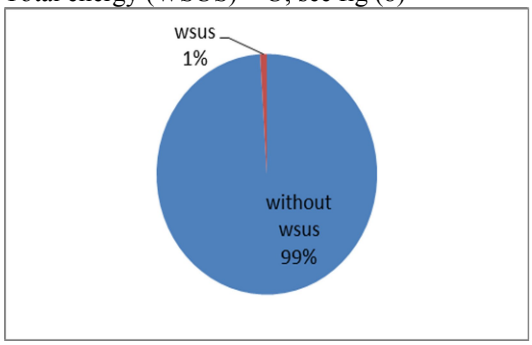


Fig (8) All computer need the same update

2. Types of update

In this scenario , we assume organization have number of computers and every computer need update for example we have (100) computers , and (10) computers need update (U1) , (50) need update (U2) and (40) need update (U3)

Total energy (without WSUS) = 10 u1 + 50 u2+ 40 u3

Total energy (WSUS) = u1+u2+u3, see fig (9)

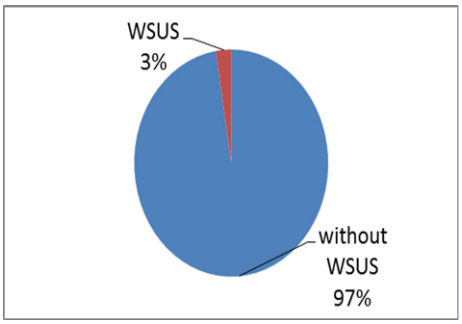


Fig (9) Types of update

2.3 Mechanism of WSUS

WSUS sends signals to the Microsoft update requesting an update, and the sending request either in automatic in a specified time by the user or in manual, if there is an update, the Microsoft update (MU) sends the update to the user ,see fig (10) .

updates available in Microsoft update after finding solutions to the errors that discovered by users or the company in addition to product developed by the company, anyway, update not available every times when users send requests and continue sending requests to the MU is loss in bandwidth in addition to that loss in energy transmitted in WSUS as well as loss of energy received in the Microsoft update, see fig (11)

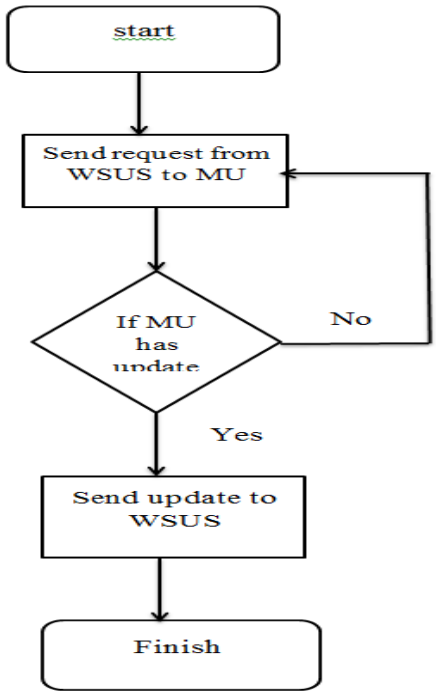


Fig (10) chart of WSUS mechanism

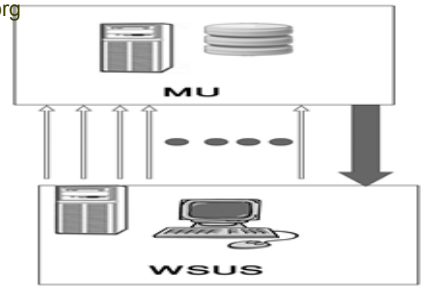


Fig (11) WSUS mechanism

2.4 The effects of requests

The requests that send to MU are consumed energy in the CPU, network interface card, all the routers between WSUS and MU, and other hardware devices.
Each network has bandwidth different in limits range according to the use of Internet, and sends requests to MU is consumption in bandwidth, because the loss of bandwidth is the sum of requests sent and this will affect the internet and quality of service (QoS).
The requests have effects on the system, because the request is instruction & may cause some problems especially when the software that send the request at high usage time of CPU.
The consumption of energy is the flow of current in hardware and this will lead to an electrical resistance that have physical effects on hardware , causing some damage and high temperature
And the number of basic operations in WSUS design is: (N +1) and (N) is the number of requests that send, see fig (23)

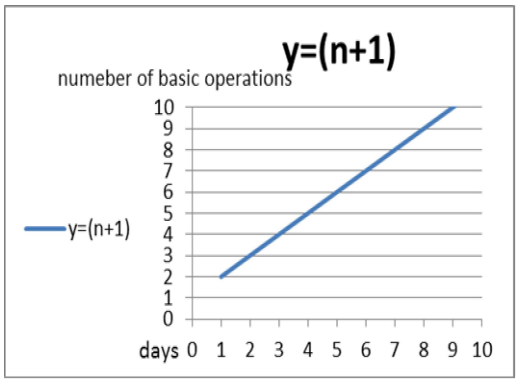


Fig (12) number of basic operations in WSUS

II. PROPOSAL DESIGN

In Proposed design there will not be change in the properties of hardware, but the change the mechanism and that by reducing the sending / receiving between WSUS & MU, when MU complete the update it is sending notification to WSUS telling it that there is an update, If the WSUS wants, it sends a request to MU and then MU sends the update to WSUS. See fig (13)

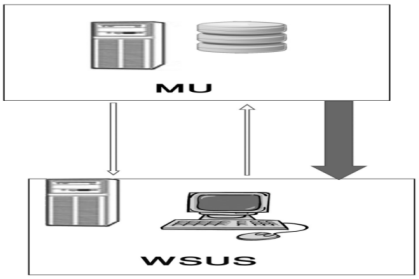


Fig (13) Green WSUS

3.1 chart of green design
The chart below explains the steps that green design used it to download update , in this chart we can see there is no loop of sending request & this reduces energy consumption and improves network effenciy and performance.see fig(14)

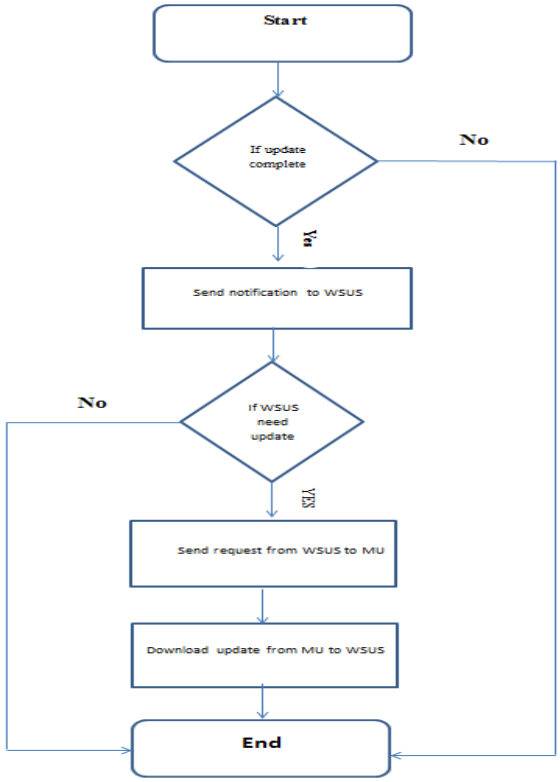


Fig (14) chart of proposed design mechanism

3.2 Basic operations in proposed design

Basic operations in the proposed design is conditional operations that mean there is no loop of requests and the operations in the proposed design does not change according to time when update available, see fig (15)

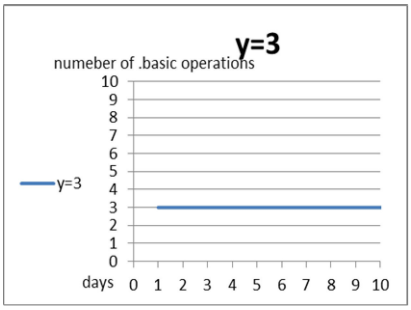


Fig (15) basic operations in the proposed design

Energy consumption between two points depends on the amount of data send and the time of transmission, more amount of data means greater energy consumption and the more time in sending/receiving means more energy consumption

Total energy = energy (transfer data) * time

The energy consumption between WSUS and MU is consuming in network card, processor, routers and any hardware device between MU & WSUS and these devices consume less energy when they idle.

Energy consumption has side effects like electric resistance in hardware atoms because electrical current and this causes a damage to devices and high temperature.

Idle time in the proposed design is greater than the idle time in WSUS for example if we assume that every day at (11 am) sends request to the MU and the update will be available each week. See fig (16) shows the idle time in WSUs and fig (17) shows idle time in green WSUS.

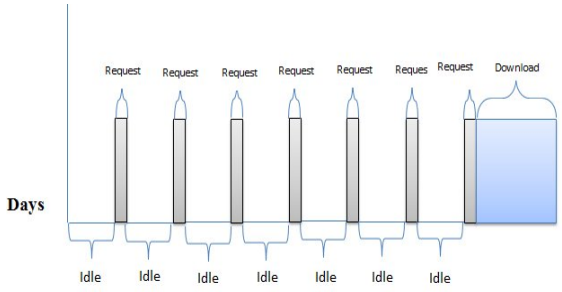


Fig (16) idle time in WSUS

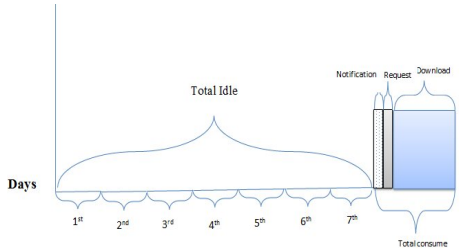


Fig (17) idle time in green WSUS

3.3. Simulation

If we assume that energy consumption in the request = M, energy consumption in the update = Y and energy consumption in the notification = S

In WSUS design:

Total energy = X * M + Y

X= number of requests that send.

In the proposed design, the energy consumed will be

Total energy = M + Y + S

S = very small message

But we will assume that S = M

We will take Four Scenarios of update and the see energy consumption:

- Scenario one

In this scenario , we assume that every day there is an update available, and we will evaluate the energy consumption between the MU and WSUS through one month between the WSUS design and proposed design , we will note that the consumption of energy very close. See fig (18)

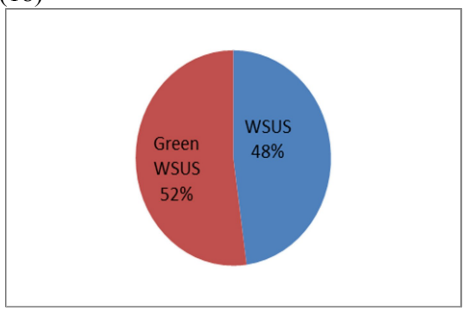


Fig (18) energy consumption in the first scenario

Scenario two

In this scenario, we assume that every week there is an update available, and we will evaluate the energy consumption between the MU and WSUS during the six months between the current design and the proposed design, we will note that the energy consumption in the current design is the largest than the energy that consumed in the proposed design. See fig (19)

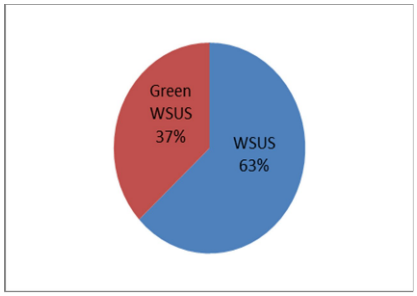


Fig (19) energy consumption in the second scenario

Scenario three

In this scenario, we assume that update will be available every month, and we will evaluate the energy consumption between WSUS and MU during full year between the consumption of energy in the current design and energy consumption in the proposed design, see fig (20)

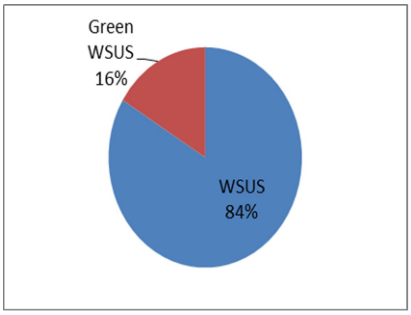


Fig (20) energy consumption in the third scenario

Scenario four

We assume that update will be available at random, for example (1, 6.8, 11, 16,21,27) days, and we will evaluate the energy consumption between WSUS and MU during the period (90 days) between the energy consumption in the current design and energy consumption in the design proposed, see fig (21)

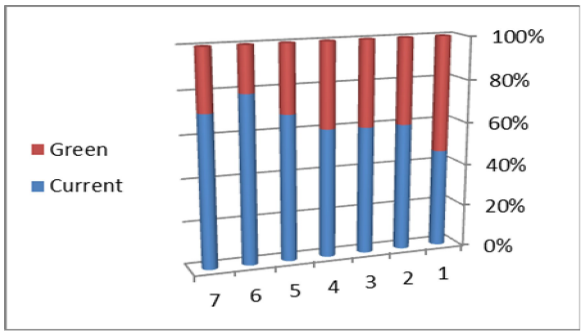


Fig (21) energy consumption in the fourth scenario

The fourth scenarios above shows that the relationship between the consumption of energy and time which update is available in the current design is direct correlation, this mean when increasing in time when update available, the energy consumption will be more, the length of time depends on discovery of the problems and then find solution for it, while the energy consumed in the proposed design does not depend on the of time for the update available

Some side effects related with the energy consumption such as high temperatures or resistance in hardware because of electrical current in addition to fixed rate of energy loss.

Traffic in the network is one of the most important things for internet performance, and more operations cause more bandwidth consumption and this may cause some problems in network like Jitter or delay

The speed of the Internet affect the latency of information, the greater the latency of information cause delay in transmitting data and this mean more energy consumption.

The relationship between the number of basic operations in the current design is related with time, and when time of update available increase, the basic operations will be more, while the proposed design is not related with time which the update is available, see fig (22)

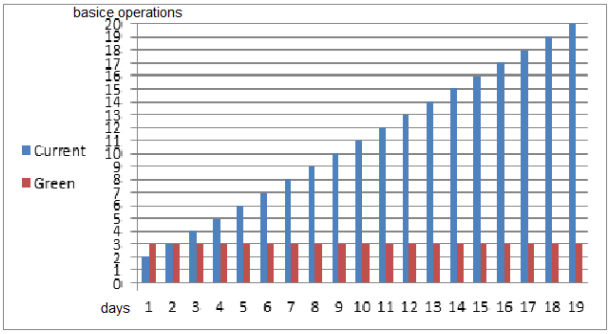


Fig (22) relation between time & basic operation

In the current design the process of the update request be alternating at random, based on the desire of the user to choose a time that favored and thus it is possible that the difference in time for the users (24 hour * 60 min) This makes sending the update to a specific area in which the rotation of randomly added to obtain by the user to update his desire

Proposed design does not have alternative download because it depends on the time availability of the update in the MU and this may cause significant problems in the internet if it send notification to all, and the number of WSUS that it need to update is greater than internet bandwidth in addition to the problems of the Internet, they can cause loss of large energy because it will send data without downloading available update

In the proposed design is central to send updates so it can control when to send the update added to control the processing of data within MU and this will provide better performance in addition to reducing of the processing time which will reduce the energy consumed within the MU

$C >= \sum U$

In the proposed design is central to download the updates and this provides a central data processing and this ensures efficiency in energy consumption because it will be the total data processing equal to or less than the amount of

MU and this ensures to processing of the data in less energy consumption

3.4 future work

In order to reduce energy consumption with good performance, MU must use conditional send, by dividing all WSUS connected to MU areas and use conditional download.

Divide WSUS into groups provides MU with the probability to choose the right time to send according to bandwidth of internet and the suitable time for WSUS according to database in MU.

Update time Directly proportional with size of update (in MU) & proportional reverse with speed of internet (bandwidth)

Time update = size of update /internet bandwidth

This conditional download can reduce energy consumed in MU and select the suitable WSUS according to the action (A)

A= (group, WSUS)

This conditional download can be used in new work in order to specify time for send notification and time to wait request from WSUS in order to reduce energy consume and improve performance

III. Conclusions

The great usage to technology led to consume high energy, the energy's sources around the world mainly depend on non-renewable energy which is limited sources, causing major pollution to the environment and causing significant challenges facing the world, and because of these challenges, the human must find solutions for sustainability and access to technology with less energy consumption.

WSUS is intermediate server between Microsoft update center and users in order to download the update and distribute it to computers that are connected with it by local area network and this provides a lot of energy, for example, if we assume in a organization there is (200 PC) connected to internal network and want to update, if you use WSUS, WSUS will download the update and then distributed to computers and this also provides the benefit in distribute the updates and so we can distribute updates according to the sections that need add to the ease of downloading the update on one computer at times when low internet usage

The WSUS is an example to add technique for reducing energy consumption and can be more green through change in the algorithm used, instead of using the fixed algorithm based on the principle of loop of requests from WSUS to MU can use the algorithm more dynamic depends on the update available, in the proposed design after the update is available in the MU, the MU send small message to WSUS, If the WSUS wants the update ,WSUS send the request to MU, this proposed design will reduce repeats requests and reduces the time of energy consumed and this will reduce energy consumption in addition to that the proposed design will helps reduce energy consumption in MU during the transmission by using conditional download because MU will be able to determine the WSUS that wants to download update with less energy-consumed through a set of conditions, for example the speed of the Internet and the volume of data to be download, etc. .. This will reduce energy consumption and improves performance

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