Implementing eco friendly highly reliable upload feature using multi 3G service

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Abstract. The current trend of eco friendly Internet access is preferred. In this research the understanding of eco friendly is minimum power consumption. The devices that are selected have operationally low power consumption and normally have no power consumption as they are hibernating during idle state. To have the reliability a router of a router that has internal load balancing feature will provide the improvement of previous research on multi 3G services for broadband lines. Previous studies emphasized on accessing and downloading information files from Public Cloud residing Web Servers. The demand is not only for speed but high reliability of access as well. High reliability will mean mitigating both direct and indirect high cost due to repeated attempts of uploading and downloading the large files. Nomadic and mobile computer users need viable solution. Following solution for downloading information has been proposed and tested. The solution is promising. The result is now extended to providing reliable access line by means of redundancy and automatic reconfiguration for uploading and downloading large information files to a Web Server in the Cloud. The technique is taking advantage of internal load balancing feature to provision a redundant line acting as a backup line. A router that has the ability to provide load balancing to several WAN lines is chosen. The WAN lines are constructed using multiple 3G lines. The router supports the accessing Internet with more than one 3G access line which increases the reliability and availability of the Internet access as the second line immediately takes over if the first line is disturbed.

Keywords: Power consumption, 3G Service, redundancy, reliability

1. Introduction
The file size of information that is exchanged will continuously increasing due its rich multimedia content. Information must not only be accessed but stored as well. In some cases the information must be send to the Internet by a user. The user its self can be nomadic or mobile. User confined in a specific location most likely has high speed line readily available. Both uploading and downloading information must have adequate speed or capacity to avoid excessive transmission time of data. Insufficient bandwidth could cause excessive delay time. The information itself might lose its value.
due to the delay or loss of data. To mitigate the possibility of excessive delay various algorithms and standards were developed to reduce the number of bit data while keeping the information quality, integrity, and reliability. Due to the demand of high quality multimedia content and its inherently rich information, the information size in bytes is still fairly large. Generally broadband infrastructure that can support the demand is fixed. Fixed in this case means from users that are not mobile. They are in their premises that has Internet access infrastructure the nearest Internet Point of Presence. The infrastructure itself is preferably fiber optics or at least ADSL. In certain cases high speed fixed line is not available but 3G cellular service is readily available. 3G service can be considered broadband service even though for certain applications such as multimedia rich application sometimes the capacity is inadequate in terms of excessive transmission time.

Excessive delay time can be due to unreliable and also low quality of service of access line. Unreliable or low quality of service line resulted in the possibility of loss of data. The IP protocol will attempt to ensure the receipt of the required packet. Repeated attempt costs valuable time. If the access line is really not operational, the upload or download process must be repeated from the beginning. The incident might render the information lose its value, or loss of data. To decrease the negative side effect of the incident, the use of redundant line could be considered. Fiber access infrastructure is generally highly reliable for corporate network infrastructure including Internet connection. The advantage of fiber access is its stability and guaranteed quality. Its disadvantage is it cannot address the demand of mobility. Mobility is mostly available within the corporate premises using wireless LAN. The access infrastructure must meet a number of stringent technical requirements to provide high quality signal to the receiver. Unfortunately not everywhere fiber optic infrastructure is deployed. Its availability is still limited to designated business complex and upper income dense residential area. Quite often it does not cover a geographical area where the demand for high capacity access line is unforeseen. High capital expenditure and limited revenue growth besides geographical constraint are the major the reasons for limited availability beyond the business complex and upper income residential area.

The emergence small businesses, which are mostly creative start-up businesses, is the current phenomenon especially in developing countries. They are considering how to have economical high capacity and reliable Internet access for timely information access and most likely dissemination as well. In major cities optical fiber broadband service is readily available in business locations. Even though small businesses can be nomadic or highly mobile, it still needs reliable high speed Internet access. A reliable broadband transmission system is even more essential as more and more information has value that is time limited. Retrieval and storage of large files of information within a short time along with mobility is essential.

Cellular service changed the telecommunication services. Geography practically does not constraint communication facility availability. Telecommunication data and voice service are ubiquitous and economical for everybody. The infrastructure to support mobile communication changed the telecommunication landscape. Mobility is currently the norm; thus; enables the anywhere and anytime communications. Cellular infrastructure has nationwide coverage. The demand of mobile communication service changed to broadband data communications. The third generation of mobile communications also known as 3G communication system is increasingly superseded by the fourth generation (4G). 3G data communications is classified as high speed broadband data communication. 3G communication provides users Internet access. The carriers structured their 3G pricing competitively.

It takes more than a decade after the launch of the first 3G services for the data communication services take off. The 3G service grows tremendously with the introduction of smart phones and cloud computing. There are studies examining the success in the use of 3G network service. With the
success of 3G services especially for Internet data communications, 3G gradually moves to 4G service with its higher speed or higher capacity data service. Users will only see improvements in line capacity or bandwidth. The next generation data cellular services will be named 4G and 5G. 3G technology is still sufficient to connect devices to the Internet and is accessible to everyone. The current important role of 3G in the information and communication services is providing ubiquitous anytime anywhere access. 3G service and its successors are the current technology providing solution for the demand of speed, mobility and economy besides of overcoming geographical limitation.

Mobile Internet access is now economical, widely available and reasonably broadband. In this research a system with reliable high-speed access line using 3G services is developed. The system is interesting as a fix line or a 3G line with other 3G channel is used to provide a highly reliable access broadband line. Capitalizing in the advantages in overcoming geographic obstacles, availability and speed of data transmission, this research wants to add value to the 3G data service. A router is configured to obtain automatic continuous transmission of information in case of the failure of the main access line and return to the main line as soon as it is in service again. The user will not notice that there were a slight disturbance during its file uploading process. The resulting system reliability will depend on service quality of the 3G operator especially the traffic carrying capacity.

The current trend of technology is eco friendly. In this research the understanding of eco friendly is minimum power consumption. Highly reliable Internet access minimizes power consumption as large files need not repeated attempts for successful upload. Repeated attempt means transmission of the same information repeatedly. Indirectly decreasing power consumption resulted in decrease of carbon release to the atmosphere. 3G services are based on CDMA technology that is energy efficient. The devices that are selected have operationally low power consumption and normally have no power consumption as they are hibernating during idle state.

The objective of this research is to provide a solution for highly reliable broadband access that is suitable for nomadic and mobile user and foremost ecofriendly. Nomadic and mobile user have limited and almost impossible access to the broadband fixed line. The solution should be simple, economic and mobile. As broadband access line the system will use several 3G data services and network devices that are configured to provide the reliability. The crucial development is choosing a router that can provide multiple WAN for the multiple 3G channels to get the desired channel bandwidth. The existence of network devices which has features allowing redundant use of WAN lines to provide reliability for the acquisition and storage of information files. The geographical coverage of the system will depend on the service availability of the 3G service subscribed. The system will provide relatively reliable high speed connection. Its operational cost is economic and easy to subscribe.

This research will be beneficial for nomadic or mobile users to obtain highly reliable broadband Internet access system. Micro and Small sized companies need to have a solution have highly reliable broadband Internet access lines that are economic and technically simple. Mobile user will benefit from the system due to the availability of 3G data service that is broadband Internet access, economic and simple. The first paragraph after a heading is not indented.

2. Literature review and Previous works
3G Service which is the third generation mobile communications that satisfies the demands for high speed mobile data communications. The evolution of cellular communication objective is to provide high speed mobile communications. The recent commercially available mobile data service is known as 4G services. Currently 3G service is stable and has ubiquitous presence. It can support wide applications that need high data speed and mobility. Its quality of service is improving. It is low cost and supports the needs of mobile Internet. It can fulfill the broadband data services needs such video
streaming, games on line, and other multimedia applications including video conferencing. Smart phone applications are exploding due to the ubiquitous coverage of 3G services.

Result of researches described generations and applications beyond 3G. Technologies beyond 3G are further developed for the purpose of improving data communication services. Service Providers that moves toward 4G needs massive change in their infrastructure. 3G services have been improved with new approaches to provide increased capacity and spectral efficiency. HSUPA and later HSPA are implemented by GSM Operators to provide 3G high speed data services. Abdel El Al, Saadawi, and Lee discussed an extension to SCTP (Stream Control Transmission Protocol). SCTP uses multi-homed hosts for redundancy. The proposal works at the transport layer for heterogeneous aggregation through a number of mobile channels such as 3G services. It is necessary to have a mechanism that gives the mobile applications a logical channel that is multiple of the allotted channel bandwidth.

The use of several 3G lines to construct a high speed line has been investigated. The solution was reported that it mainly works for downloading large files from public Cloud such as Google drive. The proposed system is based on dormant transmission technique known as inverse multiplexing. The technique is called inverse multiplexing as it splits a high speed channel to several low speed channels, instead of combining several low speed lines to a high speed line for transmission to a destination. Inverse multiplexing only supports digital data. Large files can be sent to storage through several lower speed lines. A higher throughput can be achieved by the system as the lower speed channel is used to its full capacity. In the mean time lower speed lines such as the common 3G lines were readily available. Previous research was an attempt to implement the Inverse Multiplexing concept in the IP environment. The mechanism for IP based and cellular network must consider the probability of instability compared to fixed wireline network.

Another factor that must come into consideration is the reliability of broadband access line in downloading or uploading large files. Repeated attempt to achieve the intended result could need excessive time; hence, resulted in low throughput and low access line efficiency apart from increase in cost. Adding redundant line that can be automatically activated in case of main access line failure could improve the overall performance. The time value of the information of interest can be maintained. The demand for high speed broadband is increasing continuously due to the explosion of applications and services that require large size files. The availability of fixed Internet access line is mostly limited due to perceived difficulty in recovering investments. 3G/4G cellular services which enables global reach to the Internet could fulfill the broadband or high speed line demands. 3G/4G is currently ubiquitous and relatively economical for business Internet access.

Communication system due to its role as the infrastructure of information technology must have reliability, high availability and provide continuous serviceability [1][2]. Reliability is the probability a system’s produces the expected result during some given time [5]. Reliability a value added characteristic that enhanced the system’s performance. The value added feature generally can avoid detriment result mostly due to hardware faults or service outage. Reliability feature could silently continue and deliver intended results. The 3G service could provide this feature. Reliability provided by the 3G line is limited to the availability of the Internet infrastructure. The take-over of affected operational connection due to interruption of service is performed without providing any alert. The connection will return to the main line as soon as it is operational again [5].

The availability of the system is another value added feature that increases operational time or the length of time it is operating correctly. Normally it is the percentage of total time it is operating versus the time should be operating. Availability feature allows the system to provide service regardless the Internet access line status. In this high available system, the system would disregard the malfunctioning line and continue operating with minimum disruption. The users will not notice what
happens, but notice a slight delay during the change-over to the operational line. Availability measured as percentage of the expected available time. There is a slight difference between reliability and availability. Reliability concerns the ability of a system to function correctly whereas availability is a measure how often the system is available for use regardless its performance [6].

Reliability and availability are value added features that protect a system against failure. Generally the probable failure types of this kind of system concerns physical faults. They can be intermittent, temporary or permanent. Permanent faults resulted in continuing error and are due to some physical failure. Disruption of 3G service is considered permanent fault as the affected line will need some time to return to active service. Temporary faults are caused by disruption could be result in transient and intermittent faults. Transient faults could become to independent one-time errors and quite often are not due to permanent hardware fault. Intermittent faults generally occur due to a weak system component or parameters degrading that resulted to errors that are likely to recur. Intermittent faults are difficult to eliminate [5].

Redundancy is the duplication of critical components or functions of a system to increase the reliability of the system. Redundancy is usually in the form of a backup or fail-safe that could to improve the overall system performance. Some system may be triplicated,[1] which is formally termed triple modular redundancy (TMR). An error in one component may then be out-voted by the other two. The system has three components which must fail before the system fails. [4].

To maximize system reliability, it is crucial to select the appropriate redundancy methods. In communications system active redundancy or dual system is generally implemented. The optimal system design is distinctly different design obtained with only active redundancy.

The result of the research showed a solution that takes advantage of configuring its LAN port to WAN port and accessing 3G service. This research is based on our previous work in configuring the router to perform inverse multiplexing for downloading large files from a cloud storage service such as Dropbox (www.dropbox.com) or Google Drive. The solution is suitable for small businesses due to its simplicity, economic, and intangible value of information content that are time sensitive.

3. Methodology
The physical diagram that must be configured by the chosen hardware is shown in Figure 01 below:

![Figure 1. Physical Diagram](image-url)

The User Computer accesses any Internet services. The service of particular interest is the storage service such as Dropbox. The User generally is connected to a Router that has a WAN to the Internet. The primary WAN line is normally a fix connection coming from an ISP. Under certain condition the primary WAN could use 3G service.
A second Internet access line is defined and uses a LAN port to perform its function as WAN. The second line is connected to 3G data service. In this research the access lines are multiple 3G lines. The access line is used to upload files to the cloud. In this case two 3G lines will be used. The router will be configured in order to have two WAN lines to the Internet. The two WAN lines are subscribed to a 3G operator. In the current research the two lines are subscribed from the same operator.

The router itself is configured with one WAN interface and four LAN ports. Each LAN port can be configured as WAN with some limitations. All ports supports Ethernet, The 3G service needs 3G modem that normally has USB for connection to the computer. To obtain 3G service, the router ports must use a USB to Ethernet converter. The converter function is provided by a device produced by TP-Link. It has the intelligence to serve the 3G data service provider and automatically accesses the Internet. The 3G Internet connectivity looks like fixed line connectivity. This connectivity is investigated whether the multiple 3G line can provide the increase of reliability in case of connection failure. For downloading and uploading file to the Internet through WAN lines; one line is acting as the operational line whereas the other lines are the back-ups. If the user uploads information and the first WAN line is connected to the Internet, the packets will flow through it to the server at the cloud. Any disturbance to the first line that is actively transferring data packets to the cloud and renders it inoperable or inactive will cause the packets to flow to the second WAN line that was idle and active. The cloud server transparently handles the packets and stores the uploaded file. The same process takes place if the second WAN is actively transferring packets instead of the first WAN line. Hence; the reliability of uploading file is improved as idle and active WAN line will take over and return to the original line as soon as it is considered active and operable.

4. Results
The experiments showed that configuring this particular type of router of having 2 WAN lines, where one line was a LAN line resulted as an N+1 reliable WAN line. If both lines are active, only one line is transmitting packets to the Internet. Normally the original WAN line (line 1) is selected. If the original line is disturbed, automatically the second line will take over. The time required is around 4 seconds. The uploading file to the Cloud (in this experiment Dropbox and Google Drive) succeeded perfectly. If the original line is restored, packets will flow via this line. The second line will return as a backup line. If a line cannot take over within the applicable time out, then the uploading failed and the uploading process must be repeated anew.

5. Conclusions
The experiments showed that the configuration increases the reliability of Internet access. The reliability is due to the fact that if one line is disturbed during the packet transfer process, the idle line will take over until the original line is restored. The server at the cloud will receive the packets and store where it belongs. This feature helps increasing the reliability and availability of interest connection with multiple 3G lines. 3G line is inherently unstable due to its public nature and use of electromagnetic wave as its transmission medium.

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