Comparative Analysis of Performance of 3G Networks over TCP Protocols

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Abstract:
3G Networks are getting day by day popular and they are interfering in normal human life. Still there are some performance issues in this technology; here we compare the performance of packet transfer in 3G Networks with a wired Dedicated Networks using a small network and by to find out the factor affecting the performance of a 3G Networks.

Key words:
3G, TCP, Wireless

I. INTRODUCTION

Third generation systems develop faster communications services, including voice, fax and Internet, anytime and anywhere with seamless global roaming global standard for 3G has opened the way to enabling innovative applications and services multimedia entertainment, infotainment and location-based services, among other. The first 3G networks were deployed in Korea and Japan in. 2.5G networks, such as GPRS (Global Packet Radio Service) are already available in some parts of Europe. It is to be noted that analog and digital systems, 1G and 2G, still co-exist in many areas. Similarly, 2G and 3G systems will co-exist for some time.

1.1 Internet

A computer networks is a group of computers that has been connected together so that they can communicate with each other. They can send messages to each other and can share information in the form of computer files. Internet is a computer networks that connects million of computers globally and provides world wide communication to business, home, government and school. The Internet is a network of networks. The Internet is a network of thousands of different networks. It is the world's largest group of connected computers .Some of the network belongs to government bodies, some to universities, some to business, some of local community library system etc. In the Internet there are smaller networks like LAN and WAN to connect two computers together.

A protocol defines how computers should talk to each other. It is like a language. If groups of different people all agree to speak English and Hindi they can all understand each other communication protocols provide a set of rules that define how different modems, computers and programs can communicate. Data communication protocol is the set of rules and procedures established to control transmission between two points so that receive can properly interpret the stream transmitted by sender.

The world's largest computer network, the network of networks, scattered all over the world. In simple terms, internet can be defined as a global network of over a million of smaller heterogeneous computer networks, which is accessible to the general public. These interconnected computers work by transmitting data through a special type of packet switching which is known as the IP or the internet protocol.

These networks enable the internet to be used for various important functions which include the several means of communications like the file transfer, the online chat and the sharing of the documents and web sites on the World Wide Web.

All computers and other equipments within any given network are basically connected to each other with the help of cables. In order to accomplish the task of messaging across a network, computers use a networking protocol. These protocols, such as Internet Protocol (IP), Transmission Control Protocol (TCP), and Hypertext Transfer Protocol (HTTP) etc. are the integral part of the network, as they provide the services of the internet [13]. TCP is the main transport protocol utilized in IP networks. These Protocols offer a simple naming and addressing scheme, whereby resources on the internet can easily be located. These addresses are called IP address. Information on the internet is carried in packets. These packets are transferred into the computers through the network of Web computers [15].

Internet connection can be classified into following category.

I. Gateway Access
II. Dial-up Connection
III. Leased Connection
IV. DSL
V. Cable Modem Connection
VI. VSAT

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Internet services require an Internet connection from "Internet Service Provider ". There are two type of connection according to our requirement

II. What is 3G

The third generation is a generation of wireless technology used for the next generation for attractive delivery of multimedia range services. It is an enhancement technology over previous wireless technology such as advance multimedia access global roaming and high speed transmission are often used. In this case mostly mobiles and handset phone are used to connect the internet for making voice and video calls, uploads and download data etc. It has been developed to provide more efficient system over the air transmission to overcome shortcomings of existing system. Support services are also taken by the core and connectivity to provide different networks like peer to peer network used by the next generation operator. This developed network is also use for controlling local area network particularly on the special feature like AAA. Some autonomy is also provided for maintaining reliability and quality of services. The third generation technologies allow mobile operators to provide more service options to their users, including mobile broadband. Third generation offers greater flexibility and services by making more efficient use of mobile bandwidth than its predecessor second generation . The relationship between second generation and third generation is similar to that of dial-up and broadband, or terrestrial TV and digital TV. In all of the latter examples, greater spectral efficiency has enabled more consumer choice and a more effective service. Simply put, more data can be transmitted faster. The volume of Internet traffic over third generation wireless networks is sharply rising. The range of offered services has already been extended from basic speech telephony to multimedia and interactive data transfers. In such an environment, one can expect that a major portion of the overall traffic will be carried by TCP/IP. Thus, particular attention must be paid to the performance of TCP/IP over third generation wireless networks. However, it has been found that wireless link losses have an adverse impact on performance as TCP/IP cannot distinguish them from congestion losses. Third generation provides higher-layer functionality and support services for applications, for example , location services, content distribution and Application Layer Multicast (ALM). This overlay is divided into two tiers, That is lower tier and higher tier .Lower tier function are relatively close to the core such as Application Layer Multicast where as higher tier provides locational services . The four horizontal abstract layers as stated above are further subdivided . The functions are grouped into vertical collections it is called "facets" which contains key ability to span several layers. These facets are security, transport, mobility, interworking, and service control resource control and other similar coordination functions. Each plane and each layer is largely independent of the others which is highly object-oriented network architecture and easy to maintain and upgrade. The lower layer is the access network layer and gives necessary access control and wide-area mobility , physical and MAC level connectivity, and quality of services switching capability. This layer is topped with IP-based access network that gives inter-subnet handover capability with fast Mobile IP, IP connectivity along with necessary access control, address assignment, integrated quality of service management. These two layers are flexible mixed with different combinations depending on the access network technology and also particular topology requirements of the network. The core network layer consists of a pure IP Different server core that gives raw bandwidth to connect different parts of the network. It also contains gateways to connect to external networks, such as the Internet, and employs necessary protection against denial of service attacks from outside networks. The network services that help other layers achieve their tasks are called support services. These are divided into two tiers. First one provides supports services mostly related to transport functionality of the network , while second one provides supports services functionality for end macro mobility management . This layer provides application-layer AAA service for the end services . An overlay network which facilitates application and content distribution . A certification service for the applications and a set of gateways which gives with legacy network services such as voice and video in third generation networks [1].

The air interface frames are the data units of fixed or variable size. It is used to transfer information over the air. It is a data packet and the output block of a speech or video coder. The base transceiver station (BTS) terminates the physical radio layer. It consists the basic functionality needed for radio transmission. If macro diversity is applied, the BTS adds quality information to each received air interface frame . This quality information is necessary for the combining process in the macro diversity unit. In upstream direction the air interface frames are transformed to the transport medium used for the interconnection of BTS and Intermediate Unit (IU), and vice versa for the downlink [2]. This is particularly designed to carry low bandwidth services with hard delay constraints. The drawback is the overhead when used with very small packets three byte overhead packet. In addition, it will add more complexity to ATM components like switches minicell switching etc. It permits multiplexing of various small bandwidth connections into one ATM connection, whereas manically can overlap consecutive ATM cells. This is possible to receive higher efficiency

than by using partially filled cells and cope with delay sensitive services at the same time. UMTS/IMT-2000 may permit the possibility of a mobile station to connect to many base station continuously. This macroscopic diversity is necessary for soft handover in CDMA systems. It is also useful to improve link quality and increase capacity in TDMA systems. The macro diversity functionality gives an extra burden on the fixed access network in terms of increased bandwidth usage and system complexity. The trail going to 3G mobile technology reflects many significant trends. Major mobile players have been investing to 2G and the succeeding technology. The third generation mobile technologies are looked to provide fast and high data rate or bandwidth, & give packetized data communications. Still third generation is under the cloud of the sensible standards creation, ITU and IEEE form many teams to work on the possible completion for the third generation mobile standards. The first pre-commercial trial network with third generation was implemented by NTT DoCoMo in Japan in the Tokyo region in May 2001. NTT DoCoMo implemented the first commercial third generation network on October 1, 2001, using the WCDMA technology. The first third generation networks on the rival CDMA2000 1xEV-DO technology were implemented by SK Telecom and KTF in South Korea in 2002, and Monet in the USA. By the end of 2002, the second WCDMA network was implemented in Japan by Vodafone KK now Softbank . The first European implemented of third generation were in Italy and the UK by the Three/Hutchison group, on WCDMA on March 2002. By the end of 2007 there were 295 Million subscribers on third generation networks worldwide, which indicated 9% of the total worldwide subscriber base. About two thirds of these are on the WCDMA standard and one third on the EV-DO standard. The third generation telecoms services generated over 120 Billion dollars of revenues during 2007 and at many markets the majority of new phones activated were third generation phones. Now a days, There is no supply of the second generation phone in Japan and South Korea. Early in the decade there were every doubts whether third generation would be commercially success. By the end of 2007 it had become clear that 3G was a reality and was clearly on the path to become a beneficial proposition.

The third generation is considered as a standard, common consensus with the features, developed and innovated networks. Third generation become ready to live up to its performance in Bluetooth, mobile devices area and computer networking [8] .

III. Comparison of 3G Network with Dedicated LAN Network

A **LAN (local area network)** is a privately owned computer network that connects computers and other information processing device within a limited area (few kilometers) such as a home, school/classroom, building, manufacturing plant, computer laboratory, or office building using network media. LAN is useful for sharing resources like files, printers, games or other applications. In many organizations, it has become commonplace for LANs to provide telecommunications network capabilities that link end users in departments, offices, and other workgroups. Coaxial cable, ordinary wiring, and even wireless radio and infrared systems, to interconnect microcomputer workstations and computer peripherals are some examples of LANs that are used with telecommunications media. WLAN (Wireless Local area networks) is a more advanced form of LAN which utilize radio waves/microwaves to maintain communication channels between computers. However, LANs/WLANs are subjected to interference because of their operation in the unlicensed spectrum. WLANs' coverage ranges from about 30 to 300 m. Therefore, they are suitable only in high-density areas and thus not able to provide ubiquitous coverage. LAN technology is relatively inexpensive and quick to deploy.

On the other hand, **3G refers to the third generation** of mobile telecommunications technology which came just after 2G, the second generation technologies. 3g generally refers to the standard of accessibility and speed of mobile devices. It was first used in Japan in the year 2001. This technology enables use of various services like GPS (Global Positioning System), mobile television and video conferencing. It not only enables them to be used worldwide, but also provides with better bandwidth and increased speed. 3G is a set of technologies and standards that include W-CDMA (Wideband Code Division Multiple Access), WLAN and cellular radio, among others. It comes with enhancements over previous wireless technologies, like high-speed transmission, advanced multimedia access and global roaming. 3G is mostly used with mobile phones and handsets as a means to connect the phone to the Internet or other networks in order to make voice and video calls, to download and upload data and to surf the net. 3G telecommunication networks support services that provide an information transfer rate of at least 200 kbit/s. 3G finds application in wireless voice telephony, mobile Internet access, fixed wireless Internet access, video calls and mobile TV.

LANs (Local area networks) or WLANs (Wireless Local area networks) are subjected to interference because of their operation in the unlicensed spectrum. LANs' coverage ranges from about 30 to 300 m. Therefore, they are suitable only in high-density areas and thus not able to

provide ubiquitous coverage. LAN technology is relatively inexpensive and quick to deploy. WLANs (Wireless Local area networks) were designed to extend LANs in corporate environments, but they are becoming increasingly popular to provide IP connectivity in residential, small office home office (SOHO), and campus environments. A new phenomenon in populated areas has emerged to deploy WLANs in public hotspots including airports, coffee houses, convention centers, hotels, and other public areas with a high demand for wireless data.

Though both WLANs and 3G are capable of providing higher-speed wireless connections that cannot be offered by earlier 2G cellular technologies, they have their own limitations and preferences. WLANs can cover only a small area and allow limited mobility, but provide higher data rates. Therefore, WLANs are well suited to hotspot coverage where there is a high density of demand for high-data-rate wireless services requiring limited mobility. On the other hand, 3G wireless networks, with their well-established voice support, wide coverage, and high mobility, are more suited to areas with moderate or low-density demand for wireless usage requiring high mobility. Therefore, WLANs and 3G are complementary. The integration of 3G wireless and WLANs is highly significant to make wireless multimedia and other high-data-rate services a reality for a large population. A multimedia 3G/WLAN terminal can access high bandwidth data services where WLAN coverage is offered, while accessing wide area networks using 3G at other places. However, this approach alone will only allow limited multi-access functionality. To make multi-access solutions effective, we need an integrated solution to provide seamless mobility between access technologies, allowing continuity of existing sessions. 3G/WLAN integration promises to offer these capabilities seamlessly.

IV. PROPOSED WORK

In this work we have tried to compare and analyze the performance of two modes of internet access. We are trying to find out that how much 3G network are efficient to use for high speed data. How does it perform when compared to a dedicated Lease line network accessed through a LAN in an Organisation and conclude which is better in given conditions.

For the above mentioned purpose we are using the same machine with Intel Processor and 1 GB RAM. It is assumed that the conditions given are ideal and very less atmospheric and peripheral interference is there**.**

We have used two networks for the work details of which are as follows:

1. 3G data card with 7.2 Mbps high end download speed for Scenario 1.
2. A LAN Network is established with 10/100 MB Ethernet with a backbone of 32GB dedicated optical network for scenario 2

We have tried to analyze the results on following three parameters

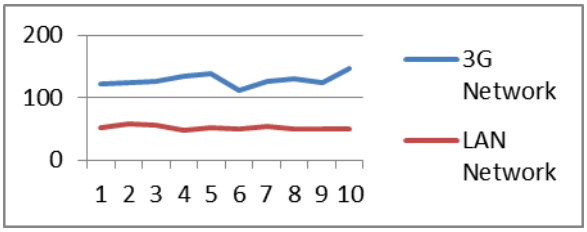
1. Ping Test: In this test the tool used tried to analyze the time taken by the system to get a ping to distant server in both the scenario. In both the cases the server remains the same. The size of the does not matter in case of Ping Test
2. Download Speed Test: In this test the tool analyses the speed of downloading the files of various sizes from a given server at various incidences. The speed is calculated in Mbps, and the packet size each time is increasing.
3. Upload Speed Test: In this test the tool analyses the speed of uploading the files of various sizes to a given server at various incidences. The speed is calculated in Mbps, and the packet size each time is increasing.

The analysis is performed both for 3G Networks and dedicated LAN Network. The tool used is an online speed test module (freeware) namely “Ookla Speed Test” which also records the ping address of both source and destination.

V. RESULTS & ANALYSIS

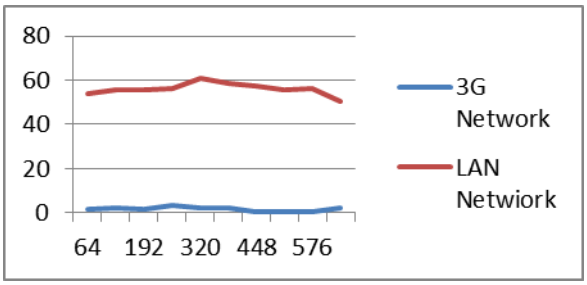
5.1 Test 1

Ping Test: As stated above in scenario 1 of 3G Networks the ping is made and results obtained show that ping time of given server varies from 112 msec. to 146 msec. While in scenario 2 of Dedicated LAN Network the ping time is quite low that is ranging from 48 msec. to 57 msec.



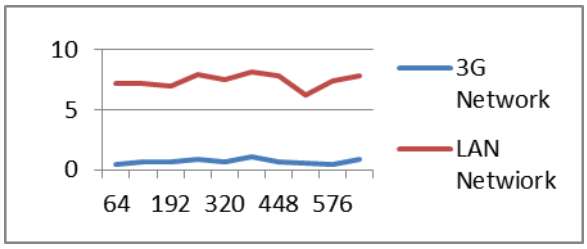
5.2 Test 2

Download Test: As stated above in scenario 1 of 3G Networks the attempt is made to download 10 files of different packet sizes and results are obtained, which prove that download speed from given server varies from 0.63 Mbps. to 3.14 Mbps. While in scenario 2 of Dedicated LAN Network the download speed is quite high that is ranging from 50.48 Mbps. to 60.62 Mbps.



5.3 Test 3

Upload Test: As stated above in scenario 1 of 3G Networks the attempt is made to upload 10 files of different packet sizes and results are obtained, which prove that upload speed to a given server varies from 0.44 Mbps. to 1.09 Mbps. While in scenario 2 of Dedicated LAN Network the upload speed is quite high that is ranging from 6.24 Mbps. to 8.09 Mbps.



V. CONCLUSION

A depth study has been made to find out the results of the work. The aim of this work is to do ANALYSIS OF PERFORMANCE OF A 3G NETWORK OVER TCP PROTOCOL. It is opined that the work would be very beneficial / useful for the promoters / manufacturers, services provider and also for users. Efforts have been made to highlight different aspects of 3G networks such as technical aspect, deficiency areas, advantages, disadvantage and processing aspects of data transmission etc. The work will be also useful for the academic sectors, research centres, retailers, official persons etc . The third generation network consists of very advance technology which is very useful and beneficial to the users and services providers. Despite 3G launched in India in the year 2009 still it is not fully popularized / adopted by the users. Till now benefits have been derived by a few sectors mostly big companies, institutions, scientific research centres etc. The reasons behind it are observed that systems are expensive, high technical and prevailing interruption in data transmission etc. It is felt that required amendments if done by the promoters / inventors , it will definitely get very success and will be adopted by the users even living in remote areas . Keeping in view the forgoing facts, It is concluded that 3G network needs some specific attention for removing the deficiencies so that country like India derives more and more benefits and use them in different developmental works and provide most comfortable and sophisticated device for the working people through use of third generation networks and also 3G networks will work successfully over Transmission Control Protocol.

The results prove that

1. The ping time required by 3G network is more than double of the LAN network.
2. The download speed of LAN network is almost 20 times of a 3G network.
3. The upload speed of LAN Network is almost 6 times of a 3G Network.

This means that even though 3G networks give high portability and good facility for ubiquitous devices still they fall far behind of a LAN Networks.

VI. FUTURE WORK

There might be various factors which involve in the throughput of 3G Networks, namely location, environment and system configuration, still efforts shall be made to strengthen the signals of a 3G networks like handover factors, antenna capacity etc.

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