THIRD GENERATION (3G) MOBILE NETWORK MARKET DEMAND AND FEASIBILITY STUDY FOR IMPLEMENTATION IN BANGLADESH

By

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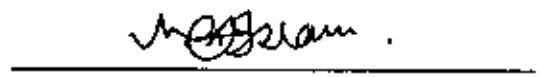

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ABSTRACT

The purpose of this study is to find out Third generation (3G) mobile network market demand and feasibility study for implementation in Bangladesh.

This 3G technology is implemented in so many countries in the whole world. There are some successful and some unsuccessful cases in adopting this technology. In this report the concentration is given on the new feature of this technology, survey for the market demand, capital cost and operational cost, customer segment and demand analysis, future trend, advantage and disadvantage with current technology in mobile operator, cost effectiveness and overall feasibility for implementation.

The market of mobile communication is very attractive as Bangladesh is a highly populated country. But the inflation rate is very high here and GDP is comparatively low. So it is a matter of consideration for implementing costly technology because it may so much costly for most of the people.

Technological and economical balance is an important issue in this case. The Return of Investment period is important as the technology is quickly changing. The 3G technology is a solution of High speed data service demand, but the market is not big enough yet to invest extensively because license fee, tax is a big issue. Also the recent penalty paid by operators forced them to cut down their cost. In this situation feasibility analysis and forecasting is a big issue.

Here in this report the data and trend analysis has been done with respect to the recent growth of this technology in different countries. Also the cost analysis has been done for implementing this technology.

From our study it has been found that implementation of 3G technology at existing GP network system is feasible as because from financial analysis IRR has been found 30%, the NPV positive and Discounted Payback Period 4.1 years (considering 13% discounting factor). Moreover, 2G is going to be absorbed by 3G all over the world and 2G is now at its declining phase, then it will be the right time to switch into 3G technology at our network system.

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INTRODUCTION

1.1 Background

Technology is rapidly changing. Today's technology will be replaced by tomorrow's technology. 3G or Third Generation technology is a convergence of various Second Generation telecommunication systems. **3G is the third generation** of mobile phone standards and technology, superseding 2G. It is based on the International Telecommunication Union (ITU) family of standards under the International Mobile Telecommunications program [1].

3G technologies enable network operators to offer users a wider range of more advanced services while achieving greater network capacity through improved spectral efficiency [1].

A. Video calls and Video Conversation.
B. Live TV at Mobile Hand set.
C. Wide-area wireless.
D Audio Video Conferencing.
E. Fax Service from mobile set.
F. Broadband wireless.
G. High speed internet form mobile hand set.

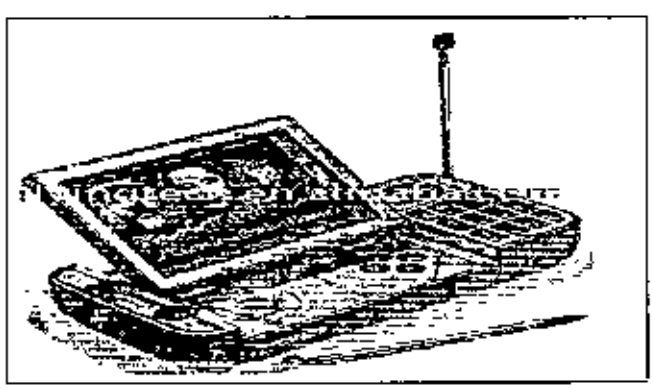


Fig.1.1- Model picture of a 3G handset

This 3G technology is implemented in so many countries in the whole world. There are some successful and some unsuccessful cases in adopting this technology [2]. In this report we have concentrated on the new features of this technology [1], survey for the market demand, capital cost and operational cost [2, 3], customer segment and demand analysis [4, 5], future trend, advantage and disadvantage with current technology in mobile operator [6], cost effectiveness and overall feasibility for implementation.

The mobile phone industry in Bangladesh is growing rapidly, and is making a significant contribution to economic development and employment generation. Mobile phone operators in Bangladesh should invest more to raise capacity of their network or run the risk of losing unhappy clients to their rivals. Bangladesh may have lesser GDP compared to many countries but its people are willing to spend for communications due to the increasing affordability of mobile phone. The country has been impressively progressing with an increasingly connected population and the operators should now consistently invest on their networks' capacity.

Call rate of mobile phone has been reduced drastically in last couple of years. Hence ARPU has decreased recently while subscriber has been increased tremendously. As Bangladesh is a high density populated country of over 150 million people and only 44.64 million people are using mobile phones.

So there is a great opportunity for mobile operator to catch the subscriber by offering better services as per the requirement of people. Recently the demand of non-voice service is increasing with the introduction of GPRS (2.5 G), EDGE (2.7 G) in our country [6]. The use of internet is getting popular day by day as the mobile phone can be used as internet modem in personal computer.

World telecommunication market is converging towards 3G to 4G. Recently BTRC is also thinking about giving 3G license in trial basis to operators. So operators are thinking about transforming their network to 3G and going through cost benefit analysis.

1.1.1 Global Implementation history of 3G network:

The first pre-commercial 3G network was launched by NTT DoCoMo in Japan, in May of 2001 on a pre-release of W-CDMA technology. The first commercial launch of 3G was also by NTT DoCoMo in Japan on October 1, 2001. The second network to go commercially live was by SK Telecom in South Korea on the CDMA2000 1xEV-DO technology in January 2002. By May 2002 the second South Korean 3G network was launched by KTF on EV-DO and thus the Koreans were the first to see competition among 3G operators [7].

The first European pre-commercial network was at the Isle of Man by Manx Telecom, the operator owned by British Telecom, and the first commercial network in Europe was opened for business by Telenor in December 2001 with no commercial handsets and thus no paying customers. These were both on the W-CDMA technology.

The first commercial United States 3G network was by Monet, on CDMA2000 1x EV-DO technology, but this network provider later shut down operations. The second 3G network operator in the USA was Verizon in October 2003 also on CDMA2000 1x EV-DO, and this network has grown strongly since then [8].

1.2 Purpose

The purpose of this thesis is to market study 3G mobile market and finding out the cost benefit analysis of deploying 3G Network for the mobile expending minimum cost on the network equipment and maintenance. Hence high-tech equipment should be productive and cost-effective related to service quality. The future prospect of high speed data also should be account with respect to the educated people in our country. Competitive advantage and distinctive capabilities can be gained by the technology replacement with effective manner [4]. Market opportunity, threat, strength and weakness will also be analyzed.

The demand of voice services increasing with parallel to high speed non voice data. A huge amount of revenue can be earned from non-voice service. Regarding all those

issue with respect to market share, opportunity, technical strength and infrastructure the feasibility of 3G has been analyzed [9].

1.3 Methodology

Methods for approaching a problem

There are two different methodologies for approaching a problem.

A. Qualitative Methods
B. Quantitative Methods

The most important difference between them is how we use numbers and statistics. Often, one can combine quantitative and qualitative methods in the same research Below, the methods are described [10].

Quantitative and qualitative research methods

When a quantitative research method is used, data collection implies some sort of measuring in e g., experiments or surveys. By measuring, it is possible to describe or explain a phenomenon. The quantitative research method contains several phases: hypothesis formulation, investigation planning, data collection, process and analysis of data [11].

Qualitative research methods are harder to describe. The questions at issue are, in contrast to quantitative methods, constantly growing, evolving, and changing during the research. Frequently, these methods contain case studies. Many people therefore regard case studies as almost equal to qualitative methods. The condition is, however, that the case study builds upon qualitative data and qualitative data collection methods [11].

The starting-point of a qualitative research is the prejudices and the pre-understanding that the researcher has. Pre-understanding is the perception of a phenomenon that the researcher has through e.g., own experience, education, or other scholarly work. The

researcher often regards this as an "objectively" given starting-point for the research. Prejudices are also important ingredients in the research process. It is impossible to get rid of these subjective frames of reference, which are a necessary characteristic of every research project.

In my study, I have gone through both quantitative and qualitative approach. I have studied on technical roadmap and market demand of 3G network service for different operators for qualitative measurement and also gone through a questioner design and survey for market study as a quantitative judgment.

1.3.1 Data collection and sources

There are two types of sources: primary and secondary sources. While primary sources are interviews and phenomena experienced by the researcher, secondary sources include printed books, reports, articles, the internet, and other types of written material.

I have worked on the secondary data from my company, research article, journals, magazines from the internet, website of different mobile company and BTRC and also gone through a market survey to collect information for 3G market demands.

1.3.2 Source inspection and source evaluation

Source inspection consists of four phases: observation, determination of origin, interpretation, and determination of usability. During the observation phase, the researcher searches for information about the identified problem. When data is collected, the origin of each source must be determined. The vital part of this stage is to find out who the author is and whether the source is correct or incorrect. Next, an interpretation phase follows during which the researcher analyses the content. The last phase is to determine the usability of the source. An important part of this phase is to determine the credibility of the source. Source inspection also deals with criticism of the sources. The purpose of criticizing the sources is to determine whether the collected material is valid, relevant, and reliable [10].

I have tried to find as valid information as possible. For example, I have used multiple sources and crosschecked them. I have also carefully studied the origin of each source and determined whether the source is correct or incorrect. Further, I have questioned the credibility of the sources in order to prevent getting unrealistic results. In cases where I have used web-based encyclopedias, e.g., Wikipedia, or online news sites, I have analyzed the information and crosschecked it with other sources as well.

1.4 Feasible Market Demand

Feasible Market Demand may be defined as "The performance of all business activities involved in the flow of goods and service from the producer to the consumer". It is one of the most critical segments of project feasibility analysis. Through this the company assesses the opportunities and threats in the environment, and develops the strategic response that ultimately leads it to its objective. The objective of market analysis is to see how much of the goods and/or service the community is disposed to acquire and at what price. The market analysis is concerned initially with study of demand of a projects output. Market analysis covers the following aspect:

I. Definite the target market structure
II. Find out the end users and customers benefit
III Estimate market size. How big the opportunity is?
IV. Does the demand of the product or services of the project duly assessed considering all factors?

Living standards and economic growth in developing countries are invariably linked to the availability and use of telecom services. Effective policy decisions require the best estimates of the drivers of these services. In recent decades we have witnessed dramatic changes in mobile telecommunications technologies and services. This phenomenon raises wide research interests as the general availability and widespread adoption of advanced telecommunications technologies are linked to the economic potential of nations [7].

Below, there is a description of what product life cycle theory implies and how it is applied to the study.

1.5.1 The product life cycle

The *product life cycle* (PLC) is the most well known concept for predicting the succession of stages a product goes through. It takes the form of an S-shape consisting of four to five stages: introduction, growth, maturity, shakeout (sometimes included in the growth phase), and decline (see Figure 1). The model has often been applied to whole industries, instead of only one product. Even though the product life cycle has been the subject of a large amount of criticism – many industries do not follow the model and it can in fact be affected through product innovation and repositioning – it can be of use when analyzing industries [12].

Industry growth does not always go through the S-shaped pattern at all. Sometimes the industries skip maturity, going straight to the growth and decline phases. Other times industry growth revitalizes after a period of decline. The evolution of production and the consumption norms affect the product life cycle, making some products no longer suitable for some markets whereupon other products substitute them. Thus, the PLC model describes the sales history of a particular product technology consisting of one specific solution among many others for a specific group of buyers and market need. A life cycle of a product means that the economic and competitive environment differs, where upon the product's cost and profit structures vary throughout the phases. Firms should try to shorten the introductory phase, accelerate the growth phase, prolong the maturity phase, and slow down the decline phase [12]. The nature of competition shifts with the different stages. Kristensson and Gahnström have described these phases as follows:

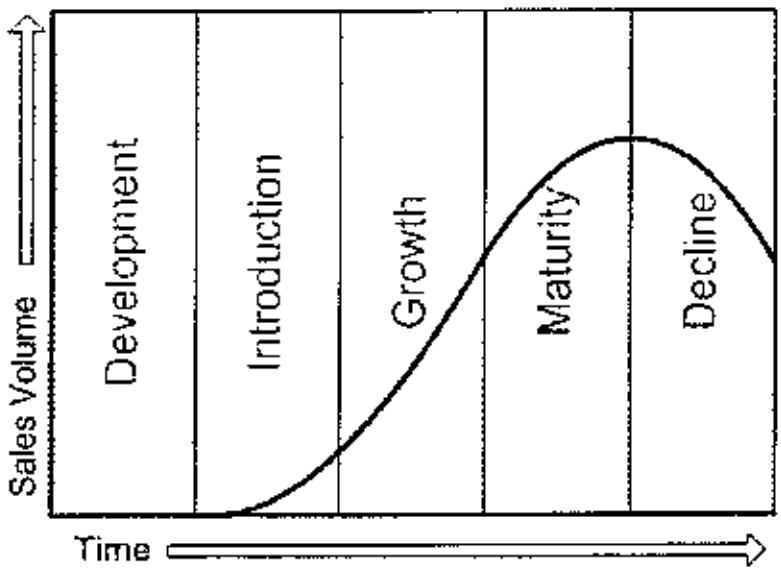


Figure 1-2: Different Stages of Products

The introductory phase: During the introductory phase, markets can be characterized by slow growth due to external environment factors. One such factor is *technology uncertainty*. The technology may not be fully developed and undergo improvements, thus restricting the producer from producing at maximum capacity. Another factor is the *distributors* who need to be familiar with the product in order to want to distribute it. It is more difficult to get an unproven product distributed than a well-known one. A third factor is *potential buyers*. It often takes a while before the consumers buy a new product. This demands that they change their consumption or production habits. There is also often a switching cost and caution towards the innovation hindering the buyers from buying the product instantly. The fourth external factor is *substitute competition*. In the introductory phase, this can be a strong factor.

The introductory phase is characterized by a high degree of uncertainty. During this period, current and potential competitors are not well known, the market is poorly defined, and the information is scattered. The length of the phase depends on the quickness of adoption by the potential buyers. Factors influencing this are e.g., degree of importance of the product's benefits, compatibility with current modes of consumption or production and other costs associated with the switching, possibility of trying the product prior to purchase, and competitive pressure. To create demand, the firm must create awareness of the product's existence, inform the market of the

benefits, persuade potential customers to try the product, and secure channels for current and future distribution.

The growth phase: During this phase, the sales numbers grow at an accelerating rate due to wider distribution, which creates larger availability of the product. Further, the entrance of competitors increases the total marketing pressure, thus generating more customers. Internally, lower production costs due to increase in the production volume characterize this phase. Prices have a tendency to fall, allowing the progressive coverage of the entire potential market. Cash flows also become positive and profits keep rising.

To be able to sustain the high growth, the firm must expand the size of the total market, not just its own portion. It must focus on maximizing the occupation rate in the market, building a strong brand image, and create brand loyalty. In this phase, the rivalry between the market players is not strong. Efforts of any firm contribute to expand the total market and therefore benefit all the market players.

The shakeout phase: This phase is transitory and can be very short. During the shakeout phase, the rate of sales growth slows down, the price decreases, and the market becomes more concentrated. Further, the total demand decelerates and the weakest competitors leave the market. To survive, firms must maximize their market share and differentiate the product guided by market segmentation. The competition becomes more aggressive and the key indicator of performance is the market share.

The maturity phase: During the maturity phase, the primary demand has slowed down and has stabilized at the growth rate of real GNP or the rhythm of demographic expansion. This is due to several factors: 1) the rates of occupation and penetration of the product in the market are very high and unlikely to increase further, 2) the coverage of the market by distribution is intensive and cannot increase further, and 3) the technology has stabilized, implying that only minor modifications to the product is

expected. The firm's most important objective is to defend, and if possible to expand, market share and to gain a sustainable competitive advantage over direct competitors. To achieve this, it can differentiate the products through quality, features or style improvements, enter new market segments or niches, or gain competitive advantage through the non-product variables in the marketing mix. The competitive climate becomes more intense, with a few powerful competitors dominating the market. Price competition is frequently occurring and affects all competitors' market shares. The product is highly profitable, but the margins decrease constantly [12]

1.5.2 The life cycle theories applied to the study

The product life cycle is applied to the GSM system in order to describe its evolution and to determine what phase it has reached. The sales of GSM include the demand for voice services and the Short Message Service (SMS). This theory serves the purpose of facilitating the market description. The demand-technology life cycle has come to use when describing the evolution of the demand for voice services through mobile communication. The systems described are NMT, followed by GSM, and finally UMTS. The development of the mobile technology has made other services than voice, such as GPRS, EDGE, and other data transmission technologies for UMTS, available. The report will also in brief cope with these. The life cycle theories have not been used as means of making forecasts of the future demand. They have merely facilitated the description of the market and the analysis of current conditions. They have also given an understanding of the dynamic market structure of the mobile telecommunications industry. and the changing strategic objectives within this industry.

1.6 Feasibility Study

A business feasibility study can be defined as a controlled process for identifying problems and opportunities, determining objectives, describing situations, defining successful outcomes and assessing the range of costs and benefits associated with several alternatives for solving problems. The business feasibility study is used to assist decision makers in determining whether or not to implement a particular project or

program. The feasibility study is conducted during the deliberation phase of the business development cycle prior to commencement of a formal business plan.

It is estimated that only one in fifth business ideas are actually commercially viable. Therefore a Business Feasibility Study is an effective way to safeguard against wastage of further investment or resource. If a project is seen to be feasible from the result of the study, the next logical step is to proceed with full business plan. The research and information uncovered in the feasibility study will support the business plan stage and reduce the research time. Hence the cost of the business plan will also be reduced. A through viability analysis provides and abundance of information that is also necessary for the business plan e g a good market analysis is necessary in order to determine the business concept's feasibility. The objectives of a feasibility are not find out if an information system project can be done and to suggest possible alternative solutions A feasibility study should provide management with enough information to decide:

1. Whether the project can be done?
2. Whether the final product will benefit its intended users?
3. What are the alternatives among which a solution can be chosen (during subsequent phases) is there a preferred alternative?

The main purpose of financial appraisal is to assess if the proposed project is viable in terms of its operation in the future years and its financial solutions. The bottom line in many projects is economic ir financial feasibility. During the early phases of the project, economic feasibility analysis amounts to little more than judging whether the possible benefits of solving the problem are worthwhile. As soon as specific requirements and solutions have been identified, the analyst can weigh the costs and benefits of each alternative.

Break-even Point - An analysis to determine the point at which revenue received equals the costs associated with receiving the revenue. Break-even analysis calculates what is known as a margin of safety, the amount that revenues exceed the break-even point. This is the amount that revenues can fall while still staying above the break-even point.

Payback Period (PP) - The Payback period is perhaps the simplest method of looking at one or more investment projects or ideas The Payback Period method focuses on recovering the cost of investments. The Payback Period represents the amount of time that it takes for a capital budgeting project to recover its initial cost.

The length of time required to recover the cost of an investment.

Calculated as.

$$\textbf{Payback Period (PP)} = \frac{\text{Annual Cash Outflows}}{\text{Annual Cash Inflows}}$$

The economic and financial feasibility of the 3G initiative can be assessed after having calculated CAPEX and OPEX expenses and having estimated some key indicators, such as BEP. PBP and IRR.

CHAPTER 02

BANGLADESH MOBILE MARKET AND HISTORY OF 3G TECHNOLOGY

2.1.1 History of mobile communication in Bangladesh

In 1989 Bangladesh Telecom Limited (BTL) was awarded a license to operate cellular, paging, and other wireless communication networks. Then in 1990 Hutchison Bangladesh Telecom Limited (HBTL) was incorporated in Bangladesh as a joint venture between BTL and Hutchison Telecommunications (Bangladesh) Limited. HBTL began commercial operation in Dhaka using the AMPS mobile technology in 1993 and became the 1st cellular operator in South Asia. Later that year Pacific Motors bought 50% of BTL. By 1996 HBTL was renamed as Pacific Bangladesh Telecom Limited (PBTL) and launched the brand name "Citycell Digital" to market its cellular products.

The idea of providing wider mobile phone access to rural areas was originally conceived by Iqbal Quadir, who is currently the founding director of the Program in Developmental Entrepreneurship at MIT.[6] He was inspired by the Grameen Bank microcredit model and envisioned a business model where a cell phone can serve as a source of income. After leaving his job as an investment banker in the United States, Quadir traveled back to Bangladesh, after meeting and successfully raising money from New York based investor and philanthropist Joshua Mailman, and worked for three years gaining support from various organizations including Nobel Peace Prize laureate Muhammad Yunus of Grameen Bank and the Norwegian telephone company, Telenor.[7] He was finally successful in forming a consortium with Telenor and Grameen Bank to establish Grameenphone. Quadir remained a shareholder of Grameenphone until 2004.Grameenphone received a license for cellular phone operation in Bangladesh from the Ministry of Posts and Telecommunications on November 28, 1996. Grameenphone started operations on March 26, 1997, the Independence Day in Bangladesh.

Telekom Malaysia International Bangladesh (TMIB) Limited is a subsidiary of Telekom Malaysia Sdn. Bhd. of Malaysia and a local company A. K. Khan & Company Ltd has minority shares in it. AKTEL launched its operations on the 15 November. 1997 in Dhaka and in 26 March, 1998 in Chittagong. AKTEL is the third largest mobile phone operator in Bangladesh with 7.36 million subscribers as of February, 2008. AKTEL boasts of the widest international roaming service in the market, connecting 315 operators across 170 countries. It is the first operator in the country to introduce GPRS to its subscribers. AKTEL uses GSM 900 MHz standard.

TeleTalk is a GSM based state-owned mobile phone company in Bangladesh. TeleTalk started operating on 29th December, 2004. It is a subsidiary of Bangladesh Telegraph and Telephone Board (BTTB), the state-owned telephone operator. TeleTalk provide GPRS internet connectivity. Teletalk is the first operator in the country that gave BTTB incoming facility to its subscribers. TeleTalk is the sixth largest mobile phone operator in Bangladesh with 1.00 million subscribers as of February, 2008

In December 2005, **Warid Telecom** International LLC obtained a 15 year GSM license to operate as the sixth mobile phone operator in Bangladesh for 50 million US dollars. Warid Bangladesh launched their operations on the 10th of May, 2007 .Warid Bangladesh has acquired a million subscribers within 70 days of launch. The company started rolling out network from mid-2006. In less than a year, amidst much speculation, Warid Bangladesh launched their commercial operation with 26 districts – the largest ever launch in terms of network coverage and BTS Stations. Unlike its operations in other countries Warid Bangladesh uses the slogan **be heard** instead of **we care.**

2.1.2 Current situation

At present, the mobile phone industry in Bangladesh is growing rapidly, and is making a significant contribution to economic development and employment generation. Now, the number of mobile subscribers increased to 42 million in 2008, from 3.85 million in 2004.

Among the six companies that are currently operating, GrameenPhone (in partnership with Telenor of Norway), which has the highest market share, more than doubled its customer base to over 19.5 million during this period. Other companies, which include Aktel, Banglalink, CityCell, and Teletalk, also experienced robust growth in terms of number of subscribers and customer revenue. The market competition structure is differentiated oligopoly.

2.1.3 Current Technology

Five operators in our country are using GSM technology and one operator CityCell are using CDMA one technology. Current GSM operators in Bangladesh can be considered upto 2.75G for EDGE by Grameenphone (2.5G for GPRS by Aktel, Banglalink, Warid).

2.1.4 Market share of Mobile Operators

The total number of Mobile Phone Subscribers has reached **44.64 million** at the end of **December, 2008**. The Mobile Phone subscribers are shown below:

Table 2-1: Status of Mobile Phone Subscribers in Bangladesh

Operators	Subscribers
Grameen Phone Ltd. (GP)	20.99
TMIB (Aktel)	8.20
Orascom Telecom Bangladesh Limited (Banglalink)	10.33
PBTL (Citycell)	1.81
Teletalk Bangladesh Ltd. (Teletalk)	0.98
Warid Telecom International L.L.C (Warid)	2.33
Total	**44.64**

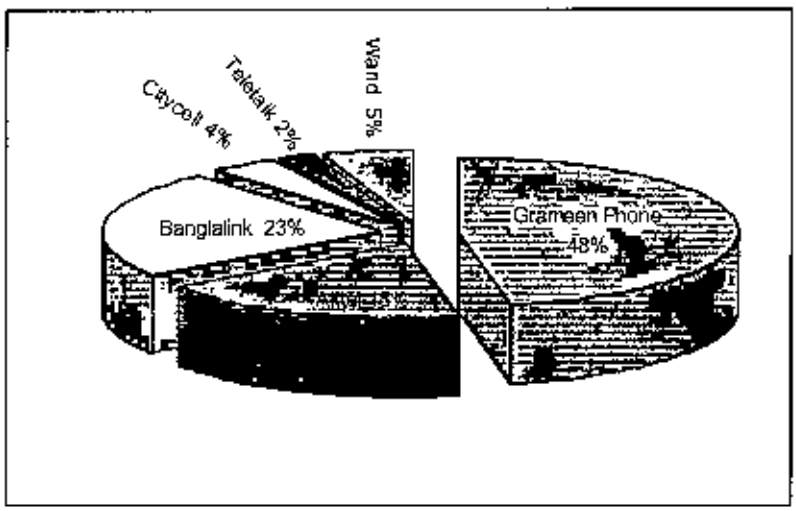


Fig. 2-1: Market Share of Mobile Phone Operators in Bangladesh

2.1.5 WiMAX and 3G introduction in Bangladesh

In a recent talk show, the chairman of BTRC (Bangladesh Telecommunication Regulatory Commission) Major General Manjurul Alam (Rtd) has said that WiMAX and 3G license will be issued in Bangladesh soon. The WiMAX license will be issued within 3/4 months and in the mean time Ericsson and Huwei will be given a trial license (for 3 months period). 3G license will be issued at the end of this year. The BTRC chairman also said that the deployment of WiMAX in Bangladesh will bring some revolutionary changes in the telecommunication sector although it will cost a high price to be deployed. The chairman also discussed on some technical advantages WiMAX and 3G will provide. The revenue from this sector has increased a lot and he expects that with the current trend the scope is further high. Mr. Manjur also mentioned that the alternate Optical Fiber Link which is due to connect us to the SEA-WE-ME 4, will introduce competition with the current link ensuring drop in the connectivity price. Thus people will be able to get bandwidth with much cheaper price and of course with higher data speed.

2.2 Mobile communication Technology

Since this thesis work's main goal is to understand how CV is created in new mobile services from the end-user's perspective only a brief explanation of the different mobile telecommunication technologies will be presented.

2.2.1 History of mobile network generations

Below are services offered with different technologies for mobile communications that have been used until today. What pricing model that has been used or used today is in use is also presented in the table.

Table 2-2: Generation of Mobile Technology

Generation	Technology	Services	Pricing model
1G	NMT	Access to network	Monthly subscription
		Voice call	Price per minute (time dependent)
2G	GSM	Access to network	Monthly subscription or included in services
		Voice call	Price per minute (time dependent)
		SMS	Unit price
		WAP (dial-up)	Price per minute (time dependent)
2.5G	GPRS,CDMA	Access to network	Free Monthly subscription
		Voice call	Price per minute (time dependent)
		SMS	Unit price
		MMS	Unit price
		WAP	Price per data amount

The first mobile communication system that builds upon low-power transmitters in a cellular based mobile network was offered commercially in the Nordic countries in 1981; however, the concept was developed in United States at Bell Labs in the early 1970s. When the service was launched in 1981 it was called the Nordic Mobile Telephone (NMT) which is also known as the first generation mobile telephone system

(1G). The NMT network is based on an analogue technology which has the advantage of long range but was considered too expensive to expand when demand increased.

When NMT became popular a new technology were introduced in order to handle the growing demand in a cost-effective way called Global System for Mobile Communication (GSM) also called the second generation mobile telephone system (2G). GSM is a digital communication system with a number of advantages, e.g. lower levels of interference, integration of transmission and switching, and increased ability to meet the capacity demands created by the market. GSM were introduced 1991 and included the possibility of sending and receiving text messages to and from mobile telephones with the Short Message Service (SMS). The first short message is believed to have been sent in December 1992 from a PC to a mobile phone on the Vodafone GSM network in the UK.

The short message service wasn't widely used until the last years of the 1990s and became a very popular service in the 2000 – 2002. According to the GSM Association the number of SMS sent globally increased from 4 billion in January 2000 to 24 billion in May 2002. GSM can also be used for data communication enabling users to access the Internet with a transfer rate of 9,6 kbps which enhanced the use of services like High Speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS) and Code Division Multiple Access (CDMA). With the ability of transferring data faster came the Multimedia Messaging Service (MMS) which allows personalized multimedia content such as images, audio, video and combinations of these. The GPRS service is often referred to as the generation of mobile telephone system between the second and the third, i.e. 2.5G.

2.2.2 Third generation mobile network – 3G

The third generation mobile network builds upon a technology called WCDMA, which is a further development of CDMA. It is a technology that is both circuit switched and based on packages, which enables the user to be connected without any interruptions and delays with high efficiency usage of the network. A package-based network will

also create opportunities for new billing strategies based on the amount of data transmitted. One other factor is that the bit rate will be higher with WCDMA that enables users to receive and send content which require a better bandwidth such as multimedia and files. Maximum bit rates for 1G, 2G and 3G networks is presented in below Table-2 in order to give the reader an opportunity of making a rough compassion. However, the reader should note that these values are theoretical maximums, which never can be reached in practice.

Table 2-3: Theoretical Transmission Speeds for 2G, 2.5G and 3G Networks

	Transmission speed
2G	
GSM	9.6 kbps
HSCSD	57.6 kbps
2.5G	
GPRS	115kbps
EDGE	384 kbps
3G	
UMTS	2.084 Mbps (in building, <10 km/h)
	384 kbps (<150 km/h)
	144 kbps (<500 km/h)

Therefore the operator's business strategies are protected as far as possible, which explains why very little information was found about the details of the structure of the new 3G market. Even through the companies are trying to disclose as much of there future strategy as possible, it is still possible to draw some conclusion.

As long as a good alternative payment method doesn't exist the operators will have the strongest position to bill the end users for new services because end-users are used to that situation. In an alternative scenario, based on the existence of a method for payments of small amounts, the content providers could bill end-user directly for consuming their content. However, this scenario tends to make it more complicated for the user since he or she still probably would have to pay the operator focusing the network as well. Since there is a great value in handling the user's payment, there are reasons to believe that attempts will be made for new methods of payment to be introduced.

2.2.3 Existence of 3G Technology

3G Technology was implemented in Japan for the first time in the world. Today the technology is serving 25 countries over more than 60 networks having its existence in Asia, Europe and USA. Video conferencing has been a major factor in the success of the technology.

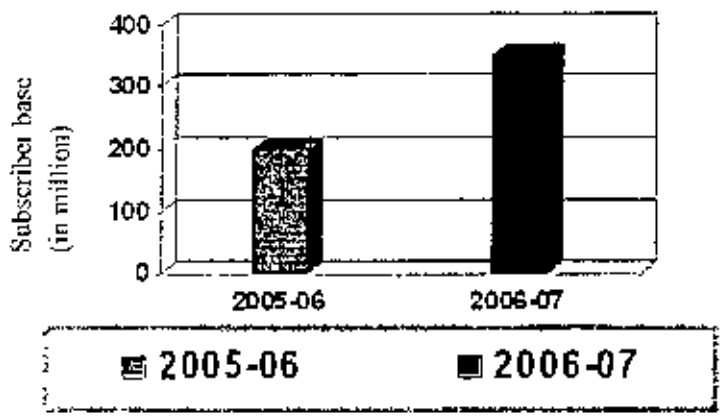


Figure 2-2: CDMA2000 3G Subscribers Base Worldwide (in million)

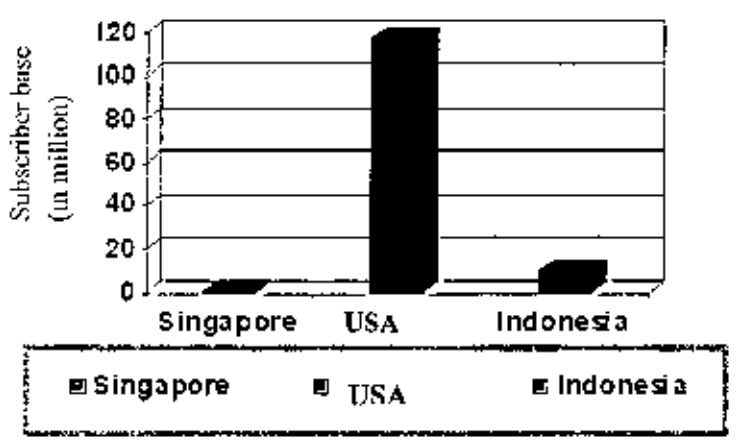


Figure 2-3: 3G Subscribers Base (In Millions)

2.2.4 3G Technology and Human Resource

Not only the media and entertainment but the business sector too has started utilizing the 3G applications worldwide. Video conferencing allows two individuals at a distance to interact in the same way as they could have done in person. The technology is being implemented at various functional level of the business such as, marketing, human resources, etc.

Mobile Interview

In today's global scenario, the 3G technology will enable organizations and qualified candidates to have a telephonic interview in a modern way through video conferencing. Traditional telephonic interview and personal interviews may be replaced by 3G voice and video conferencing. This will reduce the cost and save the time of both the organizations and the candidates.

Conferences

3G technology provides for video conferencing which can help the Human Resource Department interact with their seniors at the time of urgency without wasting other resources. This can be very much helpful when the concerned person is out of state or country.

File Transfer

With the advent of video and audio multimedia and a faster rate of downloading e-mail attachments, employees in an organization can request any urgent file or report they need to present to the clients. This will again reduce the burden on organization's resources and increase employee effectiveness.

2.2.5 Competitive advantages of 3G:

Third generation services are expected to facilitate far higher speeds and data throughputs, which facilitate the delivery of a wide range of multimedia services

including video telephony, television, etc. 3G in fact represents the true convergence of fixed and mobile telephony. Certain issues related to 3G are-

1. **Voice Facility** – 3G can deliver low cost voice call facility as it provides vast amounts of voice capacity (typically 3 times as much as 2G network) at a lower price (typically a quarter of the cost per minute). As a result operators are thinking of displacing voice from the fixed networks. By offering large bundles of minutes as part of their monthly tariff, operators could encourage subscribers to use their mobile phones instead of fixed line phones. This could be seen in America where large bundles are common place- subscribers talk on their phones for 700 minutes per month on an average. Operators must price their bundles carefully, and distinguish between peak time and off peak minutes to avoid getting caught out.

2. **Killer Application** – As such there is no killer application in 3G which reflects the realization that 3G allows operators to offer lots of new services- music downloads, low cost voice calls, wireless broadband access to laptops- the appeal of these services varies widely from one group of customers to another. Unlike traditional voice service, the application of 3G services is very much customer-segment specific. The challenge for 3G operators is to understand the appeal of different types of customers. Like in India, the 3G technology can play a dual role. In urban India there is a spectrum crunch and 3G can treble voice capacity and can solve the spectrum issue. A study by Ericsson found that almost 50% of the urban Indians are looking for services beyond voice and SMS, which could be provided by 3G. For rural India 3G will be a boon for e-governance. The best way to do this would be going for segmentation of the market

3. **Service oriented Approach**- While offering 3G services, the operators must make sure that services are easy to get to, user friendly and probably customizable. For many regions having individual portals for users to define the services they prefer would be more suitable for the non-Asian regions. In Asian regions it would be beneficial to first stress more on the voice services and then slowly move on to the services by demand. It could take the route of voice, SMS, MMS, music downloads, video and so on. Along with the services it is important to have a flexible billing system that is capable of differentiating and charging for each service correctly. The customers as such are not interested in a particular technology, what they want us service. If 3G is able to provide better and appealing services to them they would switch to it immediately.

4. **Pricing**- When 3G starts picking up, one major concerns become the pricing of these services in such a way that both profits and subscribers roll in. Experience from existing 3G operators shows a decline in revenues form price cuts. But at times the price cut could prove beneficial like in the case of 3G in Hong Kong, which reduced prices to churn away subscribers from other networks to 3 and also facilitate migration of existing 2G users to 3 and create a suitable addressable market while they go about building relevant content and applications. There could be many ways to price the 3G service which could be done according to the ease of the operators. Most Asian operators could go for the same approach as that of 3 as here the killer application is primarily voice.

   At other places, some operators might work closer with certain handset vendors to offer special offers. Operators could go for bundled or subscription based pricing for less popular services and information-based

services such as news alerts, streaming, stock alerts and per download pricing for premium content downloads. In the Asia-pacific region, bulk of the future users is expected to come from prepaid so carriers must make prepaid access easy. They must fid ways to liberate prepaid users so that they have access to a much wide variety if services and applications with the goal of encouraging traffic and usage and to increase their profits.

5. **Revenues and Costs**- Market size if the 3G technologies appear to be big enough for infrastructure suppliers to make attractive products available. A greater market volume would lead t higher volumes per supplier, translating into lower manufacturing cost per produced unit as fixed costs are shared between more units. A lower cost structure naturally opens up for lower unit prices. It is expected that the initial cost per minute voice of 3G will be high due to slow initial subscriber adoption but gradually it will come down Operators deploying 3G would get an increasing cost advantage over others.

Data service access is the main key enabler. Subscriber numbers and ARPU have been seen to increase as a consequence of new enabled data services and more advanced terminal features. Thus, this can be used to increase the revenues for 3G. International roaming is an area gaining importance with importance with increase in traveling and of household incomes and is becoming a major revenue generator. WCDMA has better roaming facility and is predicted to lead to significant revenue potential advantages in three respects:

- A WCDMA (GSM) operator competing with EVDO in the same market will offer a stronger value proposition to high-paying travel-intensive user segments boosting subscriber growth.
- WCDMA (GSM) operators will gain revenue from their own subscribers visiting other networks.
- Revenue will come from incoming roamers from other operators.

CHAPTER 03

3G MOBILE MARKET DEMAND AND COST ANALYSIS

3.1.1 Questioner design and survey for Market Study:

For the quantitative judgment I have gone through a market survey in 3 divisional cities with a questioner design that helps me to find out the market demand of 3 G in Bangladesh. As I suspect that the initial phase of demand will be at divisional area that's why the survey was conducted in divisional cities only.

Here is the sample question that was conducted among different sample population.

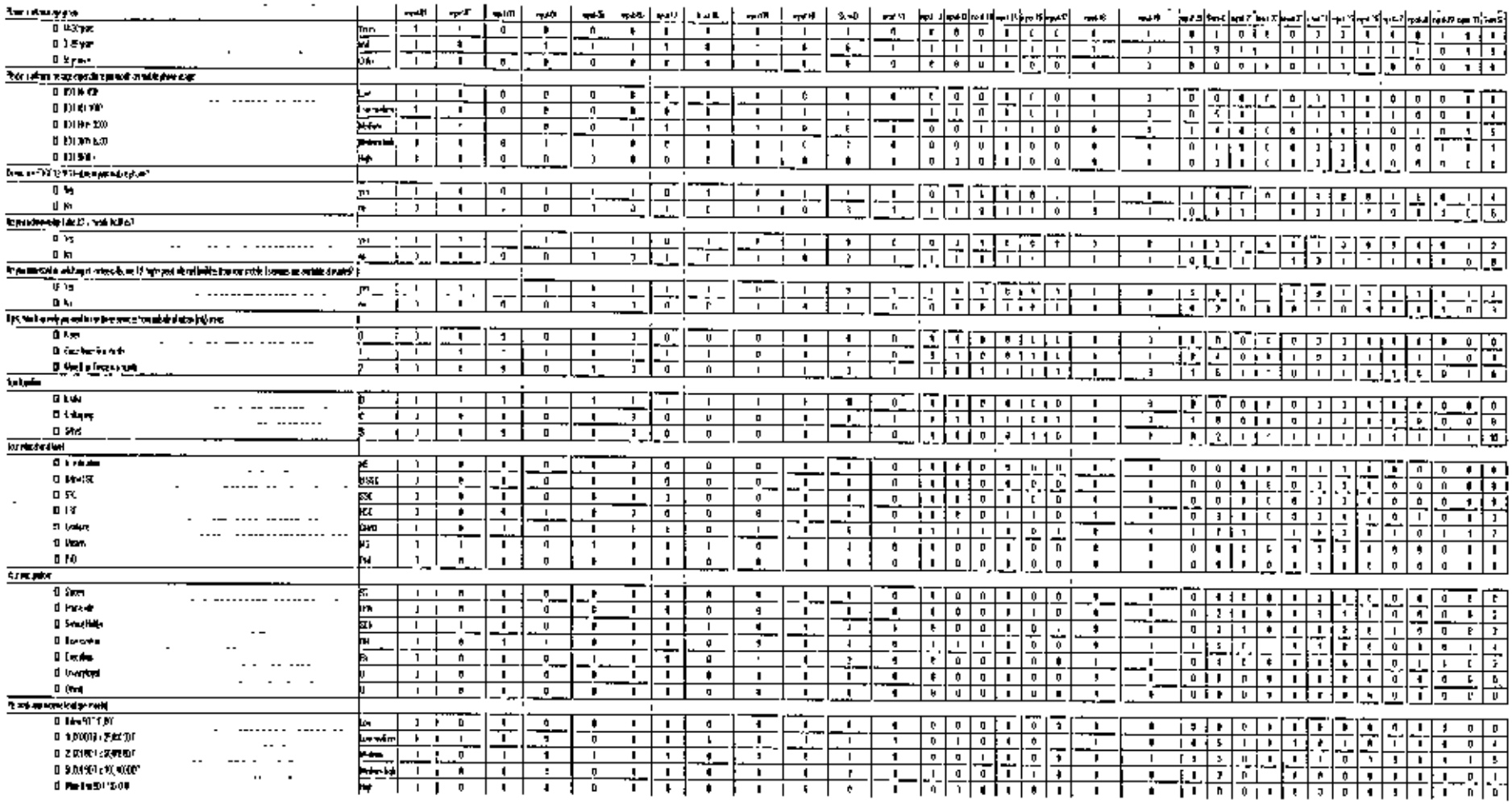
Survey Questions:

Please find the survey question format in the Appendix B.

3.1.2 Survey result and analysis:

Questioner was surveyed to three of the divisional head quarters Dhaka, Chittagong and Sylhet to analyze the 3G demand among the subscribers in those areas. The survey was conducted with a small sample size of 30 in each division and the total out put from the survey is plotted here.

Table 3-1: Survey Records (Sample 01)



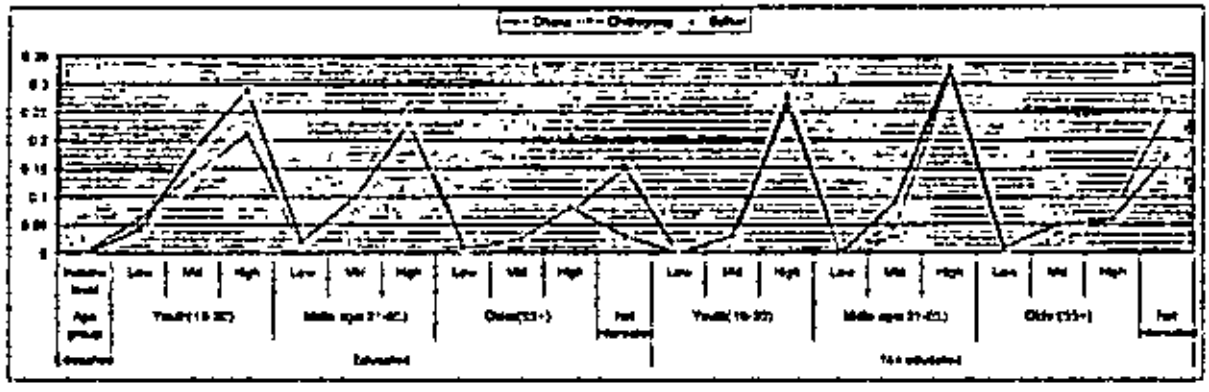


Figure 3-1: Compiled Survey Result plotted in Graph (For 3 divisions)

From the survey I conclude In Dhaka city 95.5% mobile subscriber are interested to switching into 3G network those are educated, from medium income level and from youth age group. For Chittagong the feedback is more or less similar. Where the 86% of mobile subscriber are interested to switching into 3G network those are from Educated, Low- medium income level and from youth age group. In Sylhet also it was observed the similar kind of demand from low medium income level group with 82.5%. It was also observed from the survey that there is significant demand within not educated people with high or medium high income level throughout these 3 divisional areas. Total analysis is discussed in key finding part of this study.

Here is the summary of the survey inputs.

Table 3-2: Summary of the survey

	Age group	Usage level	Occupation	Income level	Interested to switch into 3G
Dhaka	60% Y	60% mid	40% B	40%mid	95.5%
Chittagong	60% Y	50% LM	50% B	50%L-m	86%
Sylhet	60% Y	50% M	40% B	50%m	82.5%

Limitation of the survey:

Due to time limitation it was not possible for me to work with a large sample size that could give a more realistic data. In this survey I conducted the survey among 3 divisional head quarters assuming the initial demand for 3G will remain within strong economical background population. On this consideration I omitted the rural areas and other 3 divisional head quarters those are comparatively has less economical strength.

3.2 Implementation of 3G Technology

All the steps those are required to consider for implementation of 3G technology discussed below:

3.2.1 Basic requirement for implementing 3G mobile technology

Considering the technology, it is primarily the interoperability which is a major concern for the choosing between the two technologies on 3G path. A technology evolution path should be driven by the future profitability impact that the decision will have: with which technology the operator would maximize revenues and which path would require least additional investment. There primary non-technology considerations include spectrum allocations, regulatory requirements, existing 2G footprints and timing of high speed data deployment. Other considerations could be-

1. **Co-ordinated availability** – a basic pre-requisite for choosing an evolution path is the availability of appropriate spectrum, a supply of infrastructure from a sufficient mass of vendors and terminals capable of supporting the bearer. The availability of these different items needs to be well co-ordinated in time.

2. **Cost efficiency**- a preferred technology should ideally allow high degree of reuse of already made investments, it should have high future economies of scale to

minimize cost, and the evolution scenario should allow gradual investments (avoiding high up-front costs such as network capex and new handset subsidies).

3. **Service attractiveness-** intimately related to revenue potential, a preferred technology should enable an attractive service offering to the end-user. The service migration should be simple, preferably transparent, to the user. Finally, to maximize the service attractiveness, the terminal portfolio should be rich and attractive and be available at non-prohibitive prices.

3.2.2 Importance of implementing 3G technology in Bangladesh

1. **Alleviate growing capacity constraints-** As the number of subscribers and the minutes of use rise, the networks approach capacity exhaust. Spectrum is a precious and scarce resource. and there is only so much capacity that can be squeezed out of it using the existing 2G technologies. Carriers can either get new spectrum more efficiently – in both cases using a 3G technology enhances the goal.

2. **Offer QoS differentiation-** In matured markets churn is a key problem for wireless operators. To retain customers, there arises a need to offer differential quality of service. 3G technology can enhance the customer experience by improving the quality of existing offerings as capacity opens up, as well as offer new innovative services.

3. **Drive new revenues-** By offering customers a suite of new multimedia services, operators can increase revenues and profitability. As data intensive multimedia applications become popular, they will constitute an increasing proportion of end users' spending and, hence, wireless carriers revenue.

3.2.3 Worldwide 3G Market Scenario

The growing penetration of 3G (third generation) into the worldwide mobile market swelled its customer base to over 400 Million in 2006. Globally, out of all the fast growing 3G markets, Asia-Pacific is surfacing as the most promising one due to advanced 3G markets like Japan, South Korea, Hong Kong, Taiwan and Australia, says the new market research report "3G Market Outlook (2007-2010)" by the leading market research company, RNCOS. The study says that the emerging market of India and China are also expected to chip in into the burgeoning subscriber base of the region in the post-2008 era.

As per the study, in 2006, Asia-Pacific had around 50% of the global 3G subscribers. But based on its analysis of the Asia-Pacific market, the research has predicted that 3G revolution is yet to come in the Asia-Pacific region and has identified the reasons for the impending boom in the 3G market of the region. Currently, says the research, Japan and South Korea are the leading 3G markets in the region but soon, China, which is still striving to make its place on the 3G map, will emerge as the big market, thanks to its 2008 Beijing Olympics. The report discusses the technology in detail that has been used in China as 3G standard. It also outlines the various measures being undertaken by the Chinese government and telecom operators to roll out the 3G service in the country as a preparation for the mega event.

Other than China, India too will add significantly to the subscriber base of Asia-Pacific region. The country is bolstering its efforts to launch the trials of this super-fast technology, highlights the report. The report predicts that going by the pace of development, India might launch its 3G networks before China but it will take some time to reach the masses.

"3G Market Outlooks (2007-2010)" thoroughly reviews the 3G market by technology, subscribers, and countries. It examines the scenario in emerging markets of Asia-Pacific, Africa & Middle East and America and highlights the driving forces and roadblocks for

the widespread expansion of 3G globally. The research looks into the new vistas being opened up by the technology for related industries. After prudently analyzing all the factors, the report has predicted the future direction of the global 3G industry by technology, handset shipment and subscribers.

3.2.4 3G Market Outlook

"3G Market Outlook (2007-2010)" report provides extensive research and objective analysis on the 3G markets worldwide, its performance, and future prospects. This report helps the clients to analyze the key trends and developments in the worldwide 3G market.

This report also examines and provides insight into the various dimensions of the worldwide 3G industry, including market segmentation, current market size, and its forecast across segments, major players and their market shares, end user analysis, regional market analysis, key industry drivers etc. It also highlights the success factors and opportunities in worldwide 3G industry.

3.2.5 Focus and Segmentation

A marketer can rarely satisfy everyone in the market, but must segment the market. A market segment consists of a group of customers who share a similar set of wants. Through segmentation, the operators can divide the market and focus only on these target markets. For each of these segments, the operator develops a market offering, which it positions in the minds of its target buyers as delivering some central benefits.

In 3G, focus and segmentation will be of greater importance as the high bandwidths make it possible to offer a whole abundance of services. The operators must therefore decide on what markets they want to target. Competition in this area is not limited to any appreciable extent by the shared network. For example, the operator however, to target a

certain segment, specific services that require larger bandwidths or other bearers may be necessary. In that case, network sharing indirectly affects competition in the area of focus and segmentation.

3.2.6 Network Deployment from 2G to 3G

In the initial network deployment phase the operators determine the amount of radio base stations that must be deployed, as well as all other infrastructure equipments that compose a mobile network, in order to provide service coverage either in a specific geographical region or to a specific fraction of the population. The roll-out process is basically driven by the operator's strategy for covering a certain fraction of the population or a certain surface area, but it must also satisfy the minimum coverage requirements specified by the country's regulatory agency. Different deployment strategies are usually considered by greenfield3 and incumbent4 operators to overtake the substantial investment in infrastructure that is involved during this phase. The mobile market evolution gives the operators the opportunity to a large coexistence between 2G and 3G systems. Both systems may live together in the same town. Utilization of existing base station sites is important in speeding up WCDMA deployment and in sharing sites and transmission costs with the existing second generation systems. For instance, an incumbent operator may deploy a WCDMA network in the downtown area to provide high rate data services and use its existing GSM base stations to provide mainly voice service in the remaining areas. Operators migrating from 2G to 3G are able to achieve important savings in capital expenditures (CAPEX) by reusing part of the previous investment in infrastructure on their initial roll out phase. Co-siting GSM and WCDMA sites allow for major savings in site costs (e.g. license applications, location rent, site foundation, reusing antennas, feeders and transmission lines, etc). This leads to several considerable Return on Investment (ROI) benefits. Despite the coexistence advantage for incumbent operators, some extra radio base stations sites might still are required in order to cover the higher requirements on coverage, capacity and service quality imposed by 3G networks.

Another interesting strategy, especially for Greenfield operators, is network infrastructure sharing, where the subscribers of multiple operators connect to the same radio access network via, e.g., roaming based methods. Depending on how much each operator pays, they should then be guaranteed a certain capacity in the shared network. It reduces substantially the high initial capital expenditure required for the network roll out. Another advantage of network sharing is that it lowers the operating costs in the long run. Deploying a mobile network to provide service coverage is a continuous process that might take years to be completed. During this process, the amount of subscribers in the network may be very small and the volume of traffic flowing may be insignificant if compared to the available network capacity. In the next section we provide a description of some actions that can be taken to expand the capacity of WCDMA networks.

3.2.7 The process of 3G Network dimensioning

The process of WCDMA radio network dimensioning is that through which possible configurations and the amount of network equipment needed for expansion are estimated. based on the operator's requirements related to the following:

- **Coverage:**
- coverage regions;
- area type information;
- propagation conditions.

- **Capacity:**
- spectrum available;
- subscriber growth forecast;
- traffic density information.

- **Quality of Service:**

• area location probability (coverage probability);

• blocking probability;

• end-user throughput.

3.2.7.1 Trade-off between coverage and capacity

Trade-off between coverage and capacity that is inherent to any WCDMA system. Coverage is a constraint to capacity and vice versa. Capacity can be defined as the maximum carried traffic that is compliant with a given coverage constraint and coverage as the fraction of the offered traffic that can receive service with guaranteed minimum quality.

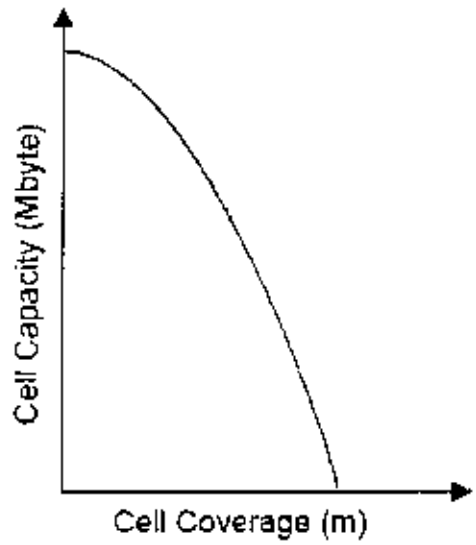


Figure 3-2: Tradeoff between Coverage and Capacity

The radio base stations in a network cover different areas. The area covered by each of these in square kilometers also varies through the geographical areas. Usually, the more

urbanized the area, the more densefied is the network, i.e., there are more RBSs/km2 in the type area. There are four type areas:

- Metropolis Area
- City Area
- Town Area
- Sparsely Populated Area

More RBSs/km2 mean that the coverage area of one RBS can be smaller without bringing coverage problems to the subscribers. The users will continue to access the services with the desired quality. The probability of coverage holes won't be increased. In a metropolis area, the network is highly densefied, the cells are small. On the other hand, in a sparsely populated area, the cells are quite big.

3.3 Cost Calculation of 3G network

3.3.1 Assumption for the distribution and calculation of Network element and Subscribers.

Some assumptions that we need to bring under consideration to calculate different costs of network elements have

3.3.1.1 Distribution of Radio Base Stations In the Type Areas

In order to simulate the networks' dynamics we have to distribute the RBSs in the geographical areas. A measure of the percentage of radio base stations per type area has been used to unevenly distribute the RBSs.

We can make an estimate of the percentage of RBSs per type area by analyzing information on coverage requirements or ambitions, RBS density and size of the surface area to be covered (square kilometers).

3.3.1.2 Cell Capacity Distribution

If we assume that all radio base stations have a default layout, 3 sectors, each with one cell, also knowing the size in square kilometers of the type area being analyzed, and the number of RBSs in this type area, it is possible to calculate an approximate cell radius. The cell radius is the reaching limit of this cell's coverage area. Having information on the cell's coverage area we can use more accurate capacity estimates. From this analysis we could reach a distribution of cell capacities through the networks. It is not assumed in this work that all the radio base stations have the same capacity, but that their capacity is constrained by their cells' coverage area and sectors' tuning.

3.3.1.3 Subscribers Distribution

Subscribers are also not evenly distributed across the type areas; their distribution follows the population distribution among the same type areas. People tend to live in urban conglomerates, and only small parts of the population live in rural areas. This distribution of subscribers will also influence the traffic distribution as our traffic forecasts are estimates per subscriber.

3.3.1.4 Traffic Distribution

Our model receives as input traffic forecasts per subscriber. However, as these are estimates for an average subscriber, when applied to the network (as a demand on the network's resources), every cell in the same type area would present similar utilization and expansion needs.

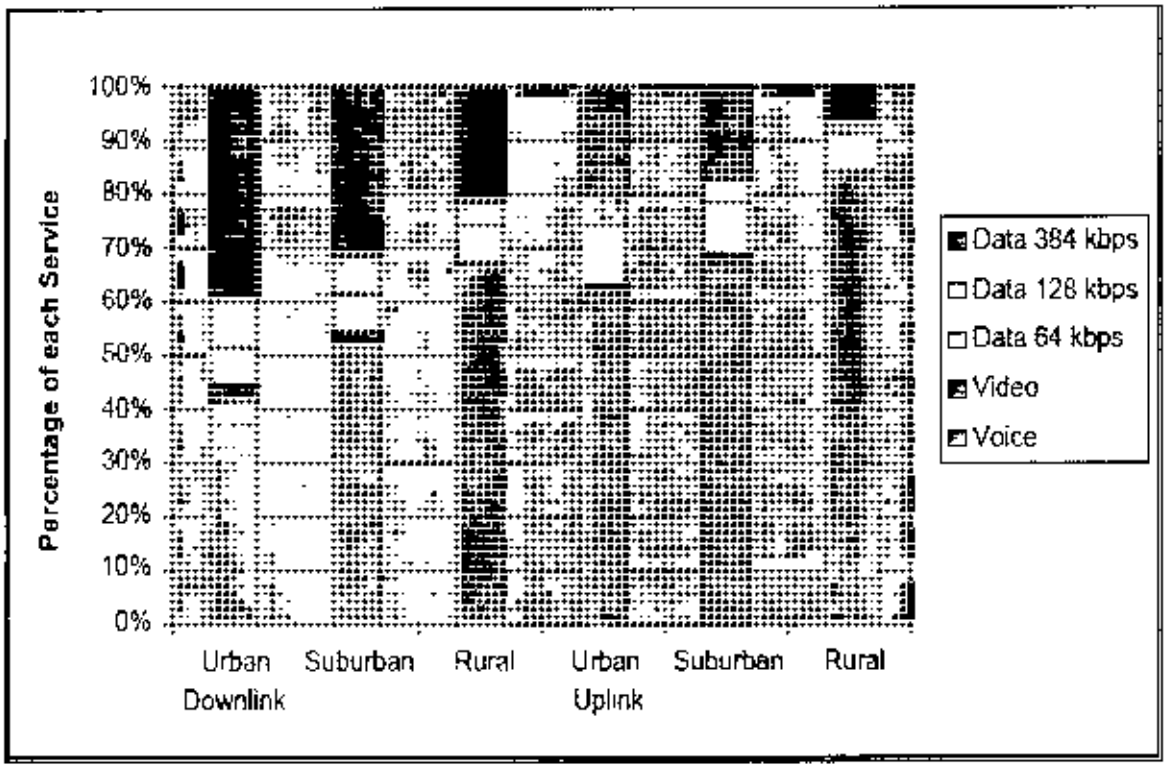


Figure 3-3: Mobile Usage Pattern in Different Area.

3.4 Return on Investment (ROI) for 3G deployment in Cell Sites

The cost of cell site consists of CAPEX (Capital Expenditure) and OPEX (Operational Expenditure).

- **Capex**
  - BTS costs (usually small part of the total)
  - Fixed links (microwave or leased lines)
  - Backhaul (Fiber, microwave, satellite or leased capacity)
  - Site acquisition and construction (roof-top or mast sites)
  - Power, air-conditioning
  - Core network and services
- **Opex**
  - Annual site rental costs

- ❑ Electric power
- ❑ Transmission
- ❑ Maintenance

3.5 Particular costs dependent on network and local factors.

For 2G site capital cost breakdown is given below for both roof top and green field site:

Table 3-3: Fixed Cost for 2G

	Roof-Top Site (BDT In Million)	Green Field Site(BDT in Million)
2G Node (3x1) carrier	5	5
Transmission Link	3	3
Site Acquisition cost	0.2	1.5
Site construction cost	0.5	0.8
Total Cost	8.7	10.3

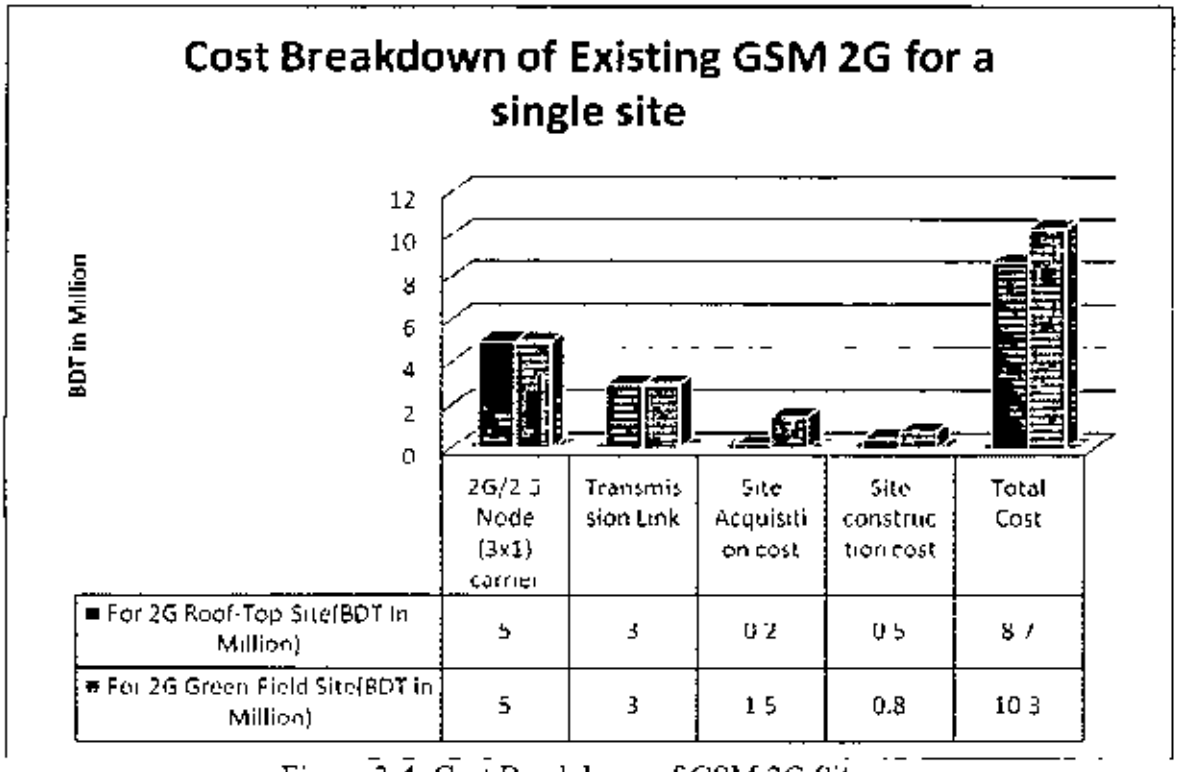


Figure 3-4: Cost Breakdown of GSM 2G Sites

For 3G site capital cost breakdown is given below for both roof top and green field site

Table3-4: Fixed Cost for 3G

	Roof-Top Site(BDT In Million)	Green Field Site(BDT in Million)
3G Node (3x1) carrier	8	8
Transmission Link	3	3
Site Acquisition cost	0.2	1.5
Site construction cost	0.5	0.8
Total Cost	11.7	13.3

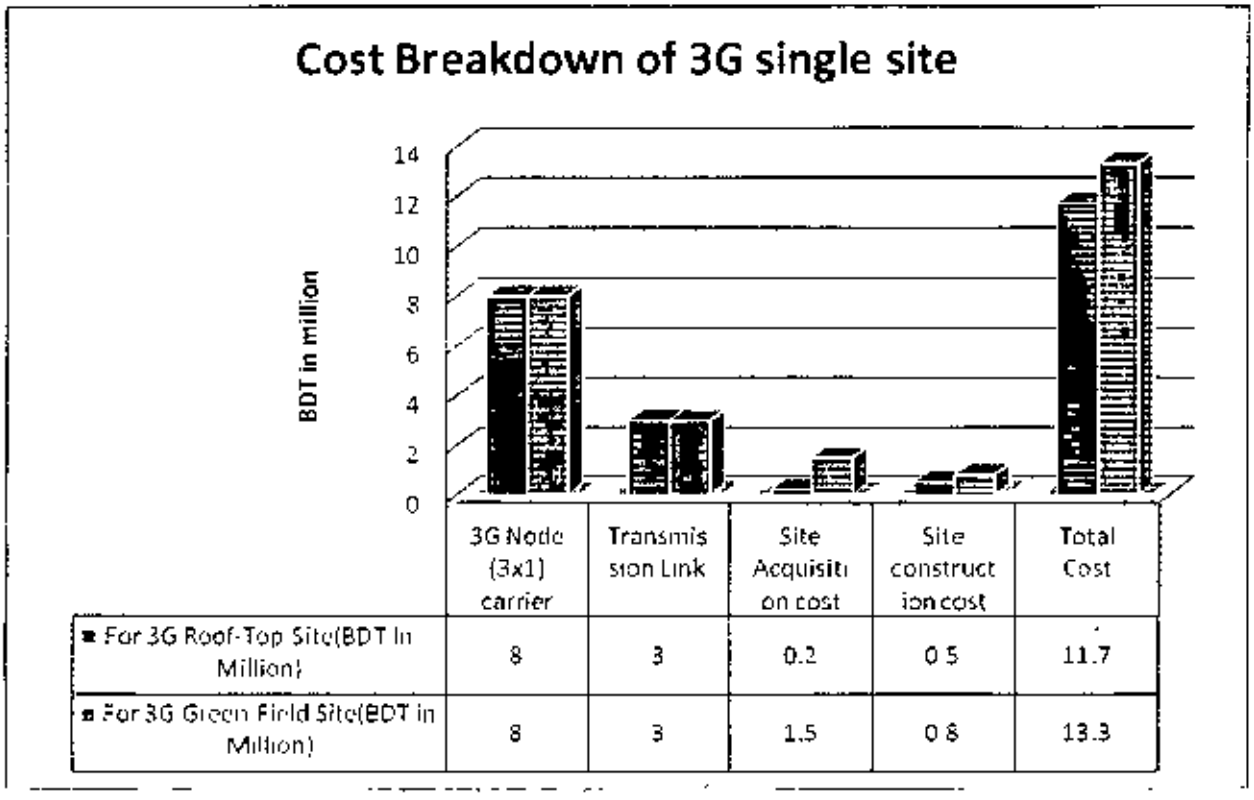


Figure 3-5: Cost Breakdown of 3G Site

Last two costs will not require for the Top most operator because the site has been established for GSM cell. Most of the place has been covered. It is just required to replace the equipment for 3G conversion.

So for 2G to 3G conversion the Extra cost needed for any Site is= (8-5) =3 Million.

From Global Service for Mobile (GSM) communication radio network, the following elements cannot be reused:

- Base station controller (BSC)
- Base transceiver station (BTS)

They can remain in the network and be used in dual network operation where 2G and 3G networks co-exist while network migration and new 3G terminals become available for use in the network.

3.6 Typical breakdown of site operating expenses

- Personnel (maintenance) =30%
- Site rental =35% - 38%
- Electricity= 8%
- Transmission= 10%
- Vendor support= 20%

3.7 Financial Analysis

3.7.1 Cash Flow Analysis

Cash flow rather than earnings is used in capital budgeting decision. Capital budgeting decision represents a long term investment decision. The capital budgeting decisions involve the planning of expenditures for a project with usually longer life. It requires extensive planning to ensure that engineering and marketing information is available, product design is completed and the capital markets are tapped for necessary funds. It is

carried out in order to evaluate key financial indicators, such as Net Present Value (NPV), Pay Back Period (PBP) and Internal Rate of Return (IRR).

Present Value

Present Value describes the process of determining what a cash flow to be received in the future is worth in today's dollars. Therefore, the Present Value of a future cash flow represents the amount of money today which, if invested at a particular interest rate, will grow to the amount of the future cash flow at that time in the future. The process of finding present values is called Discounting and the interest rate used to calculate present values is called the discount rate.

$$PV = \sum_{t=0}^{n} \frac{CF_t}{(1-r)^t}$$

Where,

PV = the Present Value of the Cash Flow System

CFt = the cash flow which occurs at the end of year t

r = the discount rate

t = the year, which ranges from zero to n and

n = the last year in which a cash flow occurs

Net Present Value

Net Present Value (NPV) is a standard method for the financial appraisal of long-term projects. Used for capital budgeting, and widely throughout economics, it measures the excess or shortfall of cash flows, in present value (PV) terms, once financing charges are met.

By definition, NPV is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of an investment or project. NPV analysis is sensitive to the reliability of future cash inflows that an investment or project will yield. Formula: Each cash inflow/outflow is discounted back to its PV. Then they are summed. Therefore

$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} - C_0$$

Where

t - the time of the cash flow

n - the total time of the project

r - the discount rate

Ct - the net cash flow (the amount of cash) at time t.

Co - the capital outlay at the beginning of the investment time (t = 0)

The Internal Rate of Return (IRR)

It is a capital budgeting metric used by firms to decide whether they should make investments. It is an indicator of the efficiency or quality of an investment, as opposed to net present value (NPV), which indicates value or magnitude. The IRR is the annualized effective compounded return rate which can be earned on the invested capital, i.e., the yield on the investment.

A project is a good investment proposition if its IRR is greater than the rate of return that could be earned by alternate investments (investing in other projects, buying bonds, even putting the money in a bank account). Thus, the IRR should be compared to any alternate costs of capital including an appropriate risk premium. In general, if the IRR is greater than the project's cost of capital, or hurdle rate, the project will add value for the company. In the context of savings and loans the IRR is also called effective interest rate.

The Internal Rate of Return (IRR) of a project is the discount rate at which the Net Present Value (NPV) of a project equals zero. The IRR decision rule specifies that all independent projects with an IRR greater than the cost of capital should be accepted. When choosing among mutually exclusive projects, the project with the highest IRR should be selected (as long as the IRR is greater than the cost of capital).

$$NPV = 0 = \sum_{t=0}^{T} \frac{CF_t}{(1+IRR)^t} = CF_0 + \frac{CF_1}{(1+IRR)^1} + \frac{CF_2}{(1+IRR)^2} + \ldots\ldots\ldots + \frac{CF_T}{(1+IRR)^T}$$

Where,

CF_t = the cash flow at time t

3.7.2 Demand Analysis

If we expect a set of data to have a linear correlation, it is not necessary for us to plot the data in order to determine the constants m (slope) and b (y-intercept) of the equation

$$y = mx + b$$

Instead, we can apply a statistical treatment known as linear regression to the data and determine these constants.

Given a set of data (x_i, y_i) with n data points, the slope "m" and y-intercept "b" can be determined using the following:

$$m = \frac{n\sum(xy) - \sum x \sum y}{n\sum(x^2) - (\sum x)^2}$$

$$b = \frac{\sum y - m\sum x}{n}$$

Linear Regression Analysis has been done for future revenue projection based on last 4 years revenue data analysis.

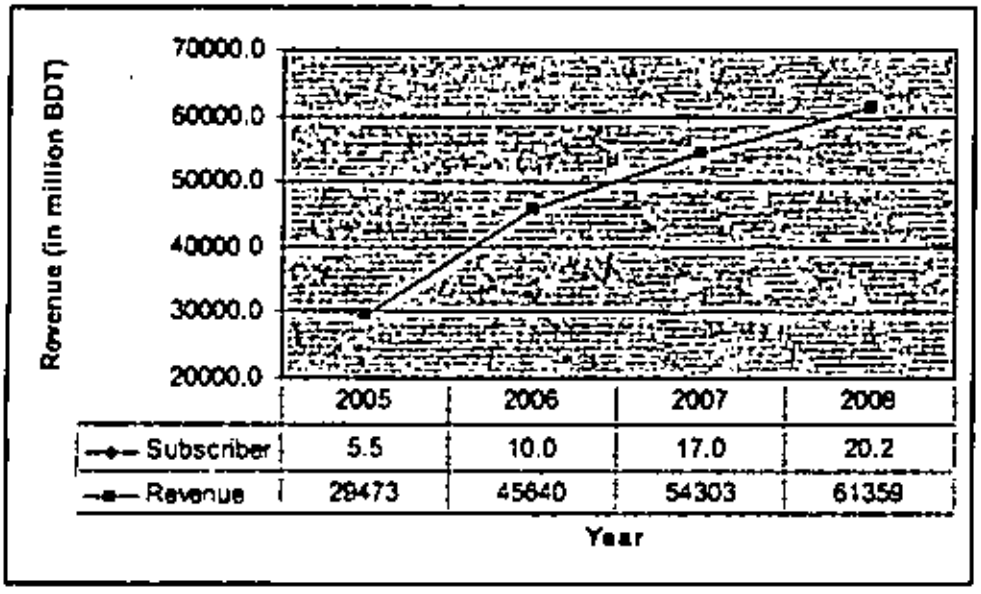


Figure 3-6: Revenue Growth in GP (Source: GP audited reports and press releases; Telenor segment reporting);

From our analysis. we have found the values of 'm' and 'b' as follows

$$m = 10.426$$

and $$b = 19.044$$

Applying these values in equation $y = mx + b$, we have got the projected revenue for the coming years.

Table 3-5: Projected Revenue and Revenue Growth

Year (x)	2009	2010	2011	2012	2013	2014	2015	2016
Projected Revenue (in mn BDT), (y)	71194	81624	92054	102484	112914	123344	133774	144204
Revenue Growth (%)	14.60%	12.70%	11.30%	10.10%	9.20%	8.40%	7.70%	_

3.7.3 Data Input and Assumptions

The definition, Cash flow (also called net cash flow) is the balance of the amounts of cash being received and paid by a business during a defined period of time, sometimes tied to a specific project.

For a mobile operator the cash inflow or earnings is revenue and the cash out flow is CAPEX and OPEX. APEX is required to build the network and OPEX is cost for network managements. To determine the CAPEX and OPEX we have to give input or have some data assumption for dimensioning the network.

Table 3-6: General Assumptions

General Assumptions	2009	2010	2011	2012	2013	2014	2015
Date of Investment	June 2009						
Operation	June 2009						
Operational length (Years)	7						
Length of calculation (Years)	7						
Length of depreciation (Years)	7						
Site status	Incase of 3G site with existing site resource						
ARPU /Yr. (Growth in 3G revenues)	14.6%, 12.7%, 11.3%, 10.1%, 9.2%. 8.4% and 7.7% increase in 3G revenues at consecutive years						

3.8 Incase of 3G site with existing site resource

Suppose we (in case of GP) want to implement 3G equipment with the existing GSM site in limited number of site (60 BTS) for test basis. According to our previous calculation additional 3 million Taka will be needed for each site and for the total 60 sites, a BSC of 90 Million Taka will be needed.

So, For 60 Sites

Total Fixed Cost = 60 x 3 + 90 = 270 Million Taka.

Monthly Variable Cost = (60x0.03) =1.8 Million.

Now we will calculate the Monthly income of from these 60 sites.

According to our present EDGE tariff (GP), we can forecast:

Average net income per minute for 3G service in one site=5 Taka (at Dhaka region)

Average net income per minute for 3G service in one site=4 Taka (at Chittagong region)

Average net income per minute for 3G service in one site=3 Taka (at Sylhet region)

For Dhaka annual income for year 2009 is BDT (20*5*60*24*365) =BDT 52.6m

For Chittagong annual income for year 2009 is BDT (20*4*60*24*365) =BDT 42.0m

For Sylhet annual income for year 2009 is BDT (20*3*60*24*365) =BDT 31.5m

Support and maintenance fee for a year is 8% of cumulative CAPEX.

Table 3-7: Financial Analysis

Financial Analysis								
Amount is shown million BDT								
	2009	2010	2011	2012	2013	2014	2015	2016
Time Scale	0	1	2	3	4	5	6	7
CAPEX								
3G equipment cost	180							
BSC for 3G	90							
Licensing fee	20							
OPEX								
Operating cost (.03m/month)		21.6	22.7	23.8	25.0	26.3	27 6	28 9
Annual Licensing Fee (5% of Acquisition fee)		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Support and Maintenance fee (8% of CAPEX)		21.6	23 3	25 2	27.2	29.4	31.7	34 3
(CAPEX+ OPEX)	290.0	44.2	47.0	50.0	53.2	56.6	60.3	64.2
REVENUE								
For Dhaka (5 Tk/Min/BTS)		52 6	60.2	67.9	75.6	83.2	90.8	98 5
For Chittagong (4 Tk/Min/BTS)		42 0	48.2	54 3	60 4	66 5	72.7	78 8
For Sylhet (3 Tk/Min/BTS)		31.5	36 1	40.7	45 3	49 9	54.5	59 1
TOTAL Revenue for 60 sites	0 0	126.1	144.6	162.9	181.3	199.6	218.0	236.3
Revenue Sharing with govt (5% of revenue)		6.3	7.2	8.1	9.1	10.0	10.9	11.8
Revenue after TAX		119.8	137 3	154.8	172.3	189.7	207.1	224.5
Cash Flow For 3G	-290.0	75 6	90 3	104 8	119 0	133 0	146.8	160.3
IRR	**30%**							
Discounting Factor @13%	1.000	0.885	0 783	0 693	0.613	0 543	0.480	0 425
Present Value- For 3G	-290.0	66.9	70.7	72.6	73.0	72.2	70 5	68.1
NPV	**204.1**							
Discounted Payback Period (PBP)	**4.1**							

GrameenPhone (mostly the mobile operators) for big investment project, the payback period is considered for 4 years. In that point of view, this financial plan is viable as we've found that for 60 sites the Payback Period we found 4.1 Years considering 13% discounting factor.

3.9 The Effect of ARPU and Subscribers on ROI

Subscriber numbers and monthly ARPU (Average Revenue per User) has direct impact on ROI and profitability. Based on benchmark data modified by local market factors:

- GDP per population, spend on similar services, current tariffs.
- Market penetration, number of competitors, estimated churn.
- Impact of other services, fixed telephone.

For most operators, peak funding requirement is key factor. Different roll-out strategies can have a large impact on capital needed but also on long term market share and profitability

CHAPTER 04

3G TECHNOLOGY SCENARIO, KEY FINDINGS AND SOME OBSERVATIONS

4.1 3G TECHNOLOGY SCENARIO AND PROBLEMS

4.1.1 Problems and Issues

- ☐ Some countries, such as the United States and Japan, have allocated spectrum differently from the ITU Recommendations, so that the spectrum bands most commonly used for UMTS (UMTS-2100) have not been available. In those countries, alternative bands are used, preventing the interoperability of existing UMTS-2100 equipment, and requiring the design and manufacture of different equipment for the use in these markets. As is the case with GSM today, this presumably will mean that standard UMTS equipment will not work in those markets, and some will work only in them, while some more-expensive equipment may be available that works in all markets. It also diminishes the economy of scale and benefit to users and network providers from the network effect that would have existed if these countries and the ITU had been able to agree on universally-applicable frequencies.
- ☐ In the early days of UMTS there were issues with rollout:
- ☐ Overweight handsets with poor battery life.
- ☐ problems with handover from UMTS to GSM, connections being dropped or handovers only possible in one direction (UMTS → GSM) with the handset only changing back to UMTS after hanging up, even if UMTS coverage returns—in most networks around the world this is no longer an issue;
- ☐ For fully fledged UMTS incorporating Video on Demand features, one base station needs to be set up every 1–1.5 km (0.62–0.93 mi). While this

is economically feasible in urban areas, it is infeasible in less populated suburban and rural areas.

4.1.2 Subscriber opportunity for 3G Service

Tele density in Bangladesh started to increase with the introduction of mobile phones a few years ago. The mobile penetration rose from 7.2% in 2005 to 18.7% in 2007. The mobile subscriber growth was double at 103.5% in 2007, primarily from the prepaid segment.

Sri Lanka became the first country in South Asia to introduce 3G when it launched W-CDMA technology in August 2006. The launch of high-speed mobile data transmission possible through 3G is expected to add more value and momentum to the non-voice segment and to the country's mobile sector.

Non-voice service revenue in Vietnam jumped at 134.0% year-on-year to 55.7% of total market revenue, while voice grew 80.5% in 2006. With SMS being the cheapest form of communication, usage is relatively high, and this trend will likely continue due to the lower income levels in the country.

4.1.3 3G as an Innovation

In the case of 3G presented here, the distinction between invention and innovation is obvious if we compare the existing specification and ideas of 3G with the non-existence of commercial and available UMTS-networks for the end-user. Still, the borders between the invention of UMTS and its forecasted precedence of an innovations, becomes blurry when we emphasize different part or level of the "product", as well as which market we emphasize. It has also become obvious that the transition from the invention of UMTS to the innovation and implementation of operational UMTS networks has become an incremental and will be an ongoing process.

The new UMTS-handsets or devices can be seen as an invention itself, as they must provide large color screens, higher bandwidth capacity, more memory and processing power, thus "new to the world". To support this, the handsets also need higher battery

capacity, potentially requiring further inventions. At the same time, they have to be compatible with the existing GSM networks, and probably only be used as ordinarily GSM-phones until a range of UMTS services is present. The new base-stations also require inventions to support UMTS, as well as the content services itself must be suited and optimized to the new handsets. In sum, UMTS implementations are not based on a single invention, but consist of a range of inventions originating from different sources, which together will make up a successful innovation. The single of these inventions will not become widespread (more than for test purposes) and have economical impact without the successful introduction of the others.

For the end-user in Bangladesh, UMTS will become an innovation when they find the services provided worthwhile using. This will of course be reflected by the service and content providers that only will be able to collect their share of the revenue when services finally are used. The network operators as licensees have already acknowledged UMTS as an (coming) innovation by significant investments in licenses, as well as with their obligations to rollout infrastructure. The auctions, and the beauty contest in the case of Norway have already have economical impact for the licensees, both when it comes to license fees and the cost of rollout where rollout has started. Accordingly the countries awarding licenses have already had significant income, and (hopefully) secured diffusion of technology by attaching rollout and diffusion obligations to the licensees. On the other hand, the rather non-existing service providers have still not invested much in development of new and value adding services.

4.1.4 3G mobile communication roadmap and Problem in Bangladesh

For the GSM companies in Bangladesh, they need to deploy a W-CDMA network at 2100 MHz to provide the 3G communication. Because it is the most common form and the existing 3G mobile phones (Nokia N-series and Sony Ericsson K800i) can only operate in this system. It is important to note that this W-CDMA 2100 will be deployed along with existing GSM 1800 network by the same operator.

Jubok Phone (Telebarta) has been given the license to use CDMA 1900 MHz frequency. The CDMA Base Transmission Centers are known to cause interference to nearby GSM Base Transmission Centers of close frequencies. For example 800 MHz CDMA BTS can cause interference in GSM 900 MHz BTS, so call drops can occur. Same is applicable for CDMA 1900 and W-CDMA 2100 networks. W-CDMA 2100 BTS can be affected by CDMA 1900 BTS. In Bangladesh, we may have problem with deploying 3G, if GSM 1800 (Grameenphone, Aktel), CDMA 1900 (Jubok Phone) and W-CDMA 2100 (3G service provider) transmission centers co-exist in same area.

So if there's problem in 3G deployment because of unplanned frequency allocation by BTRC - think about it, more CDMA 1900 BTS, more interference with 3G network and so poor 3G data transmission. Now this problem has been occurred in many countries including India and China, because of the contention between CDMA and GSM operators over the 1900 MHz band. The common solution to this problem is to use filters in BTS if we want to keep CDMA 1900 jubok phone with W-CDMA UMTS 2100 3G network. Filters have to be used in both the transmitters and the overall process will cost a lot to upgrade all the transmitters. Another solution is, as 3G is a completely different system, the existing GSM 900/1800 companies can convert to in-band W-CDMA 900/1800, rendering current mobile handsets incompatible to the upgraded network. But whatever the solution is, 3G is still a long way to achieve for GSM providers in Bangladesh. Still EDGE service, provided by GrameenPhone is sometimes considered 3G depending on data speed. But CDMA companies can easily provide 3G by upgrading to CDMA2000 1x, CDMA2000 1xEV-DO system.

So 3G is very much possible if we have need for it.

4.1.5 Mobile Data service scenario in Bangladesh

Almost all the operators are enforcing the pay-per-use model in case of browsing. The tariffs are found almost nearby for all of the operators. CityCell and GrameenPhone are offering at US$ 0.000286/KB (Kilobyte), whereas AKTEL's rate is $US 0.00022/KB. In Bangladesh all the subscribers are provisioned with GPRS /EDGE service by default

where the services are available in Network coverage area. In Bangladesh only CityCell has introduced the concept of data plan based tariff. Data services are sometimes seen as the lucrative and costly ones. So in some countries like Bangladesh it becomes very tough for the operators to invest in data service products where the percentage of data users is very less considering the entire subscriber base. So most of the South Asian countries are generally providing the basic data service (WAP Portal, Content Download etc.).

But recently the internet usage has been increased significantly in Business and Student level. People are using mobile as a modem for their Laptop/Desktop computer for the convenience of virtual internet connection all over the place. The price is also getting down with the increased number of subscriber.

In Asia there found two basic differences. South Asian countries are developing ones and rest of the Asia can be said of as developed in data service in Asian region. With the entrance of high-end handsets the trends and practices of the subscribers are changing day by day alarming the South Asian operators to concentrate on the data service. So it is the time to take the lead to make the data product brand, grab the market, educate the user and sell the service.

4.2 Some personal Observation about 3G implementation

As an Engineer in GP I am working with the telecommunication equipments, technical issues of different high tech equipment, their cost, quality, performance, maintenance and profitability. According to my opinion, 3G has a good future in our country but it depends on cost effectiveness. It is not always necessary that the high tech technology is popular than previous one. For example, Citycell in our country are using CDMA technology which is better technology than GSM. But GSM operators in our country are market leader, challenger but Citycell is market niche with very low market share. That means technology should be acceptable and cost effective. With the advent of WWW (World Wide Web) the world is available in a computer. Every information, games, news, knowledge, chat, marketing, business, infotainment, encyclopedia etc and everything is present over there which can be accessed with a click of a finger. Voice is

also passing through VOIP (Voice over Internet protocol) from country to country for international call .So internet is very essential for today. That's why speed is a big factor for data download. Everyone is mobile now. People are using Laptop and do their job by sending mail from their Laptop using their mobile as Internet Modem. In our country GrameenPhone already implement the internet in remote villages by their EDGE network. As the literacy rate in our country is increasing day by day the demand for data service also increasing. Internet becomes a new world for today's generation. So the market opportunity of 3G is very attractive. Operator in our country can implement the service after getting the license in trial basis. Market segment should be analyzed accurately to launch the service in exclusive basis in the hotpot where the data service demand is very high. According to the demand the service can be expanded to reach the valued customer. I think rather than implementing new 3G site, co-existing 3Gsite with GSM will be cost effective in our country perspective because most of the area in our country has been covered under the network coverage by the operator. Another solution of cost saving is the Civil infrastructure site sharing by different operator which will save 30-40% fixed cost.

Technology is changing rapidly; 3G has been implemented in different country before. So in the era of Globalization we have to cope with the technological challenges and should adopt the newer technology with affordable and cost effective manner.

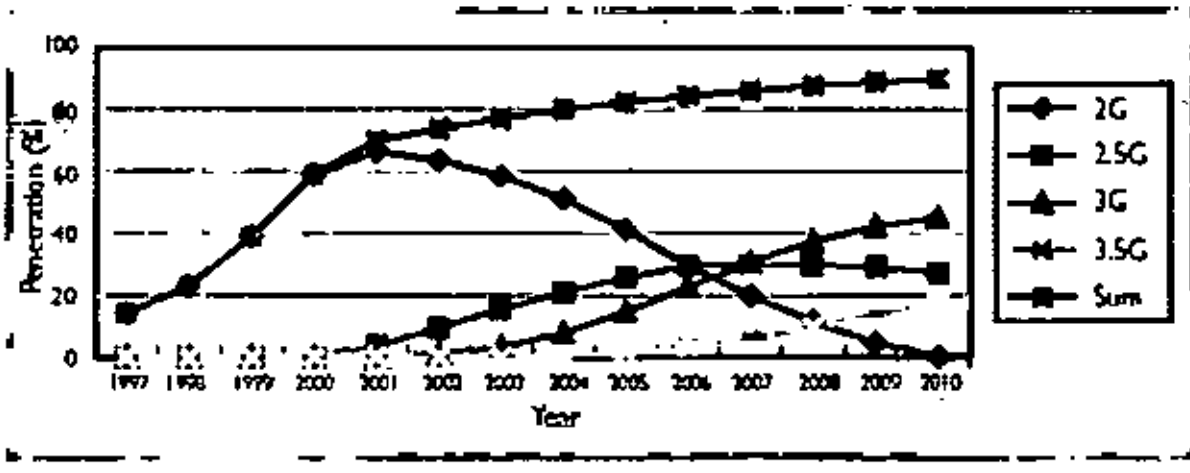


Figure 4-1: Subscriber Penetration Forecast for Different Mobile System in World [13]

Forecasts from 2002 [13] show that the subscriber penetration of 2G (2.5G excluded) will gradually decrease to reach zero in 2010 (see Figure 5-1). The figure separates between 2G and 2.5G, making it difficult to say if the operators will shut down the GSM network completely in the near future. Nevertheless, it shows that the penetration rates of GSM will decrease in favor of UMTS [13]

4.3 Key Findings

4.3.1 From the survey:

Initial stage the survey it was discovered three major factor that work as independent variable on the dependent variable ' Interested in switching into 3G network' for the subscriber. Those are Education Level, Age group and Income level. Based on our experience and social economical trained analysis, at the beginning of the survey we restricted the survey within rural area and for only the 3 major divisional head quarters. Within these 3 divisional head quarters we segmented each with Educated and illiterate peoples. Age group was segregated in 3 point linker scale like Youth. Middle age and Older. For income level also I did the same like low, Medium and high.

From the survey results it was observed that in Dhaka Divisional head quarter, 98% of the educated 2G subscribers are interested in 3G network among those majority of them from Mid/ High income group and young in age group. Also it shows a good amount of demand within illiterate 2G subscribers from the similar age group with High income level.

Table 4-1: Survey results with detail

Education	Age group	Income level	Dhaka interested to switch into 3G	Chittagong interested to switch into 3G	Sylhet interested to switch into 3G
Educated	Youth(18-30)	Low	4%	6%	3%
		Mid	18%	14%	12%
		High	29%	21%	24%
	Middle age(31-55)	Low	2%	1%	1%
		Mid	10%	7%	7%
		High	23%	26%	26%
	Older(55+)	Low	1%	1%	0%
		Mid	2%	2%	2%
		High	8%	7%	7%
	Not interested		3%	15%	18%
Not educated	Youth(18-30)	Low	0%	0%	0%
		Mid	3%	1%	1%
		High	26%	28%	31%
	Middle age(31-55)	Low	0%	0%	0%
		Mid	4%	4%	4%
		High	33%	32%	27%
	Older(55+)	Low	1%	0%	0%
		Mid	3%	3%	3%
		High	4%	7%	7%
	Not interested		26%	25%	27%

Similarly for Chittagong and Sylhet it was also observed that about 85% and 82% 2G subscribers with High medium income level are interested to choose 3G and majority of them are from young and middle age group. It is also remarkable that number of not interested to choose 3G from Chittagong and Sylhet is significantly high for the illiterate and uneducated 2G subscribers though they have good purchase power.

May be the reason behind this is "Knowledge". But it also observed in our country that, these segments of the customers are copy buyers. So there is a good chance to convert these segments into potential buyer through some promotional activities.

4.3.2 From theoretical analysis:

From the product life cycle theory we know that, each product has its different phase in its life cycle especially for the technologically developed product.
In Bangladesh the 2G market is has crossed the growth phase and now on to the transition between shakeout and maturity.
So, it is the high time to bring new technology like 3G and restrict the decline of subscriber in the challenging market.

4.3.3 From the financial analysis:

Also from the financial analysis it shows a positive business case for the mobile phone operators to build 3G network with the existing infrastructure for 2G that saves money and time. In some cases the extra investment is needed in transmission and core network elements but, after the cost benefit analysis of the study I have come to a conclusion that in most of the cases the companies will take 4 yrs to touch the breakeven point.

It is also remarkable to mention it here that, this statistical information depends on lots of factors like subscriber growth, Usage pattern, Operational expenditure, Technological cost and mostly the licensing fee and Tax imposed by the regulatory bodies.

4.4 Limitations

The exact data in every section could not be collected because of time limitation. Also the survey was conducted only in 3 major divisional head quarters with a small segment (30 in each division) of sample.

As the tariff rate in our country is rapidly changing; hence break-even point may be not always same. There may be some error in market forecasting and demand analysis because in our country market demand is very fluctuating and vary with the inflation rate in our national economy. Also license fee is a big amount but has not calculated here because it has not issued yet and very much confidential.

CHAPTER 05

CONCLUSIONS AND RECOMMENDATION

5.1 Conclusions

A large portion of Mobile subscribers in our country are very much flexible in attaining new technology and services. Also a major portion of them are very much choosy about the product and services what they are attaining and also they are price sensitive up to a certain extent. Considering the economical growth and social condition and also from the business case analysis it can be concluded like that; there is a potential demand of 3G mobile in our youth and educated segment.

From our study it has been found that implementation of 3G technology at existing GP network system is feasible as because from financial analysis IRR has been found 30%, the NPV positive and Discounted Payback Period 4.1 years (considering 13% discounting rate). Moreover, 2G is going to be absorbed by 3G all over the world and as because 2G is now at declining phase, then it will be the right time to switch into 3G technology at our network.

If we see the growth trained of developed country it seems very drastically changing and switching of the subscribers from 2.5G to 3G. Though a large portion of our people are not that much economically sound but, there are some potential segments especially in urban areas where the marketers can put their focus on.

It is important for Bangladesh Telecom operators to use the latest technology considering the high capital cost for the investment. The current trend of revenue from data services in Bangladesh suggests that 3G has a big opportunity in Value added service.

In future more data service like ticket booking, online shopping, and Live TV will be implemented. It is in very near future when we will be able to make video calls and video conferencing by using the 3G mobile network.

5.2 Recommendation

In my study, I've gone through the questioner design and survey for the individual or residential users only. But we can prepare questions and collect data for quantitative analysis for three different categories like:

i) Individual / Residential user,
ii) Small Organization User and
iii) Corporate user

The users in Home, Educational institute are considering under individual/residential user. The number of this user is high but the usage of bandwidth by them will be less. The Small Organization user are small enterprise there have the moderate number of subscribers and the usage of bandwidth is high. The corporate users the most significant users, the usage of bandwidth by them is very high.

Considering these three groups demand analysis on 3G systems, we can calculate the total market demand. And based on that we can assume that how much the market size will be for individual operators considering the present market share in Bangladesh and then we can find out the financial feasibility from this analysis as well.

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APPENDIX A GSM AND UMTS SYSTEMS

To understand how shared networks are built, it is necessary to compare them with individually owned UMTS or GSM networks. Figure 17 shows a GSM network, equipped with GPRS. This shows a typical network individually owned by an incumbent GSM operator today. The network contains two main parts: the core network and the access network. The access network consists of the Base Station Subsystem (BSS) and mobile stations (MS). The core network consists of three subsystems: the Network Subsystem (NSS), the GPRS Packet Core, and supporting nodes such as Home Location Register (HLR), Authentication Centre (AuC), and Equipment Identity Register (EIR). The core network also contains services, which fall into two groups: Value Added Services (VAS) and Intelligent Network (IN). Figure 17 also shows the interfaces between the nodes.

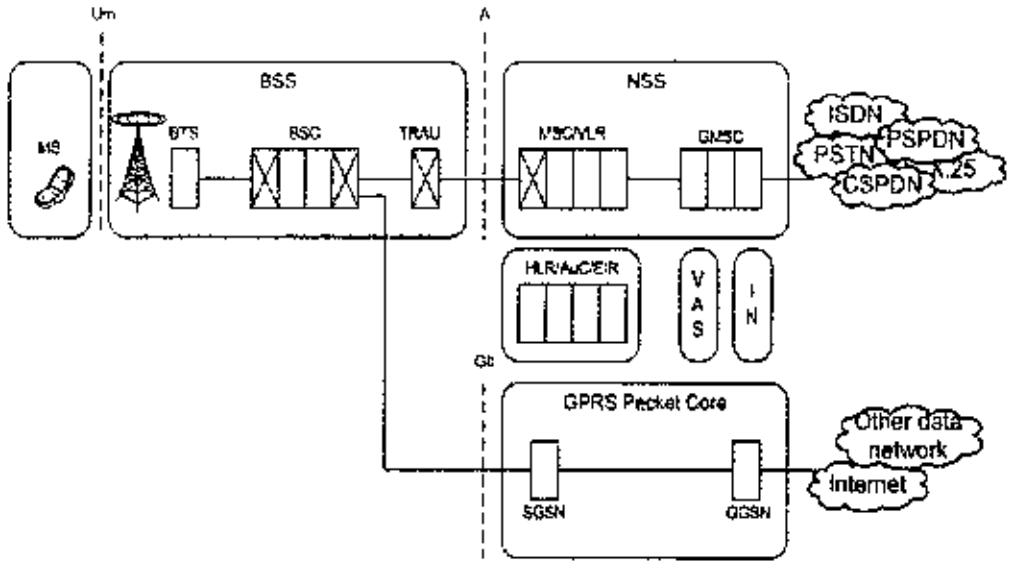

FIGURE 17: A GSM NETWORK EQUIPPED WITH GPRS (Source: Kaaranen et al. 2001, p. 20)

Mobile Station: Mobile Station (MS) is the combination of a Subscriber Identity Module (SIM) and a Mobile Equipment (ME). The SIM is the small "Smart Card" in the mobile equipment, containing information about the user's subscription. The mobile equipment is the actual handset. Without the SIM-card, it is only possible to use the mobile station for emergency calls.

Base Transceiver Station: The Base Transceiver Station (BTS) maintains the actual connection with the mobile station. It decodes and processes all messages sent to and received from the MS. Each BTS covers a certain geographical area ranging between 1 km and 35 km. The area covered by one BTS is called a cell. To avoid neighbouring cells from causing interference with each other, they use different frequencies. Frequency reuse is possible only if the cells are not adjacent. The BTS has a fixed capacity divided between subscribers in range of the BTS. Hence, the larger area it covers, the more subscribers will share its capacity. It is therefore necessary to vary the cell size to accommodate the capacity need in a given area.

Base Station Controller: The Base Station Controller (BSC) controls and supervises the BTSs in the radio network. Every BSC controls several BTSs. While the BTS takes care of the actual radio communication, the BSC is in charge of all action that is taken. The BSC tells the BTSs what to do, when to transmit, what power to use, etc. From the core network point of view, the BSC maintains the connection with the MS

Transcoding and Rate Adaptation Unit: The Transcoding and Rate Adaptation Unit (TRAU) handles speech transcoding. It can convert one speech-coding format to another coding format

Mobile services Switching Centre: BSCs are connected to a Mobile services Switching Centre (MSC). An MSC sets up, routs, and releases calls. It controls the BSS and can interconnect calls to e.g., the Public Switched Telephony Network (PSTN) via a GMSC. When a subscriber places a call, the MSC analyses the actual digits and routes the call accordingly. The MSC also handles billing data. One MSC controls a large number of BSC's, and each operator has only a few MSCs.

Visitor Location Register: Each MSC is connected to a Visitor Location Register (VLR), a database that keeps information about all the subscribers currently served by the MSC. The VLR can fetch this data either from the Home Location Register (HLR) or from the Gateway MSC (GMSC) for roaming customers

Gateway MSC: The Gateway MSC (GMSC) handles mobility management, communication management, and connections to other networks. When a call is routed to the GSM network, it first connects to the GMSC. The GMSC questions the HLR of where the MS is located, and routes the call to the appropriate MSC. Outbound calls from the GSM network are routed via the GMSC to other networks. The GMSC acts as a gateway for interfacing with external networks such as a PSTN and packet data networks

Home Location Register: The HLR is a database that contains subscriber information. It also contains routing information that the GMSC needs in order to route calls to a subscriber. Normally, each operator has only one HLR.

Other support nodes: The Authentication Centre (AuC) and the Equipment Identity Register (EIR) handle security-related information. The AuC handles authentication and encryption towards the MS. The EIR is a database that contains information about the mobile equipment, i.e., the actual hardware, in the network. Through the EIR, the operator can track e.g., stolen or unapproved equipment. In short, the AuC authenticates the user while the EIR authenticates the hardware.

Service platforms: The Value Added Service (VAS) platform provides a certain type of service in the GSM network. The minimum VAS contains typically two pieces of equipment: Short Message Services Centre (SMSC) and Voice Mail System (VMS). From the service evolution point of view, VAS is the very first step in generating revenue with services and partially tailoring them. The Intelligent Network (IN) enables more individually tailored services and makes many new services possible. For example, prepaid subscriptions are implemented with IN technology.

Serving GPRS Support Node: The Serving GPRS Support Node (SGSN) provides services similar to that of the MSC/VLR, but in the packet-switched domain.

Gateway GPRS Support Node: The Serving GPRS Support Node (SGSN) provides services similar to that of the GMSC but in the packet-switched domain

Interfaces: In short, the interfaces specify what "language" the different parts of the system should speak with each other. Interfaces are standardised to allow operators to buy different parts of the system from different manufacturers.

Figure 18 shows the same GSM network equipped with EDGE. It also shows how a UMTS network is connected to the existing nodes.

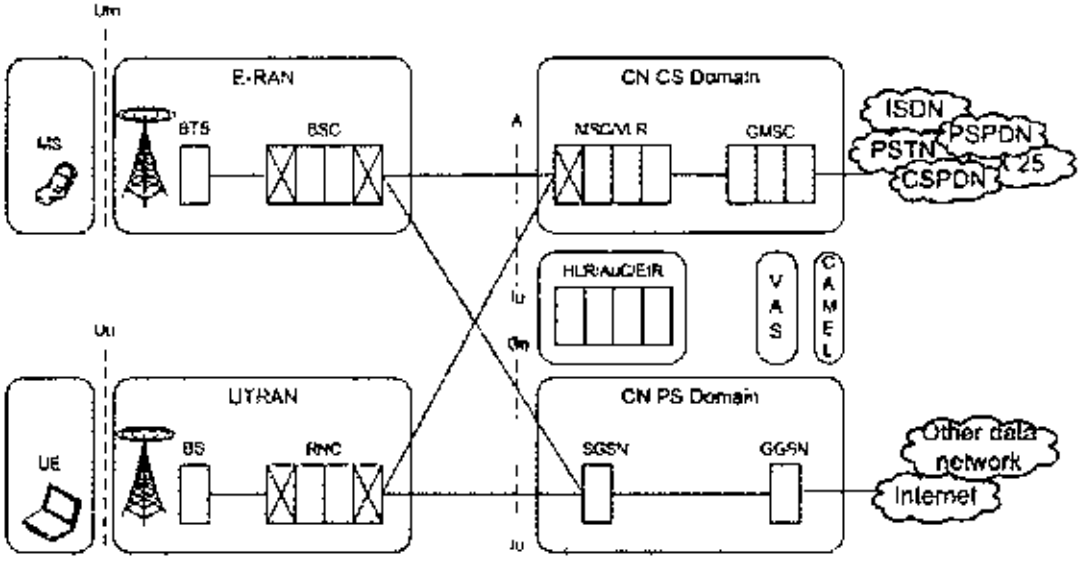

FIGURE 18: A UMTS NETWORK CONNECTED TO A GSM EDGE NETWORK (Source: Kaaranen et al., 2001, p. 21)

User Equipment: In the context of UMTS, the term User Equipment (UE) denotes terminals or mobile stations

Base station: The Base Stations (BS, also denoted Node B) have similar functionalities to the BTSs

Radio Network Controller: The Radio Network Controllers (RNC) are comparable with the BSCs in GSM. The RNCs and BSCs are interoperable, implying that seamless handover is possible between a GSM and a UMTS network. A new radio access method, Wideband Code Division Multiple Access (WCDMA) is also introduced in UMTS.

EDGE RAN: The BSS in GSM networks equipped with EDGE is denoted EDGE RAN (E-RAN)

UMTS Terrestrial RAN: The corresponding term for the radio access network in UMTS is UMTS Terrestrial RAN (UTRAN)

Service platforms: In the early releases of the UMTS specifications, the core network was similar to a GSM network with a packet-switched domain. However, the IN features have evolved into Customised Applications for Mobile network Enhanced Logic (CAMEL). CAMEL makes it possible to transfer service information between different UMTS networks. This implies that subscribers can use their services when they are roaming in other networks.

Core network: In the figure, the NSS is denoted Core Network Circuit-Switched Domain (CN CS Domain). The GPRS Packet Core is denoted Core Network Packet-Switched Domain (CN PS Domain).

APPENDIX-B

Survey Questions:

A brief introduction about 3 G mobile systems:

3G technologies enable network operators to offer users a wider range of more advanced services like:-

- ✓ Video calls and Video Conversation.
- ✓ Live TV at Mobile Hand set.
- ✓ Wide-area wireless.
- ✓ Audio Video Conferencing.
- ✓ Fax Service from mobile set.
- ✓ Broadband wireless.
- ✓ High speed internet form mobile hand set.

Please mark your age group:

- ☐ 18-30 years
- ☐ 31-55 years
- ☐ 55 years +

Please mark your average expenditure per month on mobile phone usage:

- ☐ BDT 10- 400
- ☐ BDT 401-1000
- ☐ BDT 1001- 3000
- ☐ BDT 3001 -5000
- ☐ BDT 5000 +

Do you use EDGE/ GPRS feature in your mobile phone?

- ☐ Yes
- ☐ No

Are you acknowledged about 3G mobile facilities?

- ☐ Yes
- ☐ No

Are you interested in switching into video calls, live TV, high speed internet facilities from your mobile if services are available at market?

- ☐ Yes
- ☐ No

If yes, how frequently you want to use these services from outside of urban (city) areas:

- ☐ Never
- ☐ Once /twice in a month
- ☐ More than Twice in a month

Your location.

- ☐ Dhaka
- ☐ Chittagong
- ☐ Sylhet

Your educational level:

- ☐ No education
- ☐ Below SSC
- ☐ SSC
- ☐ HSC
- ☐ Graduate
- ☐ Masters
- ☐ PhD

Your occupation:

- ☐ Student
- ☐ House wife
- ☐ Service Holder
- ☐ Businessman
- ☐ Executives
- ☐ Un-employed
- ☐ Others

Pls mark your income level (per month):

- ☐ Below BDT 10,000
- ☐ 10,000 BTD to 25.000 BDT
- ☐ 25,001 BDT to 50.000 BDT
- ☐ 50,001 BDT to 100, 000 BDT
- ☐ More than BDT 100, 000

APPENDIX C: LIST OF ACRONYMS WITH DEFINITIONS

1G	*First generation mobile telecommunications technology*. The first analogue standards for mobile communication. The two most wide-spread systems are NMT, used in Europe, and AMPS, used in the United States.
2G	*Second generation mobile telecommunications technology*. Umbrella term for the digital successors of 1G. The most widely used 2G standard is GSM.
2.5G	*Second and a half generation mobile telecommunications technology*. 2.5G is a stepping-stone between 2G and 3G, and is often placed on par with GPRS.
2.75G	2.75G is the term used for systems that do not meet the 3G requirements, but are marketed as if they do, or vice versa. The term is often placed on par with EDGE.
3G	*Third generation mobile telecommunications technology*. Services associated with 3G offer the possibility to transfer voice and data on high transmission rates. Operators that use GSM generally prefer the UMTS standard (based on WCDMA) for their 3G networks. UMTS is therefore concentrated to Europe.
BSS	*Base Station Subsystem*. The BSS is the section of a GSM network, which is responsible for transmitting to and receiving radio signals from the mobile phone.
CAPEX	*Capital expenditure*. An operator's CAPEX mainly consists of investments in the infrastructure.
CAMEL	*Customised Applications for Mobile network Enhanced Logic*. CAMEL makes it possible to transfer service information between different UMTS networks, implying that subscribers can use their services while roaming in other networks.
CN	*Core Network*. The CN consists of all network elements needed for switching and subscriber control.
EDGE	*Enhanced Data rates for GSM Evolution*. EDGE is a technology that enhances data rates for 2G or 2.5G networks.
GGSN	*Gateway GPRS Support Node*. The GGSN maintains the connections towards other packet-switched networks such as the internet.
GMSC	*Gateway MSC*. The GMSC is the switch at the point where the UMTS network is connected to external circuit-switched (CS) networks. All incoming and outgoing CS connections are routed through the GMSC.
GSM	*Global System for Mobile communications* (originally *Groupe Spéciale Mobile*). The most common 2G standard, used mostly in Europe.
GPRS	*General Packet Radio Service*. GPRS allows packet-switched services such as internet access, with lower resource usage than in circuit-switched connections.
HLR	*Home Location Register*. The HLR is a database that contains subscriber information.
IEEE	*Institute of Electrical and Electronics Engineers*. IEEE is an international non-profit, professional organization for the advancement of technology related to electricity.
IP	*Internet Protocol*. A data-oriented routing protocol used on the internet.

MSC	*Mobile services Switching Centre*. The MSC controls the BSSs and interconnects calls to e.g., PSTN
MVNO	*Mobile Virtual Network Operator*. MVNOs are operators that do not own any telecommunication license. They work as resellers, buying capacity from a network operator and reselling it to end-customers.
NDC	*National Destination Code*. The NDC consists of 1-3 digits specifying the destination within a given region. A telephone or fax number consists of a country code, an NDC, and a subscriber number.
NMT	*Nordic Mobile Telephony*. A first generation mobile telecommunications network, used mainly in the Nordic countries.
OPEX	*Operational expenditure*. For an operator the OPEX mainly consists of costs of service, sales and marketing, administration, and depreciation.
PLMN	*Public Land Mobile Network*. The mobile network, containing MSC service areas.
PSTN	*Public Switched Telephone Network*. PSTN is a term for fixed telephony networks
QoS	*Quality of Service*.
RAN	*Radio Access Network*. RAN is the subsystem controlling the wideband radio access. In UMTS, the RAN is also denoted UTRAN
RNC	*Radio Network Controller*. An RNC is an entity in UMTS networks, which controls the base stations
SGSN	*Serving GPRS Support Node*. SGSN is an element providing services similar to that of the MSC/VLR in the packet-switched domain.
SMS	*Short Message Service*. A service allowing the subscribers to send short text messages between mobile phones
UMTS	*Universal Mobile Telecommunications System*. A European telecommunications standard fulfilling the requirements of an IMT-2000 3G system.
UTRAN	*UMTS Terrestrial RAN*. UTRAN is the radio access network in UMTS. Its main task is to create and maintain Radio Access Bearers for communication between the UE and the CN.
VAS	*Value Added Services*
VPN	*Virtual Private Network*. A private communications network usually used within a company.
WAP	*Wireless Application Protocol*. WAP is an open international standard for applications that use wireless communication
WLAN	*Wireless Local Area Network*. WLAN is an umbrella term for a number of unlicensed wireless access technologies. It provides high capacity over a small area, typically less than a radius of 40 metres from an access point.
WCDMA	*Wideband Code Division Multiple Access*. A technology for wideband digital radio communications of internet, multimedia, video, and other capacity-demanding applications