

Comparative Study of ICX Business with Prosperity and Significance in Bangladesh

K. M. Salah Uddin Shoyeb Haider

Associate Professor, Department of Management Information Systems, Faculty of Business Studies, University of Dhaka, Dhaka-1000, Bangladesh

Abstract

The objective of this paper is to focus on the comparative discussion of ICX (Interconnection Exchange) business in with prosperity and significance in Bangladesh. ICX is a step towards creation of a modern and efficient telecommunications infrastructure. With the introduction of ICX, operators can combine their services in the most flexible way. Telecommunication sector is one of the most growing fields of business in Bangladesh. Government is earning a lot from this sector. Before introducing ICX government could not able to trace the exact number of calls and generated minutes, as well as they were in lack of exact revenue from those operators. After that, when Government introduced license to ICX operators, the scenario has been changed and single point of connectivity was established. As a result, interconnection capacity and the quality of voice call both have been developed. Government became capable of having accurate amount interconnections calls and minutes. Now days ICX operators are capable to handle voice calls using 2G and 3G technology. ICX operators are also connected to all the IGW (International gateway) operators to connect international calls with nationwide telecommunication operators. ICX operators share their revenue with Government according to rules and regulations imposed by the Government. As a result, Government is earning a significant amount of money from ICX operators. The KPI of Seven different ICX operators are also discussed in the study and all the values of those indicators were found in satisfactory level which means ICX operators can fulfill the required performance needed to cope up with the ANS and IGW operators. So, ICX business is proving as a very prospectus business in Bangladesh for the operators as well as for the Government as ICX operators are going to implement SMS interconnectivity throughout the nation.

Keywords: ICX business, telecommunication, revenue, prosperity, connectivity.

1. Introduction

Until 2008, Government owned BTCL (former BTTB) was by far the largest domestic fixed-line public telephony provider and exercised monopoly power in respect of both providing interconnection to other operators and international gateway services. BTTB was unable to meet expansion requests and even in case of capacity enhancement waiting times were relatively long. Moreover, the fixed telephone lines that got installed were predominantly in Bangladesh's four main cities while around 70% of the populations live in rural areas. The interconnection regime till 2008 was based on bi-lateral connectivity. Each operator was to get connected to each operator. According to a report of CRAI & GT (2007) Bangladesh had a highly unusual interconnection regime in which the mobile sector subsidized the fixed sector. And then in 2008 Government imposed 2 ICX License for interconnection among all the operators of Bangladesh like PSTN, Mobile, Fixed line. ICX was introduced with a view to reduce the complexity of Interconnection Network throughout the country among domestic and international carrier which simplified the telecom network architecture in Bangladesh. ICX also helped to increase the capacity of handling calls in all five telecommunication zone in the country. Government has also get better monitoring facilities over voice calls which results more revenue from the sector.

This scenario help government to earn maximum income from the inter operator calls. Due to huge amount of voice calls throughout the country it became so difficult for these Two ICX operator to handle so many calls. In 2012 BTRC awarded licenses to Twenty-One more ICX operators. The total number of ICX now is Twenty-Six. The incentives both from government and public sectors have helped the industry grow and it is now one of the biggest industries in Bangladesh.

In this study, the significance of ICX was described with its operation in the telecom sector and financial contribution to government. A comparison of year by year domestic and international calls through ICX is shown later in the study to indicate the growth of telecom business in Bangladesh. Based on total calls going through ICX a revenue is also calculated for ICX operators and revenue is also analyzed to show the affordability of ICX operators who are new entrants in the telecom industry. The CAPEX and OPEX also discussed based on one operator. Also performance of some ICX operators is discussed to in the study to show that they are capable of fulfilling the demanded performance to stay up with the ANS in the industry.

1.2 Rationale of the Study

Telecom market has brought significant value to customers and markets. The open market contributed to improve the quality of service, price reduction and introduction of competition among service providers. An

operator can no longer prosper simply by offering basic telephone services. Operators are growing very fast and expanding into all types of telephone services – Fixed, Mobile, Long Distance (National & International) and also into convergent networks. The geographical spread is also increasing at a fast pace. Operators worldwide are realizing the need for fixed-mobile, voice-data and carrier-enterprise convergence.

But, behind this bright scene, a complexity is also developing, which has not been addressed with a long-term perspective at its inception. These developments could lead to a complex situation resulting in monopolistic behavior by a market leader or incumbent operators, or an increase in the cost of interconnecting networks in a multi-operator and multi-service scenario. Thus, Interconnection has become one of the most important areas which may emerge as a problem with the increase in number of operators with open market conditions. With the introduction of ICX, operators can combine their services in the most flexible way. This concept refers to an arrangement which provides interconnection among the existing/future telecommunication network of the operators and allows monitoring, lawful Interception (LI) facilities and roaming number portability.

1.3 objectives

The main objective of the study is to explore The Significance and Prosperity of ICX Business in Bangladesh. To identify the affordability of the set-up cost of new technologies required for ICX business in Bangladesh.

To discuss the CAPEX and OPEX to set up an ICX operator.

Analysis of the performance of different ICX operators.

1.4 Methodology

Primary sources of data

Interview with the Core, Transmission department for technical data of implementation of ICX.

Data collected from Accounts department for the CAPEX and OPEX of organization.

Data collected from NOC (Network Operation Center) team of 7 ICX operators to evaluate the performance analysis.

Secondary sources of data

BTRC (Bangladesh Telecommunication Regulatory Commission)

Un- published data

Internet

The scope of the study is to find out the prospect of ICX business in Bangladesh by analyzing the existing set up of this business along with the prospect in future. For the purpose of the study, Gazi Networks Limited, an ICX Operator in Bangladesh was selected

1.4.1 Data Processing and Analysis techniques

Descriptive Analysis was done to explore the prospects of ICX business in Bangladesh. Minute generation over the years and revenue generated by Government over the years were chosen as variables and both are independent variables. CAPEX & OPEX was taken to find the affordability of the organization and KPI data was collected from 7 ICX operators to analyze the performance of ICX operators to evaluate the reliability of ICX operators in the telecom sector.

The collected data were compiled, coded tabulated and analyzed in accordance with the objectives of the study. Qualitative data were quantified by means of suitable scoring techniques. Tables and graphs were also used in presenting data for clarity of understanding.

1.5 Terms and Abbreviations

ANS - Access Network Service

BPO - Business Process Outsourcing

BTCL- Bangladesh Telecommunications company Limited

BTRC - Bangladesh Telecommunication Regulatory Commission

BTTB - Bangladesh Telegraph & Telephone Board.

CDR - Call Detail Records

ICX - Interconnection Exchange

IBS- Interconnection Billing System

ILDTS - International Long-Distance Telecommunication Services.

IP - Internet Protocol.

IPLC - International Private Leased Circuit

IPO - Initial Public Offer.

ISP - Internet Service Provider

IGW - International Gateways.

IX - Internet Exchange.

LI - Lawful Interception

NGN - Next Generation Network
POP - Point of Presence
PTT-Push-to-talk
PLMN - Public Land Mobile Network
PSTN - Public Switched Telephone Network
QoS - Quality of Service
VoIP - Voice over Internet Protocol
VSAT - Very Small Aperture Terminal
CAPEX - Capital Expense
OPEX - Operational Expense
MNP- Mobile Number Portability
SMS- Short Message Service

2. Literature review

Samuel Morse (1844) sent his first public message over a telegraph line between the U.S. cities of Washington, D.C. and Baltimore, on 24 May 1844 and through that simple act, steered in the telecommunication age. Telegraphy was available as a service to the general public after 10 years of this incident. In those days, each country used a different system, messages had to be transcribed, translated and handed over at frontiers, then re-transmitted over the telegraph network of the neighboring country. As a result, telegraph lines did not cross-national borders. Because of the slow and cumbersome nature of this system, many countries eventually decided to establish arrangements which would facilitate interconnection of their national networks. However, such arrangements were managed by each country at a national level; setting up telegraph links often required a huge number of separate agreements. In the case of Prussia, for example, no less than fifteen agreements were required for the link between the capital and the frontier localities bordering other German State. To simplify matters, countries began to develop bilateral or regional agreements, so that by 1864 there were several regional conventions in place (ITU, 2009).

The continuing rapid expansion of telegraph networks in a growing number of countries finally prompted 20 European States to meet to develop a framework agreement covering international interconnection. At the same time, the group decided on common rules to standardize equipment and facilitate international interconnection, adopted uniform operating instructions that would apply to all countries, and laid down common international tariff and accounting rules. On 17 May 1865, after two and a half months of difficult negotiation, the first International Telegraph Convention was signed in Paris by the 20 founding members, and the International Telegraph Union (ITU) was established to facilitate subsequent amendments to this initial agreement (ITU, 2009). Interconnection of telegraphy was the basis of today's interconnection. And Interconnection came with the Technology, the Business Case and the (inevitable) Regulation as well as the beginning of ITU. According to International Telecommunication Union (ITU), many countries placed interconnection related matters as the most essential problem in the progress of a competitive marketplace for telecommunication services (Intven & Mccarthy, 2000).

The telecommunication networks in the present Multi-Operator Multi-Service Scenario are becoming very complex. Operators are growing very fast and expanding into all types of telephony – fixed, mobile, Long Distance (National & International) and also into convergent networks (Laffont, J.J., and Tirole, J., 1996). The Geographical spread is also increasing at a fast pace. Operators worldwide are realizing the need for fixed-mobile, voice-data and carrier-enterprise convergence. Only by doing so can they enable users to combine their services in the most flexible way possible. No longer can an operator prosper simply by offering basic telephone services. End users are looking at the added value being offered by the operator. The opening of telecom scenario has brought a lot of value to the customers. The quality of service is improving, prices are coming down and competitive operators are offering many new services and value additions to their respective existing services. Behind this bright scene, a complexity is also developing, which if not tackled with long term perspective at the very beginning, could lead to a complex situation resulting in an increase in the cost of interconnecting network for multi operator multi-service scenario. Incumbent's Network generally in all developing countries does not have adequate interconnection facilities for new entrants. As a result, investments made by new entrants are required to wait for the availability of interconnect facilities (Rakesh Kumar Bhatnagar, 2004). Interconnection among telecommunication networks of operators is provided by the Interconnection Exchange (ICX) (known as switching system) and monitoring, lawful interception (LI) facilities are also allowed by it (ILDTS Policy, 2010). Jamison, Mark A. (1998) described about interconnection addressing, access and as well as advantages and disadvantages. Jamison also pointed there two important matters through which cross-subsidies can be related with interconnection and competition. Those two issues are how to fund universal service obligations and price flexibility.

Beginning in the 1970s, customers began to interconnect a growing range of terminal equipment and private

network facilities to the incumbent operator's facilities. With the liberalization of telecommunications markets over the last few decades, effective interconnection arrangements have become key to the operations of an increasingly wide range of services. These services include local, long distance and international fixed, mobile and satellite services, providing everything from basic voice telephony to high speed Internet connectivity to Internet multimedia services. Competition is the key to the growth and innovation of today's telecommunications markets. Interconnection is a critical factor for the viability of competition. For most of the history of telecommunications, operators and government administrations negotiated with each other to set the terms of interconnection without regulatory intervention. The emergence of competition has changed this. Incumbent operators have little incentive to make things easy for their new competitors, and most of the bargaining power in negotiations lies with the incumbents. (Hank Intven, 2000)

The liberalization of Bangladesh's telecommunication sector began with small steps in 1989 with the issuance of a license to a private operator for the provision of inter alia cellular mobile services to compete with Bangladesh Telegraph and Telephone Board (BTTB), the previous monopoly provider of telecommunications services within Bangladesh. Significant changes in the number of fixed and mobile services deployed in Bangladesh occurred in the late 1990s and the number of services in operation has subsequently grown exponentially in the past five years. The incentives both from government and public sectors have helped the industry grow and it is now one of the biggest industries in Bangladesh. As a populous country, its huge market attracted many foreign investors (History and Vision, BTRC). Calls which are being made from mobile and fixed operators will be received by the Interconnection Exchange (ICX) and the local calls will be passed to the destined network whereas international calls will be passed to the IGWs (National Telecommunications Policy, 1998).

The telecom sector in Bangladesh is rapidly emerging. Bangladesh Telecommunication Regulatory Commission (BTRC) is the regulatory authority for this sector, overseeing licensing, policy etc. The calling code of Bangladesh is +880. There are so many sub codes to identify different operators in between Bangladesh. ICX Business in Bangladesh:

3.1 What is ICX?

ICX Switching system which provides interconnection among telecommunication networks of operators and allows monitoring, lawful interception (LI) facilities and roaming number portability. ICX doesn't have any subscriber and is not directly connected with overseas operators. So the traffic of IGW's (International Gateway) and ANS's (Access Network Services) is also the traffic of an ICX operator.

If a Subscriber calls from another subscriber of same operator then the call get route internally. For example, a subscriber of Grameenphone calls another Grameenphone subscriber it will take their internal route to reach the other subscriber. But if a Subscriber calls from Grameenphone to a BanglaLink subscriber then the call gets routed via ICX.

3.2 Establishing ICX operators in Bangladesh

ICX is a step towards creation of a modern and efficient telecommunications infrastructure. With the introduction of ICX, operators can combine their services in the most flexible way. This concept refers to an arrangement which provides interconnection among the existing/future telecommunication network of the operators and allows monitoring, lawful Interception (LI) facilities and roaming number portability. Until 2008, Government owned BTCL (former BTTB) was by far the largest domestic fixed-line public telephony provider and exercised monopoly power in respect of both providing interconnection to other operators and international gateway services. BTTB was unable to meet at least 50% of interconnection expansion requests and even in case of capacity enhancement waiting times were relatively long. Moreover, the fixed telephone lines that got installed were predominantly in Bangladesh's four main cities while around 70% of the populations live in rural areas.

The Interconnection Exchange (ICX) will receive all calls from the mobile and fixed operators whenever the call is made to other network and will pass it to the destination network if the call is local, and will pass to the IGWs if the call is international. ICX will also deliver calls received from IGWs where the call is destined. And then in 2008 Government imposed 3 ICX License for interconnection among all the operators of Bangladesh like PSTN, Mobile, Fixed line. This scenario help government to earn maximum income from the inter operator calls. In 2012 Twenty-One new ICXs were given license to operate and now total number of ICX is 26. The incentives both from government and public sectors have helped the industry grow and it is now one of the biggest industries in Bangladesh.

3.3 Interconnection for Domestic and International calls

The three layers network architecture keeps the provision of International Gateway, Interconnection Exchange and Access Network. Services provided under these 3 layers can be translated into three types of following

interconnections:

Interconnection for Domestic telephone service: All inter operator domestic voice traffic transfer through ICX. For example, suppose an user of GP want to call to Banglalink user, then when he dial the GP network route that call to ICX and then ICX route that call to Banglalink user. Here, the GP network can't directly pass that call to Banglalink user and vice-versa. This is the function of an ICX for domestic call routing. Inter operators voice traffic of all Access Network Service (ANS) / IP telephone operators and those operators must interconnect through ICXs.

The call forwarding is as:

Grameenphone > ICX > Banglalink or

Banglalink > ICX > Grameenphon

Interconnection for International telephone service: International incoming voice traffic received by the IGW from international career from abroad and then routed to ICX and getting call from IGW the ICX terminated that call to ANS. For international outgoing voice traffic ICX received the call from ANS then ICX routed that call to IGW and IGW terminate that to international career. For these both type of call here the IGWs have primary backbone connection towards international network through SEA-Me-WE-4 submarine cable (or through other submarine cables). As backup they have connectivity through Satellite Earth Station/VSAT until the availability of alternative sea cable.

The call forwarding for International Incoming:

International Career > IGW > ICX > ANS

The call forwarding for International Outgoing:

ANS > ICX > IGW > International Career



Fig 2: Call flow diagram of Domestic and International calls

3.4 Benefits of ICX

ICX has given some benefits to government for monitoring calls and CDR. Before the establishment of ICX it was tough for BTRC to collect and monitor all calling data from all Access Network Service (ANS) and International Gateway (IGW). But after the implementation of ICX this task has become easy and the connectivity of inter operation telecom network has come less complex. BTRC now can get calling data from both called and calling operator and also from ICX operator.

Some benefits of ICX are given below-

- ✓ ICX ensures balanced traffic among all operators.
- ✓ Less complex network for inter operator calling.
- ✓ Easy access for telecom operators to national telecom network.
- ✓ ICX helps keeping records of all calls and authority to identify and monitor any calls.
- ✓ Improves revenue of government by auditing all local and international calls.
- ✓ Improves voice quality of telecom service.

3.5 Current status

All ANS, ICX and IGWs are ensuring interconnection compliance as per BTRC directives. Each month ANS are reporting to BTRC interconnection capacity and traffic volumes for proper co-ordination and further forecasting.

Like any process, the current interconnection regime has certain advantages & disadvantages.

Advantages:

Simplification of Interconnection regime: ICX simplified the interconnection network architecture. The problem mounting from scarcity of capacity of incumbent operators is reduced and macro level monopoly in certain cases has diminished.

Revenue opportunity: Addition of full subscriber base to the international network provides a new revenue opportunity for all operators.

Enhancement of Interconnection capacity: Connectivity with new ICXs and IGWs offers enhanced capacity for both domestic and international calls.

Remove single point of failure for international voice connectivity: Private ICXs and IGWs alleviate the sole dependency on BTCL for international voice traffic.

Cost optimization: ICX is responsible for capacity enhancement and traffic balancing as a result they can re-allocate un-utilized resource (E1) according to demand/forecast. ICX's centralized arrangement of interconnection reduced the CAPEX/OPEX of all ANS.

Disadvantages:

Complicated billing system: The ICX should have been played the role of clearing house as they route all kind of traffic with ANS & IGWs

Previous Interconnection Structure had to be re-arranged: Dismantling of bi-lateral transmission and switching network with PSTN/PLMN were both time and resource consuming.

Quality assurance, ASR issue, Operation & Maintenance etc. technical issues have become more complicated to execute as there are new intermediate nodes (ICXs).

The increased number of Disputes among the ANS

Direct routes with mobile operators are continued with approval from BTRC as BTCL is yet to introduce its ICX for domestic traffic in full fledges

4.2 Payment settlement procedure

Domestic inter-operator traffic:

For billing purpose concerned ANS invoices other ANS monthly bill for terminated domestic calls on the basis of daily data generated by IBS (Interconnection Billing System). Receiving party should have the same invoice data generated by their own system. But sometime this data may deviate. In case of below 0.5% deviation, concerned ANS payment is made and corresponding payment status gets updated. In case of dispute 'Cross-company Dispute Analysis Team' do the detail analysis of disputed issues and take necessary resolution measures (help of ICXs & CLI generated by the respective ANS system) as per "Dispute Resolution Process".

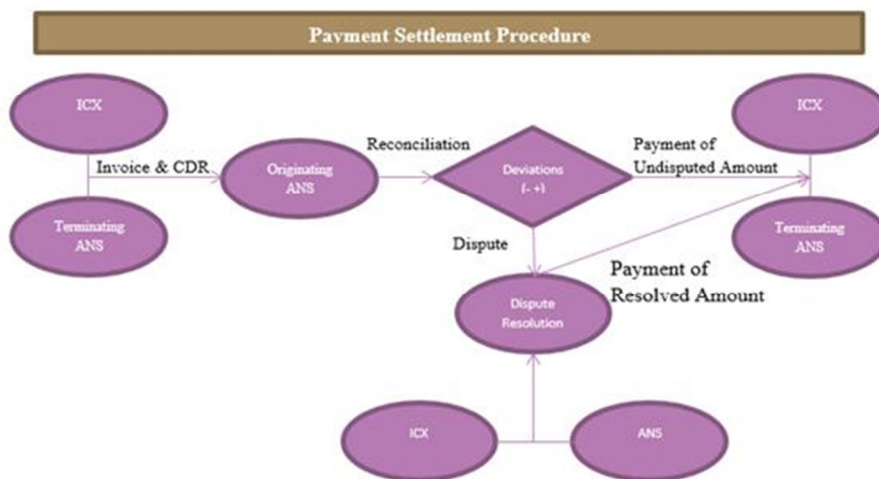


Fig 4: Payment Settlement Procedure-Domestic Inter Operator Traffic

International traffic-Incoming:

It is almost the same process as of domestic calls. Concerned ANS invoices respective IGW operator for terminated international incoming calls (on the basis of IGW pre-fix) the receiving party reconciles the invoice data with their system generated data. In case of below 0.5% deviation, concerned IGW makes the payment and corresponding payment status gets updated. Dispute procedures are similar to the handling of domestic traffic disputes.

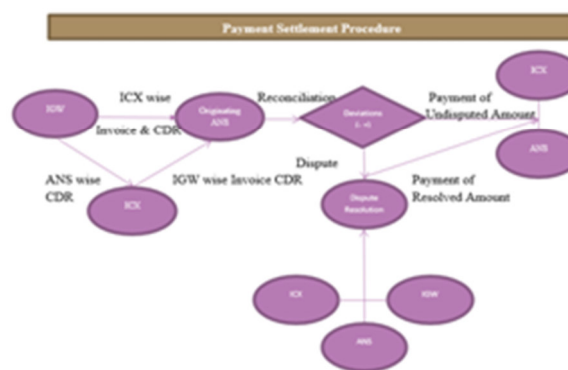
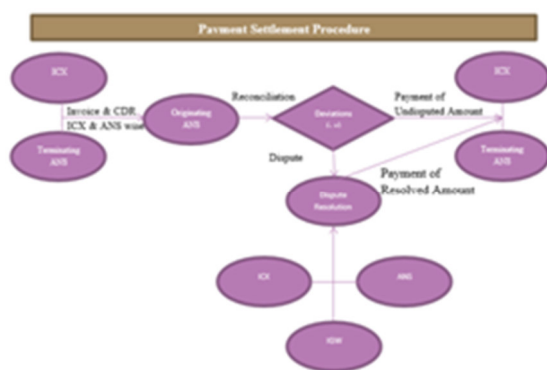


Fig 5 a) : Payment Settlement procedure- International Outgoing

Fig 5 b) : Payment Settlement Procedure-International Incoming

International traffic-Outgoing:

For international outgoing calls both ICX (only they know how much traffic is given to which IGW) and IGW (they identify ANS on the basis of respective ANS pre-fix) invoice an ANS, as the call passes through ICX first and later through IGW. Receiving party reconciles the invoice data with their system generated data. In case of below 0.5% deviation, concerned ANS makes the payment and corresponding payment status gets updated. Dispute procedures are identical to the handling of outgoing traffic disagreements.

6. Analysis:

6.1 Situation before ICX

The interconnection regime till 2008 was based on bi-lateral connectivity. Each operator has to get connected to each operator individually in a market of 13 PSTN operators, 6 Mobile operators, 1 Sea cable company and 1 international gateway operator. According to a report of CRAI & GT (2007) Bangladesh had a highly unusual interconnection regime in which the mobile sector subsidized the fixed sector. These subsidies harmed overall efficiency and were likely to hold back overall access to telecommunications services in Bangladesh. In doing so BTTB had to compete for limited Government funds against general Government expenditure such as on health and education. The limited capital expenditure had restricted network rollout, capacity enhancement and discouraged the introduction of new services. Before the introduction of ICX based interconnection, arrangement following two issues raised particular concerns:

The limited capacity (former BTTB now BTCL) for interconnection:

A World Bank study found that over half of mobile phones in Bangladesh were not able to connect to BTTB until 2003. The situation was concerning because it harmed final market outcomes. The growth of the overall Bangladesh's telecommunication sector was also held back by the lack of interconnection capacity.

The monopoly of international gateway:

BTTB retained a monopoly on IGW services in Bangladesh as a result of the current regulatory approach. BTTB has underinvested in international gateway capacity such that it cannot meet current demand and planned capacity expansion is not expected to enable it to meet the rapid growth in demand.

6.2 Situation after ICX

Simplification of Interconnection Network: ICX simplified the interconnection network architecture. The problem mounting from scarcity of capacity of incumbent operators is reduced and macro level monopoly in certain cases has diminished.

Increase of revenue: Addition of full subscriber base to the international network provides a new revenue opportunity for all operators.

Enhanced capacity: Connectivity with new ICXs and IGWs offers enhanced capacity and it alleviates the capacity constraint due to BTCL (for international traffic specially).

Remove the dependency on one operator: Private ICXs and IGWs alleviate the sole dependency on BTCL for international voice traffic. So, it allows having redundancy.

Cost optimization: ICX is responsible for capacity enhancement and traffic balancing as a result they can re-allocate un-utilized resource (E1) according to demand/forecast. ICX's centralized arrangement of interconnection reduced the CAPEX/OPEX (e.g. man-hour, E1 link etc.) of all ANS.

6.3 Revenue of ICX

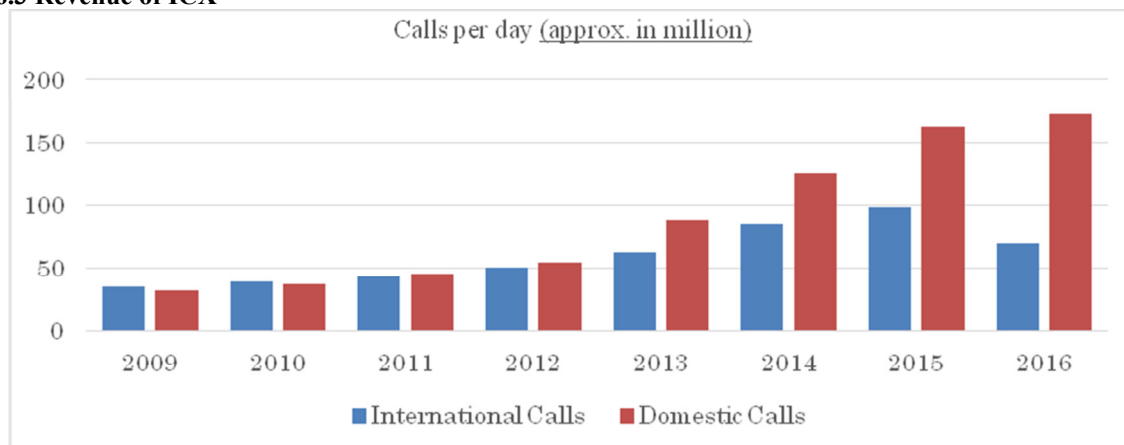


Fig 6: Calls per day in both Domestic and International route

In the table the average calls per day through ICX is shown. Since 2009 the average calls per day is increasing every year. But till 2010 international calls were more than domestic calls. As Bangladesh has adopting telecommunications rapidly and people of both urban and rural are getting in touch of mobile network, the number of domestic calls has increased since then.

It is also to be noted that, the call rate of domestic calls has gone down since the start of ICX as the cost of interconnection has also gone down by mile after implementation of ICX operators. Another thing to be noted that in 2016 the number of international calls has gone down. In the last meeting of BTRC it was thought that due to shutting down the services of City cell and low or free services of voice calls by mobile applications have caused the decrease of total numbers of calls in the last year. More people are using free calling services of Smartphone app to communicate abroad and govt don't get revenue from those calls.

Table 2: Yearly revenue of ICX (in Crore Taka):

Call Type / Year	2009	2010	2011	2012	2013	2014	2015	2016
International Calls	423.49	473.31	541.47	602.25	707.09	930.75	845.88	731.45
Domestic Calls	11.68	13.50	16.42	19.71	32.12	46.00	60.22	100.16
Total	435.17	486.81	557.89	621.96	739.21	976.74	906.11	831.62

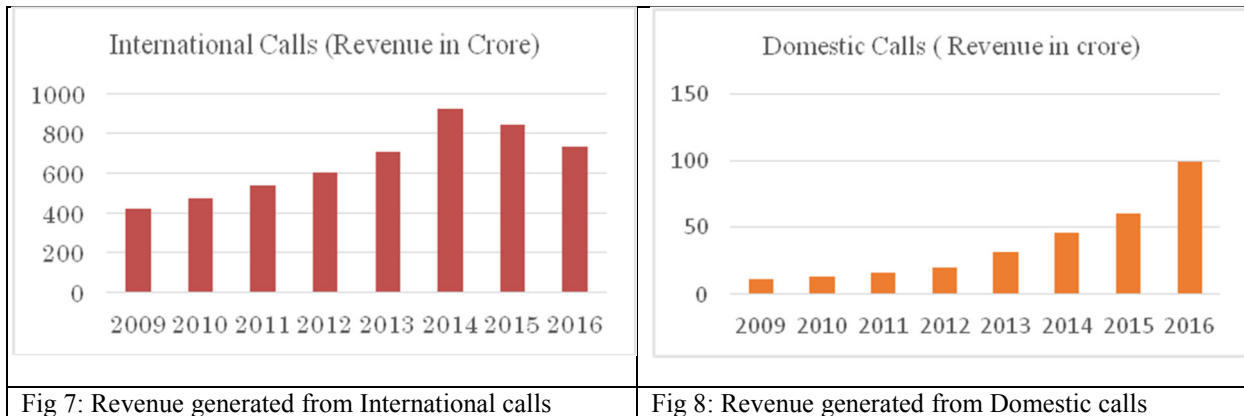
As seen in the previous table of average calls per day, here in the table we can see the revenue made by ICX. The revenue also has risen up during last few years but has fallen a bit last year because of less international calls made. When the revenue was over 400 crores in 2009, it has risen to over 900 crores in 2014. So, in 5 years the revenue increased to 124.45%. But it is to be mentioned that revenue have suddenly dropped down in 2016. The reasons behind that –

The services of Citycell was shuttled down (First ANS operator in Bangladesh) in last year

Using of Smartphone application which facilitates low cost or free calling service is also a reason.

Recently two ANS operator Robi and Airtel have merged. So, calls between them won't be counted as inter operator calls anymore. This have already affected on the revenue.

The more the revenue can be earned the more it will be added to govt's fund. Govt has a plan to increase the profit from telecommunication and so there is some plan to control illegal calls abroad. As discussed in the previous chapter an ICX operator share 65.75% of its revenue with government. So, with this rate we can calculate that the average income of per ICX operator in 2016 was 10.95 crore approximately. The cost to initialize ICX business was calculated 11.5 crore approximately. It clears that this business is definitely affordable.



6.4 KPI Analysis of Different ICX Operators

A Key Performance Indicator (KPI) is a measurable value that demonstrates how effectively a company is achieving key business objectives. Organizations use KPIs to evaluate their success at reaching targets.

Most ICX operators make KPI report based on CCR, ASR and ACD

CCR (Call completion rate): The ratio of successfully completed calls to the total number of attempted calls.

$$CCR = 100 \times \frac{\text{Successfully Connected Calls}}{\text{Total Attempted Calls}}$$

ASR (Answer-Seizure Ratio): It is a measurement of network quality and call success rates in telecommunications. It is the percentage of answered telephone calls with respect to the total call volume.

$$ASR = 100 \times (\text{Answered Calls}) / (\text{Total calls})$$

ACD (Average Call Duration): The average call duration (ACD) is a measurement in telecommunications that reflects an average length of telephone calls transmitted on telecommunication networks. The measurement is typically based on the reporting by telecommunication equipment via call detail records.

$$ACD = (\text{Total Minutes}) / (\text{Total Calls})$$

Table 3: Average KPI values of some ICX operators in September, 2017

Company Name	KPI Data								
	International Incoming			International Outgoing			Domestic		
	CCR	ASR	ACD	CCR	ASR	ACD	CCR	ASR	ACD
Gazi Networks Limited	92.3	38	4.9	86.7	19.2	1.1	93.5	39.6	1.4
New Generation Telecom	93	36.2	5.4	91.2	12	1.2	94.4	42.4	1.9
Mother Telecommunication	90.3	37	3.9	88.4	18.7	0.9	92.43	37.2	1.8
Jibondhara Solutions Ltd.	86.3	36.2	5.5	92	20	1.3	90	22	1.5
Crossworld Telecom Limited	75.77	30.65	5.16	82.85	16.6	0.8	81.55	39.91	1.33
Summit Communications Ltd	75	27	5.5	85	14.35	2	80	30	1.9
MM Communications Limited	88.2	22.1	4.1	87.3	21.2	1.3	90.2	35.1	1.8

Here in the table the value of CCR, ASR and ACD is shown of 7 ICX operators. The better the values of these parameters result the better the performance. CCR is one key factor to judge the performance of one ICX operator. CCR indicates how many percentages of calls are successfully connected to the ANS operators or IGW operators through the ICX. ASR depends on subscribers of mobile phones as it indicates the percentage of calls that are answered by the called subscriber. ACD also depends on subscriber as of their average duration of a call.

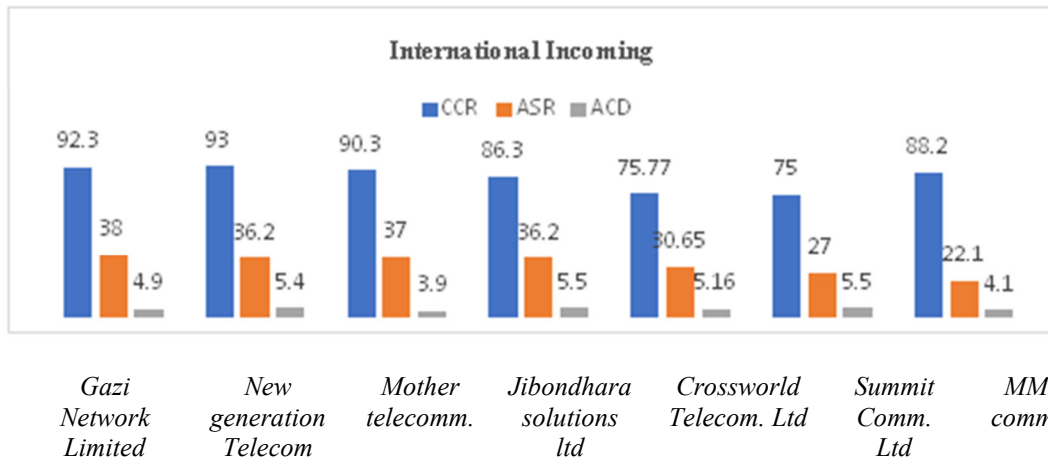


Fig 09: KPI Performance comparison of some ICX for International Incoming calls

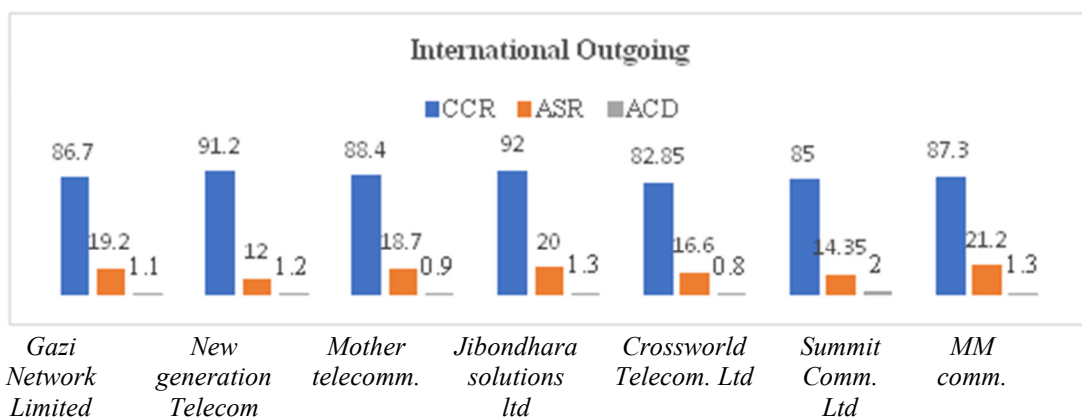


Fig 10: KPI Performance comparison of some ICX for International Outgoing calls

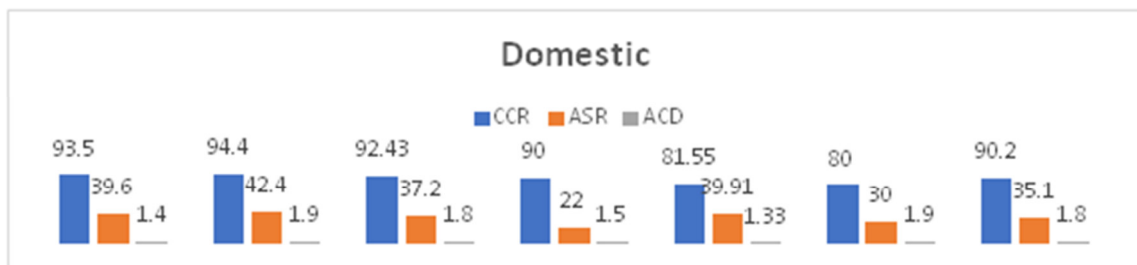


Fig 11: KPI Performance comparison of some ICX for Domestic

Here in the chart Gazi Networks Limited has a good value of CCR in all cases comparing to other ICX operators. CCR has a value of over 90% in both International incoming and Domestic calls. The value of ASR is also very high which one of key factor of conducting good business is. ACD is also among the higher side. The KPI for Gazi Networks Limited is quite satisfactory and among the mentioned ICX it has a good KPI that indicate good business. All ANS and IGW operators give priority to the ICX which has better values of CCR and ASR. So, to be in a good position in the ICX sector maintaining good KPI performance is very essential. To keep the performance high ICX operators hugely depend on their technical department. A sound technical team can maintain a satisfactory performance throughout the year. It is also to be mention that due to many factors like Fiber break down, Power failure, POI vendors difficulties, natural disaster etc. can cause sudden decrease of performance for one good ICX operator at any time

7. Conclusion

Bangladesh is one of the most attractive places to operate telecom business. Mobile phone operators are trying to enhance the mobile subscriber which will give them more revenue. Apparently increase in mobile subscriber will need increased capacity to handle more calls. Thus, the significance of ICX is defined because with the help of ICX operators ANS and IGW operators can handle more calls with less complexity. Government can also monitor calls easily which brings a good number of revenue for both government and ICX operators.

Before the establishment of ICX, government was unable to trace exact amount of calls among the operators. So, it is clear government was unable to get the exact amount of revenue. After the establishment of ICX now government's earning from interconnection calls have been increased because ICX operators are under full control of BTRC. Revenue has been increased 124.45% within 5 years. The significant growth indicates a good future in terms of revenue for ICX operators and Government. The amount of calls are increasing in every year resulting an increase to the annual income for both ICX and government from this sector.

We have seen in the study that the average income per year of an ICX operator in 2016 proves that this business is quite affordable and within one year the revenue can bring in the initial investment. The KPI of Seven different ICX operators are also discussed in the study and all the values of those indicators were found in satisfactory level which means ICX operators can fulfill the required performance needed to cope up with the ANS and IGW operators.

ICXs are using NGN (Next Generation) Switches, so they are capable to handle smart technologies in future like VMS, SMS, MNP and 3G etc. This will help Bangladesh to keep pace with the advanced world in the long run.

References

- Marcus, J. S. (2009). The Future of IP Interconnection
- Rakesh Kumar Bhatnagar (2004) – Interconnection Exchange cum Inter-Carrier Billing Clearing House
- Hank Intven, Jeremy Oliver, Edgardo Sepulveda (2000) – Telecommunication Regulations Handbook – Module 3 – Interconnection
- Eng. Mustafa AL Mahdi (2015) – Emerging Regulatory Trends in Interconnection
- Anjuman Ara Begum, Mohammad Hasan Murad, Kazi Arshadul - Telecommunication Regulation in Bangladesh: An overview
- Rasheda Sultana (2010) - Management of Multi-Operator Interconnection through Interconnection Exchange - A Case Study of Bangladesh
- Chanuka Wattegama, Juni Soehardjo, Nilusha Kapugama (2009) – Telecom Regulatory and Policy Environment in Indonesia Results and Analysis of 2008 TRE Survey
- Bangladesh Telecommunication Act, 2001
- ILDTS policy. 2007. Btrgovbd. [Online]. [30 June 2018]. Available from: <http://www.btrc.gov.bd/ildts-policy>
- National Telecommunications Policy 1998 Archived 6 July 2011 at the Wayback Machine.
- ILDTS policy. 2010. Btrgovbd. [Online]. [30 June 2018]. Available from: <http://www.btrc.gov.bd/ildts-policy>
- Intven & Mccarthy (2000). Telecommunications Regulation Handbook, Module 3. (1st ed.). Washington, DC: World Bank.