AVAILABILITY ANALYSIS OF CELLULAR NETWORK PERFORMANCE ON BSS PARAMETERS

BY

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Master of Science in Electronics and Telecommunication Engineering.

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APPROVAL

This project titled **"Availability Analysis of Cellular Network Performance on BSS Parameters"**, submitted by Rakiba Sultana to the Department of Electronics and Telecommunication Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of M.Sc. in Electronics and Telecommunication Engineering and approved as to its style and contents. The presentation was held on December 2022.

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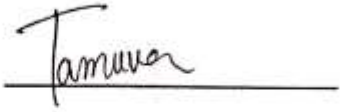

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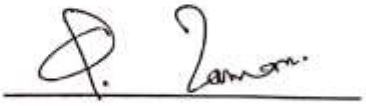

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Md. Taslim Arefin, Associate Professor & Head, Department of ETE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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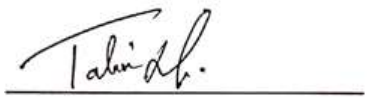

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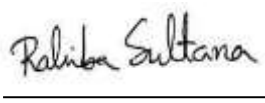

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ABSTRACT

A cellular network is a mobile network that uses a large number of base stations with limited power to provide services, each covering only a limited area or cell. Limited power allows the same frequency of multiple cells from a base station to be reuse without causing interference, allowing a large geographic area covered by a limited set of frequencies. The operation of the cellular network carried out in accordance with the GSM network standard. Base station subsystems (BSS) are one of the key areas of GSM network architecture and it is responsible for handling traffic and signaling between mobile phones and network redirection subsystems. The performance of BSS can be hampered in a variety of ways, including coverage issues, scheduling issues, fading effects, power constraints, bandwidth limitations, and different protocols and standards. As a result, the customers of the remote areas are unable to receive expected services in a day. There has been a many more parameter on availability in cellular network, however availability analysis from the academia and the telecom industry have used different definitions for availability and the related concepts. In this project, constructed different scenarios and region across the country calculated to impact of cellular network availability on BSS networks infrastructure. The main goal is determining to figure out network availability in daily weekly basis based on 2G, 3G and 4G each technology comparison. The service availability differences in daily weekly basis based on 2G, 3G and 4G technology of different districts of Bangladesh were also determining here. For the data collection Huawei could in Huawei RTN 380 V100R007C00, RTN 905 1E, Huawei U2000 were used. The screenshots of different operations were included here. Microsoft Office tools used to simulate the performance data. This project has been conducting to background research, network availability and future innovation methods for the measuring network availability and applicable to the Bangladesh telecommunications industry.

CONTENTS

LIST OF FIGURES

CHAPTER [1]

INTRODUCTION

1.1. Communication is the backbone of the development of any society. Messages need to be exchange from one person or medium to another. The world is rapidly becoming a global village, and the tool needed for this process is communications where wireless communication is an important factor. Wireless ad hoc networks formed by groups of mobile users or devices that span a particular geographic area. The users or devices that make up the "nodes" of a network. Mobile networks are increasing applications in the field of military applications such as sensor networks, tactical networks, and positioning systems. Mobile networks are increasing applications in law enforcement. A major breakthrough is the radiotelephone system available in fixed-wire in GSM (Wojuade, 2005). The GSM and CDMA are the latest developments that continue to grow to facilitate exchange of messages from one person or one medium to another. Quality of service (QoS) is typically defines as requirements a network must meet when forwarding a packet flowing between source and destination [1]. Network requirements are manage by application service requirements. Networks service end-to-end performance attributes to users with as delay, bandwidth, packet loss probability, and delay. In any case, for high quality mobile network mobile phone services, voice quality, call completion rate, call success rate, telecommunications service accessibility, service accessibility short message service, access delay short message service, etc. Services should be deliver to customers as needed, sounding properly and without noise or other related barriers [2].

1.2. Aims and objective

This project is intends to objective:

- To evaluate and measure BSS parameter availability analysis of cellular network performance.

• To determine service availability differences in Bangladesh's weekly and daily GSM network services.

• To determine the availability of 2G, 3G, and 4G mobile network operator services in Bangladesh.

• To determine 2G, 3G, and 4G daily and weekly availability comparisons.

1.3. Motivation

Network performance divided into several different infrastructure parameters. By analyzing these infrastructure parameters, can find out how or where to improve the network performance. However, Network performance businesses have specific metrics provide more valuable. For example, network availability is indicator most businesses want to improve without knowing what the benefits of focusing.

Network availability or uptime, simple refers to the network being up and running. It is important for users to connect with a network. The network unavailability affected badly on network performance. Therefore, it is very important to know the uptime performance of network.

1.4. Problem statement

On the first part of this project is to study on network availability, which occurs on all transmission and RAN networks. In second part of this project is to measure network availability on individual parameter. The networks use multiple protocols and devices of different models, network section that uses Nortel SDH devices (Nortel DX product name). These include the SDH and network backbone.

– Wavelength division ring multiplexing

– Fiber link

– Single BTS

– Macro page, micro page

These four rings consist of total 22 links, which are 66 terminations where performance parameters can be measure.

1.5. Project formations

- **Chapter 1**

  This chapter contains an overview of cellular network performance, Amis, objectives, and motivations for BSS parameter availability analysis. This project provided by GSM Network Call, a performance assessment available in key regions of Bangladesh. In addition, the discussion in the problem statement is that both network customers have problems.

- **Chapter 2**

  This chapter contains papers on Cellular Network Background Studies and Cellular Network Background History, Bangladesh GSM Technology History, Performance Evaluation Background Studies, and publications available prior to that year.

- **Chapter 3**

  This chapter contains an introduction to cellular network technology, an overview of GSM technology and network architecture, the network elements of this cellular network, and a description of this network architecture.

- **Chapter 4**

  This chapter contains a discussion as 4.1. BSS side availability parameters, network availability formulas, methodologies.

- **Chapter 5**

  This chapter contains a data collection and analysis section, a detailed log of data map calls in the five major regions of Bangladesh. Data collection materials, data collection methods and procedures.

- **Chapter 6**

  This chapter contains simulations and results comparing service network accessibility and call availability of BSS cellular network performance parameters in 2G, 3G, and 4G networks.

- **Chapter 7**

  This chapter summarizes the cellular network availability analysis of Bangladesh's cellular communications, the scope of future work, and the definition and reference of the cellular network team.

CHAPTER [2]

BACKGROUND STUDY

2.1. The professional research and development of technology and telecommunications begins with the 20th century. A research published early in the 1980s, focus mainly on acceptance, practicability and effect of information technology. The impact of telecommunication and technological developments on various fields of science and professions increasing day by day. [2]

2.2. History of cellular technology

The European standard development of digital cellular voice communications began at 1982 when the European Conference of Postal Telecommunications (CEPT) established the Group of Special Mobile Committee provide a permanent technical support group based in Paris. [3].

GSM technology

- In 1987, the first agreed GSM technical specification in created the February at Europe.
- In 1989, the Mobile Committee was transfer of CEPT of the European Telecommunication Standards Institute (ETSI).
- In 1986, European Commission proposed in order a 900MHz spectral band for GSM.
- GSM Extended standard to 1800MHz frequency band in 1991, first 1800MHz network in the United Kingdom in 1993.
- In 1995, SMS messaging data and fax services launched commercially, initially with the 1900 MHz GSM network.
- In 2000 commercial GPRS service was launched in first GPRS came compatible mobile phone was launched.

- In 2002 Multimedia Messaging Service (MMS) introduced at first time GSM network in the 800MHz frequency band went live.
- In 2010 technology specified in the GSM standard served 83% of global mobile market.

2.3. Network availability of cellular communication

Network availability is the calculation of time and average percentage of network performance intended of function. The monitoring software developed by produces two characteristics of system availability are average availability and system availability. The system availability indicates the probability of network availability is less than the specified value using level [3].

The important software feature of developed to ability evaluation of network average availability and distribution availability in normal operating conditions without running time-consuming and resource-consuming investigations. Specified 10 years, the availability distribution corresponds to normal acceleration pressure levels (normal operating conditions) and has approximately 24% chance of system availability being or less than 95%. At high acceleration pressure levels. This trend also reflected in average (expected) availability. The network availability for normal trend stress levels is 0.967, but at high-accelerated stress levels the average network of availability drops to 0.897 percent [3].

Service Level Network availability

I started by explaining the service Network level agreement. The network service level agreement (SLA) is formal contract with exists between a customer. Then service provider and specifies development services that customer receives from the service provider during trams and condition. In description, the penalties will assessed if any provision of the SLAs is violate by the condition of service provider. As more enterprises external services. SLAs to ensure a certain level of functionality and network availability.

The different types of network SLAs that manage different of vendor business. Moreover, looking at network service SLAs called network SLAs. Network

SLAs determine their purpose in network performance between one or more exchange points in the network at SLAs typically include [4].

- The Physical Network Features of this includes the types of different network infrastructure services that service providers. This is the communicated of network availability system uptime and throughput of network capacity. All companies are want 100% availability, but in many environments, this may not be necessary. For example, in an e-commerce environment, 100% availability is very important. However, in the geographical business environment targeted availability average of 99.5% to 99.9% may be acceptable. When determining throughput, bandwidth capacity, power and other factor detailed in the backbone connection capacity of core network such as 10 Gbps.

- Network connectivity's behavior aspect of SLAs provides details about available bandwidth. Acceptable data loss rates, network error rates, end-to-end response delay. Most service providers company guarantee 99% transmission packet speeds, but this might not be enough sufficient for real-time phone applications such as Voice over IP (VoIP) and interactive video calling. For dominant web browsing, traffic loss of up to 5% would be tolerate able. The data loss, latency and interference are most very important for multimedia traffic VoIP call. Most of application are requires a response time of 100 ms or less. Many service providers in the Bangladesh and South-Asia often guarantee a multiplexing delay of 85 ms between routers in core network [3].

2.4. Background study and publication of Availability Analysis

- Reality Check On Five-Nines. Audin, Gary. Business Communications Review, May 2002, pp 22-27.
- Availability and reliability of switched services of Glossbrenner, K.C. IEEE Communications Magazine, v 31, n 6, June 1993, p 28-32.
- Availability Requirements and Measurement, Hawkins, Michael.. InformIT, Oct 19, 2001.

- High Availability Networking, Kreiling, Janet. Packet Magazine, vol. 25, no. 3, Third quarter, 2003, p 53-58.
- Improving Network Availability of Narang, Sudhir.. Network Magazine India.
- ISP Guarantees: Warm, Fuzzy and Paper-Thin. Business Communications Review, Dec 1998, pp 23-27.
- Network Availability: How much do you need, of Cisco White Paper. How do you get it?
- How Cisco IT-LAN-SJ Achieved High Availability, Cisco White Paper
- Finding the Network Service Provider Who Won't Let You Down at Cisco White Paper.

CHAPTER [3]

INTRODUCTION OF CELLULAR NETWORK

3.1. A cellular network or mobile network is a communication between network links in wireless. These networks are distribution in over the transmission area called a cell. Every served by at least one fixed-position of transmitted called in a cell site on the base station. The base stations are providing cells in network coverage that can be used to transmitted voice, data so on. The cellular networks have each cell uses a different type set of frequencies nearby cells to avoid to the interference and provide guaranteed bandwidth [6].

3.2. Overview of GSM technology

The GSM (Global System for Mobile Communications) is the standard developed by the European Telecommunications Standards Institute (ETSI). GSM technology describes of second-generation (2G) digital cellular networks used in voice call mobile phones, which is Default global standard for mobile communications. 2G networks have been initially developed by a first generation (1G) analog cellular network. The GSM standard originally lunch as a digital network, which is circuit based optimized for full-duplex voice call. That time including data communication using circuit transport network first and then letter develop as packet data network as GPRS (General Packet Radio Service) and EDGE (GSM Evolution or EGPRS Extended Data Rate) [4].

3.2.1. GSM network architecture

A GSM network consists of mobile base stations, base station subsystems and network operational subsystems. The following figure shows the network architecture of a complete GSM system.

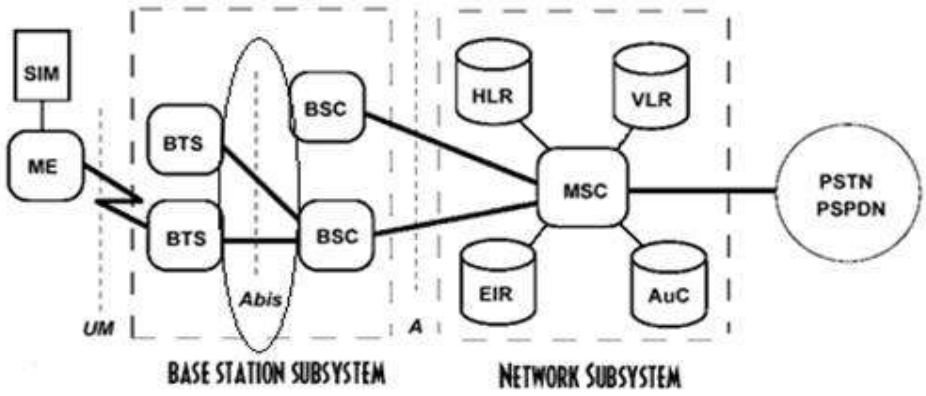

Fig 3.1 : Architecture of GSM network

3.2.2. GSM Network infrastructure

- **Base Transceiver Station (BTS)**

BTS responsible for an interface between the MS (Mobile Station) and the network, by connecting wireless coverage by the GSM antenna. The main concept of full duplex channels used for communication between BTS and MS [2].

- **Base Station Controller (BSC)**

BSC operates most wireless networks. Its most important task is to get the most out of wireless resources make connection with multiple BTS. Below the main functional of BSC.

- Wireless network management
- Multiple BTS management
- Power grid management
- Operation and maintenance of internal BSC
- MS connection management

- **Home location Resistor (HLR)**

  The HLR is a database that store customer and location information for each user those who are lives in the same MSC coverage. Individual customer assigned a Unique International Identity (IMSI), which is the number assign to identify the home user [2].

- **Visitor Location Register**

The VLR is a database define as temporarily stores IMSI customer information for each roaming customer during the visit coverage information for particular MSC. VLRs are connected between multiple adjacent MSCs in a particular place or region and contain specific information [2].

- **Authentication Center**

The Authentication Center responsible for authenticating and encrypting encryption which is a strongly protected database for each client on the HLR and VLR. The validation center contains is Equipment Identity Register (EIR), which is a stolen alone ID used to send identity data that does not match other, including HLR or VLR [3].

3.3. Design principles

3.2.1 Alignment with the Internet architecture

Today's cellular data networks claims to use transport-like networks for user traffic, even when running on packet transports, by using structures such as APNs and GTPs. Future network architectures will need to be packet networks that do not completely. Semi-permanent or per-service tunnels rely heavily on to the network intelligence. Protocols and services that proven unnecessary for the operation of commercially. Viable IP networks must meet the very high thresholds of their requirements in order to be incorporated architecture [5].

3.2.2 Endpoint centric protocols

The different wireless interfaces available on user devices and the reality of different generations. The wireless networks under different management controls, most of network protocols and application features and services. The architectures are working hard to addressing to the reality from the network side and there is may not be able to meet real needs in terms of scale, cost, performance, and management. The persistent activity in

network-based selective IP stream mobility between cellular networks and Wi-Fi. IP access and mentioned IP traffic load (LIPA-SIPTO) [8]. This is the remarkable conclusion smartphones has increased the complexity of endpoint of devices. Moreover, cellular mobile networks must be follow principles of proven successful on the Internet connectivity. Most of intelligence network needs to be at the edge of network host devices [4].

3.2.3 Simplicity

The cellular network architectures use many more protocols, including different many network round trip. Earlier network connections include mobile devices, base stations, RNCs, SGSNs, GGSNs, and HLRs those are describing of GSM standard. In addition, security part of, firewalls, NAPTs, and QoS policy servers are included. There multiple trip of depending on the previous conditions required to complete this fulfillment process. There is no doubt about that an ideal and unavoidable situation, in several aspects to the GSM architecture. Also the network carried by signal flow is complex, overloaded and multiple network layers. For each network also a big and main target prevention of hacking and DoS attacks. Therefore, protocol is simplicity should be one or main objectives of the innovative protocol design, along with protocol modality and less of failure error rate [4].

3.2.4 Designing for uncertainty

Numerous recent 3GPP activities, such as reduced latency, local traffic load, network architecture leveling, and increased peak rates, have seen unexpected demand from reality, such as web-centric content, smartphones, and push apps. The basic standard network architecture should be designed with uncertainty [7] Also, given that the standard-setting process has been significantly delayed in responding to market demand, the basic standard is from the details of features and services, even if some of the benefits of tight integration are sacrificed [4].

CHAPTER [4]

METHODOLOGY

4.1 The network availability is the operational performance of a network system at specific time duration intervals. Elapsed time is call the time when the network is fully functional and operational. Network availability is measure by a percentage, network up, and running time to ensure that the services provided are consistently running to end users. Network availability is traditionally record by active real-time performance infrastructure monitoring tools. This is allowing to the network performance to detect when an availability occurs. In addition, most networks are providing users availability tools that allow them to send support monitoring and tickets when the network facing issue.

Network up time and availability are key KPIs measured by network service providers. Maintaining a target level of network availability helps to organizations plan natural disasters, conscious when problems occur, insure to the users with standard quality of service [7].

4.2 Availability parameter

Availability classification is very flexible and depends on heavily downtime used in the calculation and it's depend on (that is, the length of time that availability means). As a result, there are various availability classifications, including:

- Power failure
- Low battery backup
- Power Equipment's
- Tx. Equipment
- Micro battery backup
- Power line disconnected
- Leased line
- BSS Equipment

- Stolen incident
- Access Work order
- SA link
- NSA link
- Maintenance
- Access trouble ticketed
- Optic fiber
- Backbone

4.3 Availability calculation formula

The formula for calculates the availability is as follows:

Availability = (1 - (1/total down time)) * 100%

One day is 24 hours' duration

Down Time = Time to repair + Restore time + Activity time.

Mean Time between failures (MTBF): Time between the two successes. This is a vendor guarantee for the availability of telecommunications mobile network operators.

Mean Time to Repair (MTTR): Average repair and test time. This is an internal guarantee for the availability of telecommunications mobile network operators, especially network operations and maintenance departments and internal quality departments. In some cases, this is a "maintenance partner" warranty for telecommunications mobile network operators.

4.4 Point of Availability

The point availability is the probability that a system component will operate at a particular time of t. The classification of commonly used in the department of

military. This is because may need to the estimate of availability system of certain times as like when certain missions occur. The Point availability is very similar to the reliability function that gives the probability the system will be function at a particular time t. Instant availability measurements incorporate maintenance of information. At some point at system, works at following conditions occur [9]:

- The system works fine from 0 to t. In other words, there is no failure at this time t and the probability this occurrence R(t).

  Or,

- The system is works fine after repair at time u, 0 <u <t, and the probability of this situation is:

$$\int_0^t R(t-u)m(u)du$$

Where m (u) is a function of system update density.

Therefore, the availability of points is the sum of above two probabilities

$$A(t) = R(t) + \int_0^t R(t-u)m(u)du$$

With block Sims, point availability can obtained through simulation. It can be estimate at various points in time and can be describe as a function time.

The Average availability is percentage of time or the length of time the system. It is representing of average value of the instantaneous availability function over a period (0, T) and is given by the following below

$$\overline{A(t)} = \frac{1}{t}\int_0^t A(u)du$$

Systems with maintenance in availability it can be zero at regular intervals. The average availability is a more meaningful of separate indicator than immediate availability. For example, availability commonly used in infrastructure and telecommunication systems.

4.5 Inherent Availability

Sticky availability is fixed-condition availability when only system fix maintenance time (CM) is considered. The classification is not including the prevention of maintenance downtime, logistic delays, supply delays, and management delays. Availability values that assume only corrective downtime are characteristic or essential to the system. The other causes of delay can be minimize or eliminate from down time. The few type of availability that an enterprise uses for product report availability like as server. This is because consider the downtime other than actual repair time of uncontrollable [9].

Actual downtime reflects of efficiency and speed maintenance of network. It also reflects the features of system designers should be not being interactive. Such as the required repair complexity, ergonomic factors, and whether repair ability (maintainability) is properly considered.

Single component, availability has calculated as following below:

$$A_I = \frac{MTTF}{MTTF + MTTR}$$

This is more complicated system, (MTBF) and calculate need to find out the mean time between failures.

$$A_I = \frac{MTBF}{MTBF + MTTR}$$

MTBF = Uptime / Number of System Failures
MTTR = CM Downtime / Number of System Failures

However, MTBF calculations can be a function of time until steady state is reached (for example, degraded systems). In such cases, the calculated MTBF will change as the system history more data is collected before it reaches steady state. Therefore, the above formulations should be used with caution. This is important the MTBF defined here is different from MTTF proper timing of first failure.

4.6 Operational Availability

Operational availability is measure by average availability the time and includes all experienced downtime. Those availability sources of administrative downtime and logistics downtime. Operational availability of customers

actually experience. This is post-availability based on actual events that can occur the system. The availability classification described as pre-estimation based on a system failure downtime distribution. The most of the case fluctuations in different location, resources, and other factors. That only manufacturer control over operational availability in user end area [9].

In operational availability is the total ratio of uptime on system mathematically calculate give below

$$A_o = \frac{Uptime}{Operating\ Cycle}$$

Herewith the operation cycles in total duration of uptime operation in under investigation. The operational time is the total time of system is functional during the operation cycle. Operation availability is a function of define as time, t

The main concept of operational availability is the closely related operational and functional. The other phone applications system number of operational and maintenance on demand configured. The spare parts supply chain and training are appropriate. In the commercial manufacturers having potential produce and reliable sustainable. However, the manufacturer's and distribution transportation system. In that case, the manufacturers are less motivated or innovated to bring their products to market.

Logistics planners are design engineers and maintenance engineers can jointly work on calculation the estimate system needs to be repair, required requirements. The paneling engineer make plan spare parts, maintenance tasks, repair and procedures, support to equipment, and other resources. Only when the all causes of downtime draw a realistic picture of system availability in real life affected.

CHAPTER [5]

DATA COLLECTION & ANALYSIS

5.1 The data collected is an active measure of availability, and a reactive measure uses, for example, the following data to calculate downtime: There is a problem with the ticket system. It not only provides an overview of the availability, but also includes information about failed equipment and resolvable errors. However, post-measurements tend to lack information about very short outages and failures during non-business hours. The in terms of customer's point of view, the responsiveness measurement is fair value because it is works based on customer-initiated data. The network operational point of view, active measurements prove to be better [10].

5.2 Data collection materials and data log

Collect data on the parameters investigated, such as network name, site code, priority, office, MSD office, district, Thana, metro and non-metro, commercial zone, area, date of occurrence, time of occurrence, recovery date, recovery time, etc. Designed to form, duration (minutes), downtime (minimum * cells), category, cause, details, effects, actions taken, problem status, required actions, dependencies, planned dates, owners, downloads Consideration, entry test start date, probability start time entry, entry probability end date, entry probability end time, access problem duration, and dependency site ID.

For the purpose of this project, the following materials will be need.

- Huawei RTN 380 V100R007C00.
- RTN 905 1E
- Huawei U2000

5.3 Browsing Alarms and Performance Data

This section provides hyperlinks for viewing alarm operations and performance data. By checking the current alarm, can find out what is happening within device. For checking this, we must be an NM user with NE monitor power or higher.

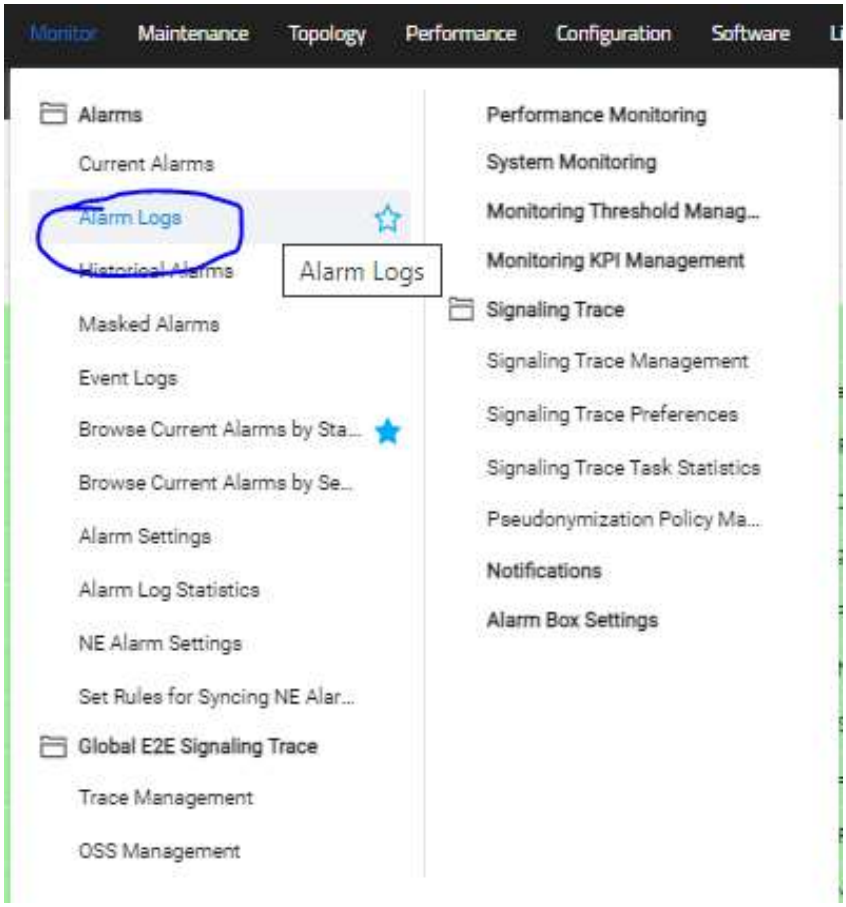

Fig 5.1: Opens the current alarm window

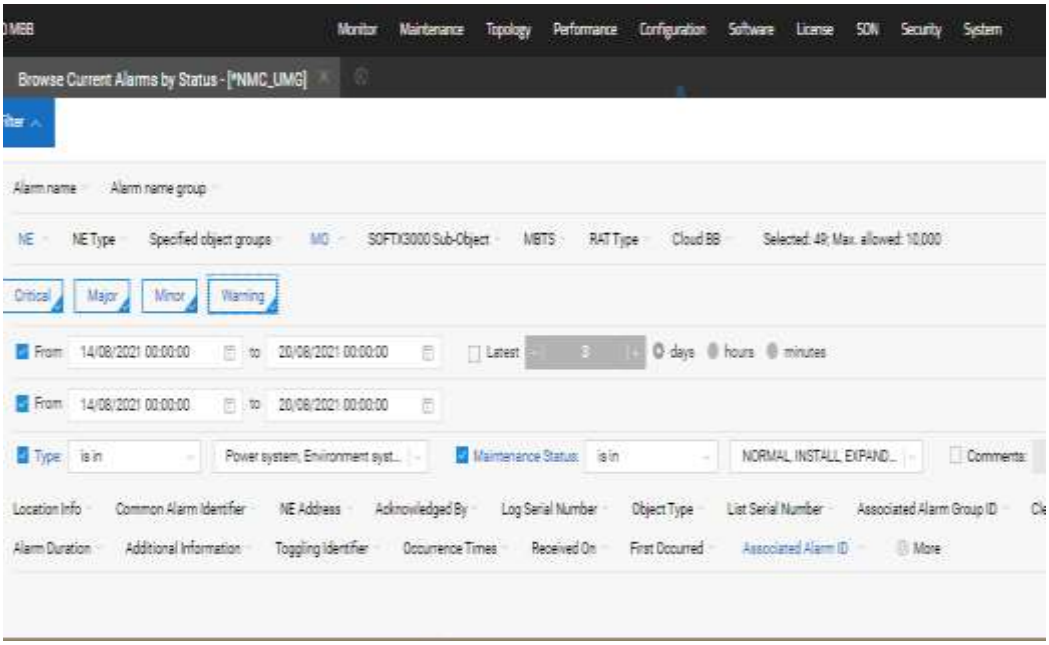

Fig 5.2: Specify filter conditions.

Opening Huawei UI and Browsing and click to Monitoring, from fault click Active alarm logs and current alarm logs and download the csv file. The Fig 5.1 shows the current alarm window and the Fig 5.2 specify the filter conditions of the Huawei UI. For this, open Huawei UI and open filter and select all the severity where is major minor and critical from monitor.

NE Name	NE Type
CR08_vSPS01_CGP	CGPOMU
dc1USCDBSPS01	USCDB
dc1vSPS_SPS	SPSV3
dc2USCDBSPS02	USCDB
dc2vSPS_SPS	SPSV3
dc3vSPS_SPS	SPSV3
GGBO01_UMG_RB03	MGW
GGCT01_UMG_YC06	MGW
GGDH11_CGP_UT11	CGPOMU
GGDH13_UMG_KT04	MGW
GGDH14_UMG_KT04	MGW
GGDH15_AJ03	MGW
GGDH16 _UMG_GZ03	MGW
GGDH17_UMG_GZ03	MGW
GGDH18_UMG_GZ03	MGW
GGKL01_CGP_CC06	CGPOMU
GGKL01_IGWB_1st	Virtual iGWB
GGKL03_UMG_CC06	MGW
GGKL04_UMG_CC06	MGW
GSDH11_IGWB_UT11	iGWB

Fig 5.3: View of alarm information.

By opening Huawei UI and Browsing, we have to select domain name and set the alarm name along with network element type. The Fig 5.3 presents the view of alarm information. The Fig 5.4 Opening Huawei UI and Browsing full alarm list and select all and download the csv files.

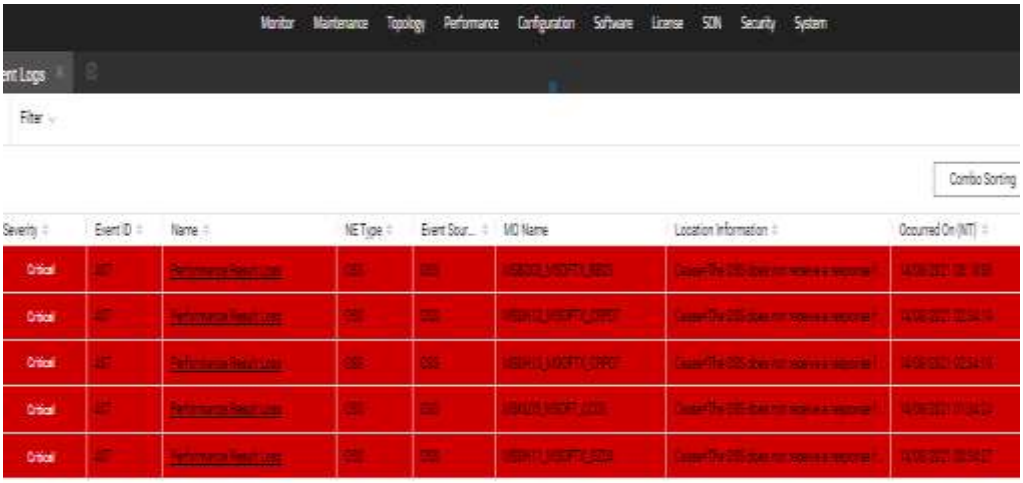

Fig 5.4: Log to clear the alarms in time.

Severity	Alarm Name
Minor	NTP_SYNC_FAIL
Major	LTI
Minor	LAG_MEMBER_DOWN
Minor	LAG_MEMBER_DOWN
Major	LAG_DOWN
Warning	SYNC_C_LOS
Minor	TIME_NO_TRACE_MODE
Major	TIME_LOS
Major	LICENSE_LOST
Critical	HARD_BAD
Critical	MW_LOF
Critical	LSR_NO_FITED
Critical	ETH_LOS

Fig 5.5: The current alarm search tab page is displayed by default

Opening Huawei UI and Browsing and click to fault, from fault click list of alarm and set those alarms for downloading only relevant alarm. The Fig 5.5 presents he current alarm search tab page is displayed by default.

5.4. Alarm severity

The current alarm is an alarm that has not been cleared.

Can browse network alarms based on the severity. For each alarm clicking the alarm indicator.

- Click (red) to see critical alarms for the entire network.
- Click (orange) to see the major alarms for the entire network.
- Click (yellow) to see a small alarm for the entire network.
- Click (light blue) to display warning alarms for the entire network.
- Red color is critical alarm
- Orange color is major alarm
- Yellow color is minor alarm
- Light blue color is warning
- Blue: event

5.5. Browsing History Alarms

By viewing the alarm history, you can know the damage of the past equipment. Historical alarms are deleted alarms.

Opening Huawei UI and Browsing and click monitor to fault, from fault click alarm and select all and logs history alarm and download the csv file. The Fig 5.6 presents the historical alarm window. The Fig 5.7 shows the historical alarm filter condition and have to select the all severity which are major minor and critical.

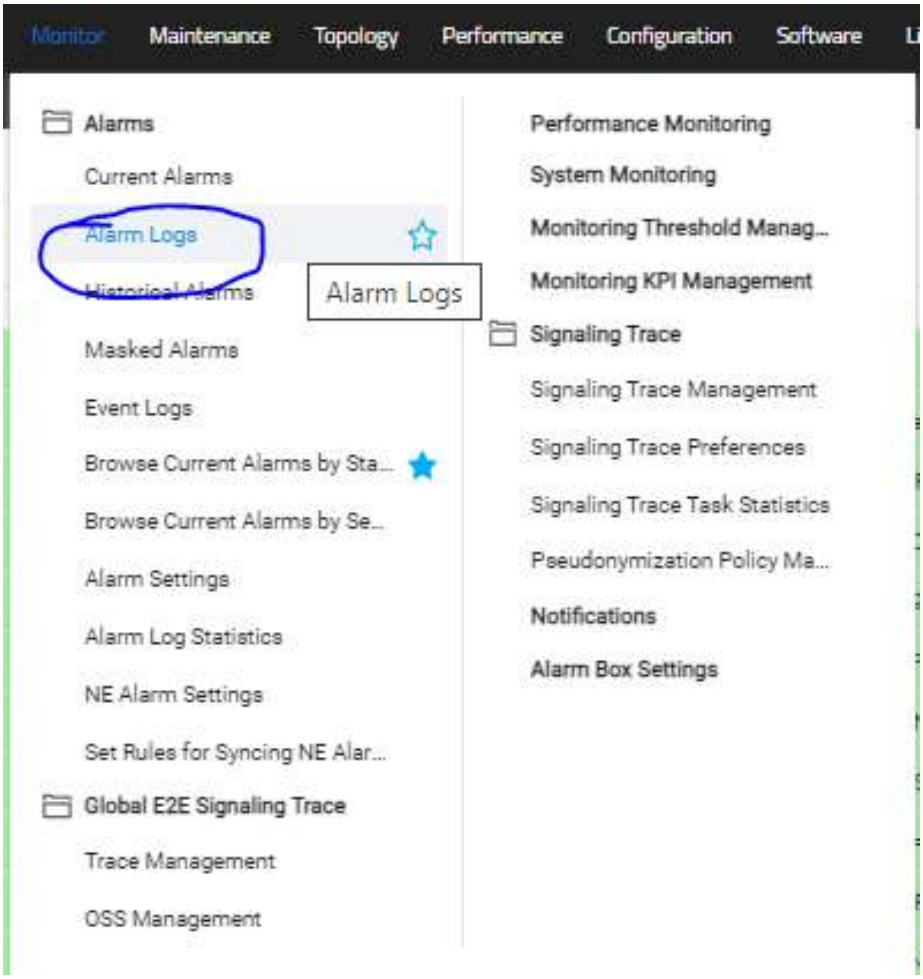

Fig 5.6: Open the historical alarm window

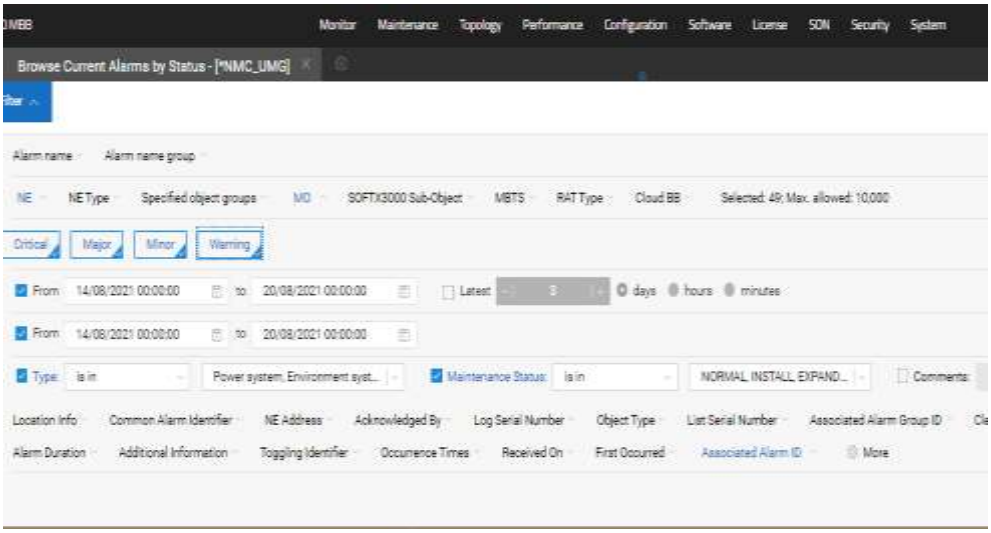

Fig 5.7: Specify filter conditions

NE Name	NE Type
CR08_vSPS01_CGP	CGPOMU
dc1USCDBSPS01	USCDB
dc1vSPS_SPS	SPSV3
dc2USCDBSPS02	USCDB
dc2vSPS_SPS	SPSV3
dc3vSPS_SPS	SPSV3
GGBO01_UMG_RB03	MGW
GGCT01_UMG_YC06	MGW
GGDH11_CGP_UT11	CGPOMU
GGDH13_UMG_KT04	MGW
GGDH14_UMG_KT04	MGW
GGDH15_AJ03	MGW
GGDH16 _UMG_GZ03	MGW
GGDH17_UMG_GZ03	MGW
GGDH18_UMG_GZ03	MGW
GGKL01_CGP_CC06	CGPOMU
GGKL01_IGWB_1st	Virtual IGWB
GGKL03_UMG_CC06	MGW
GGKL04_UMG_CC06	MGW
GSDH11_IGWB_UT11	IGWB

Fig 5.8: View of alarm information.

From the Fig 5.8 below System UI, Go to > Opening Huawei UI > Browsing History and selection to domain name and Network element.

From the fig 5.9 Opening Huawei UI and Browsing History all alarm list and download the csv file.

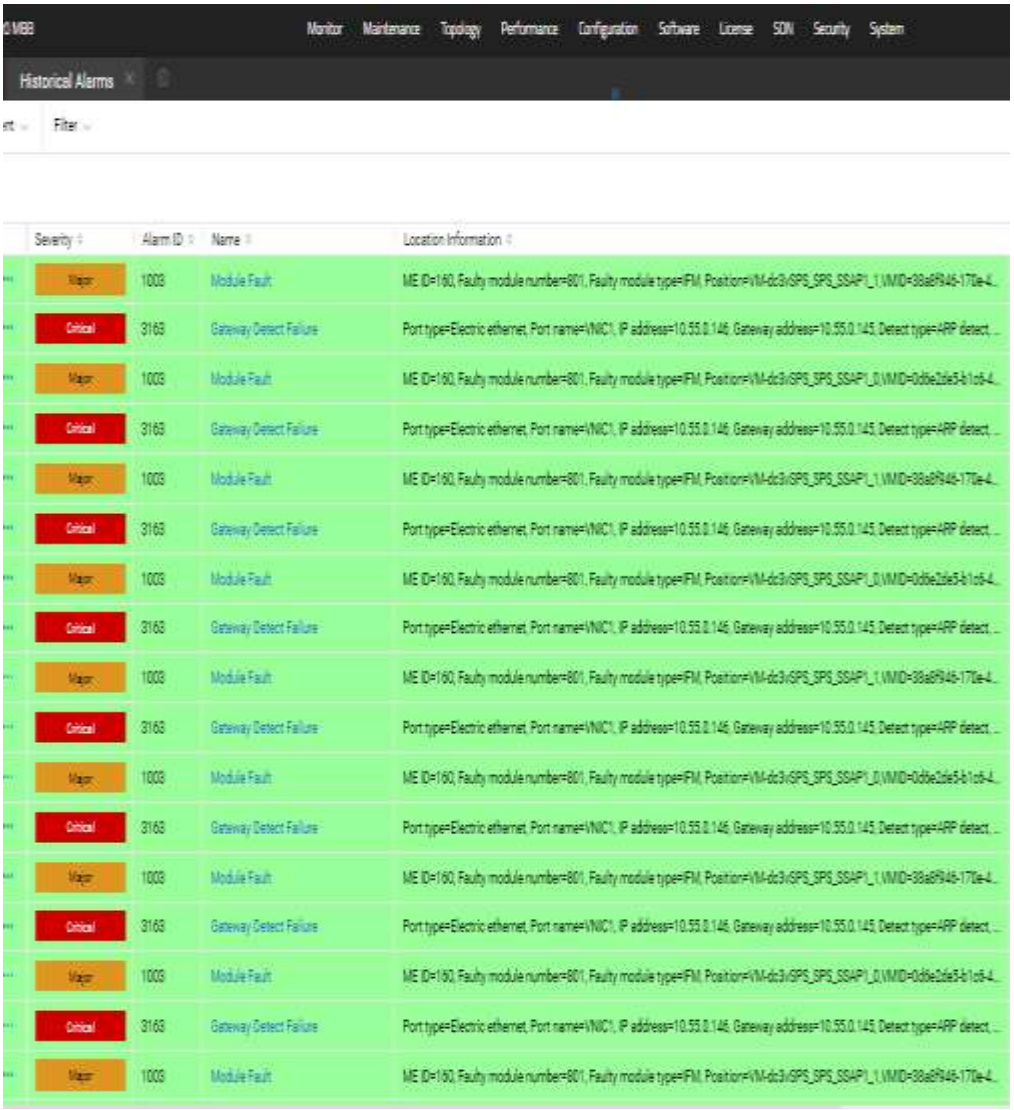

Fig 5.9: Log to clear the alarms in time.

To view historical alarms from the LCT Web, follow these steps:

Select NE from NE Explorer and click the toolbar.

Click the Browse Alarm History tab.

CHAPTER [6]

RESULTS AND ANALYSIS

6.1. The network operations center can download the terminal log reports, which has generated weekly during this period. SDH network issues can easily detected in availability reports. For the reporting and demonstration purpose, I had use Microsoft Excel. Network operations center can then begin the most frequently failures. As availability data in the database reports are expected to show trends, which used to estimate the area of network elements and network maintenance investment planning. The Future reports are including graphs shows trends over the week and ensuring the statistical accuracy of weekly and daily trends.

6.2. Availability duration

This report based on 6 divisional offices in Bangladesh, Accordingly Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Sylhet, and 2G, 3G and 4G technologies. The availability statistics for the 1-week measurement from August 14, 2021 to August 20, 2021. The graph shows the weekly average availability of each ring in the series and the total average.

6.2.1 2G Availability

- **Down time 24 hours' duration at Date wise**

  The Fig 6.1 shows the graph of 2G data down time. The graph presents the daily availability performance of 2G site down time, which are separate by different color. The period of data collection is 14th to 20th August 2021 from the different zonal offices of Bangladesh. There are 13 zonal offices in all over the country. Mentioned here Dhaka regional zone down time is very high than other zones.

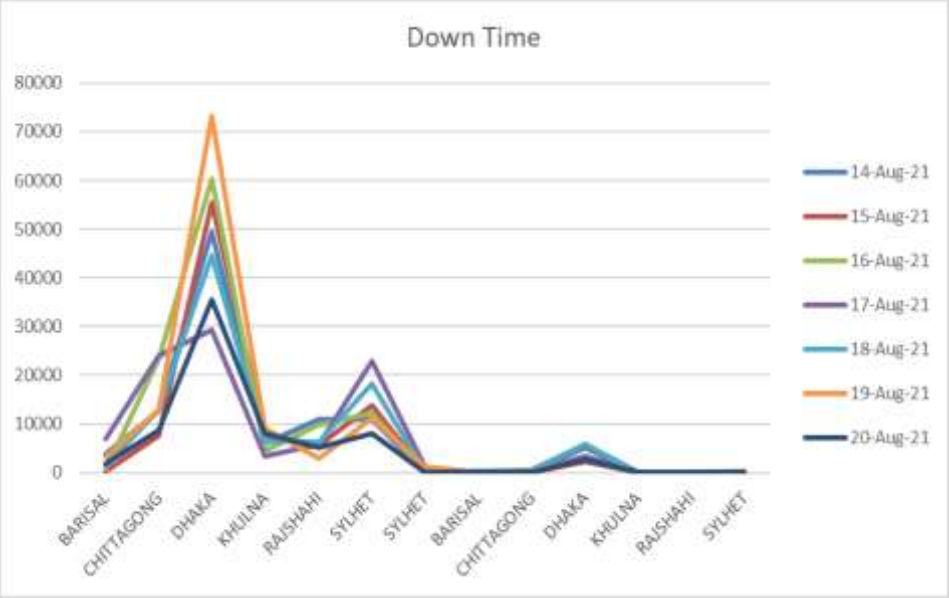

Fig 6.1: 2G BTS down time duration of day and zone wise graph

– **Availability different parameter wise**

Fig 6.2 presents the graph of 2G site daily network availability where the each day's availability is separate by different color. The period of data collection is 14th to 20th August 2021 from the different zonal offices of Bangladesh. There are 13 zonal offices in all over the country. Mentioned here availability measure on different parameter.

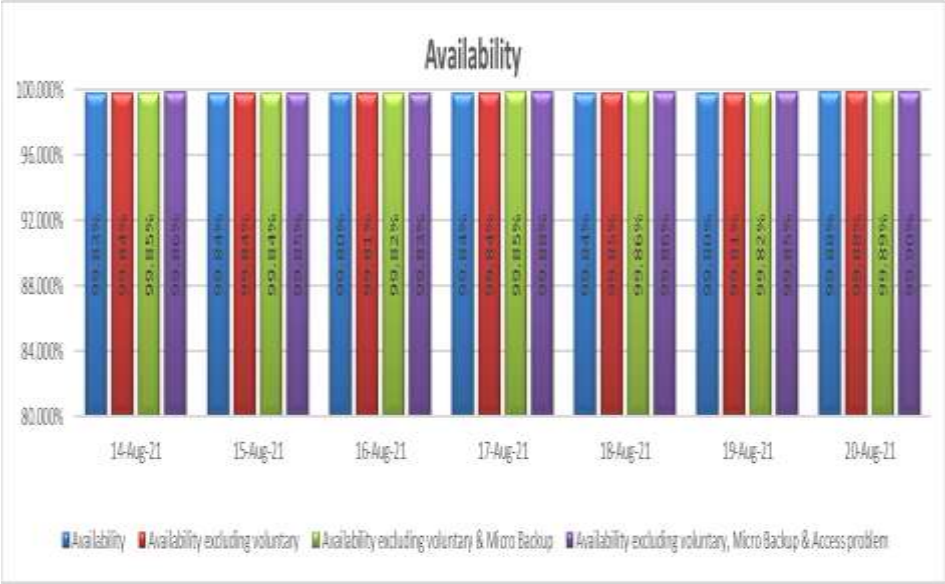

Fig 6.2: 2G parameter based availability into day wise graph

– **Availability different trouble wise**

Fig 6.3 is presenting the graph of 2G network unavailability causes of different category. Herewith all of cause category parameter are showing percentage of effect into network availability in 2G technology.

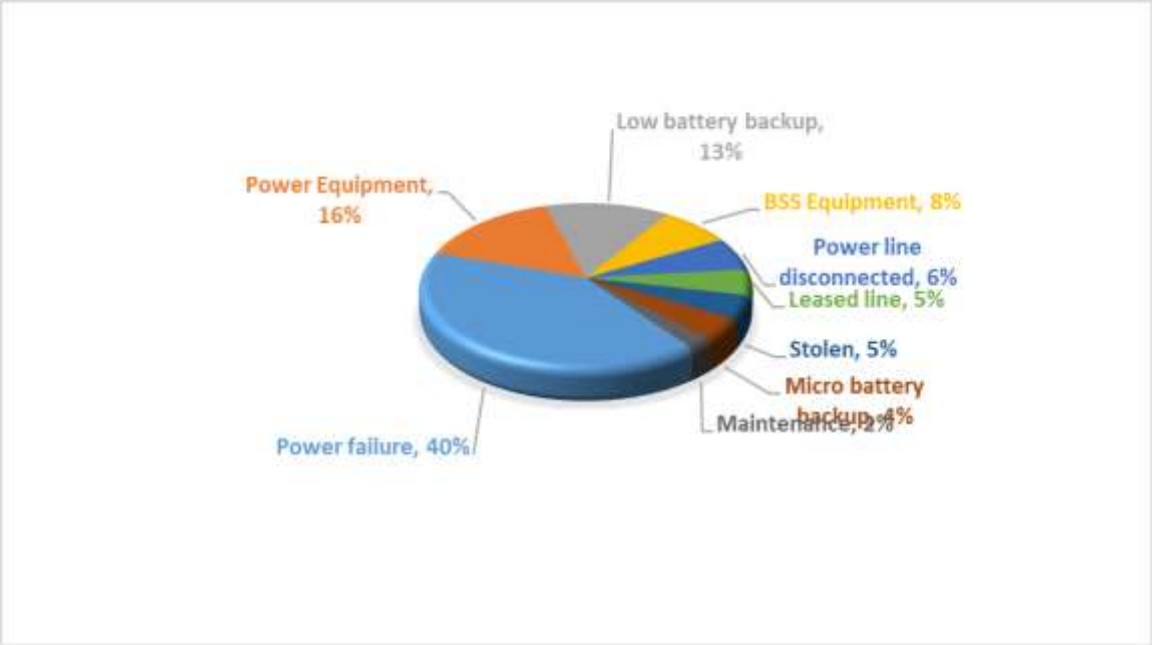

Fig 6.3: 2G BTS data Availability between different down cause wise graph

– **Daily and weekly 2G Availability**

The Fig 6.4 demonstrating the performance of network availability of individual day in a week. Herewith the performance in 20 Aug is maximum 99.88% and 19 & 16 are lowest 99.8%.

Fig 6.4: Daily 2G BTS availability graph

Fig 6.5 demonstrating the weekly performance of 2G network availability. Herewith the availability is observing almost 99.83%.

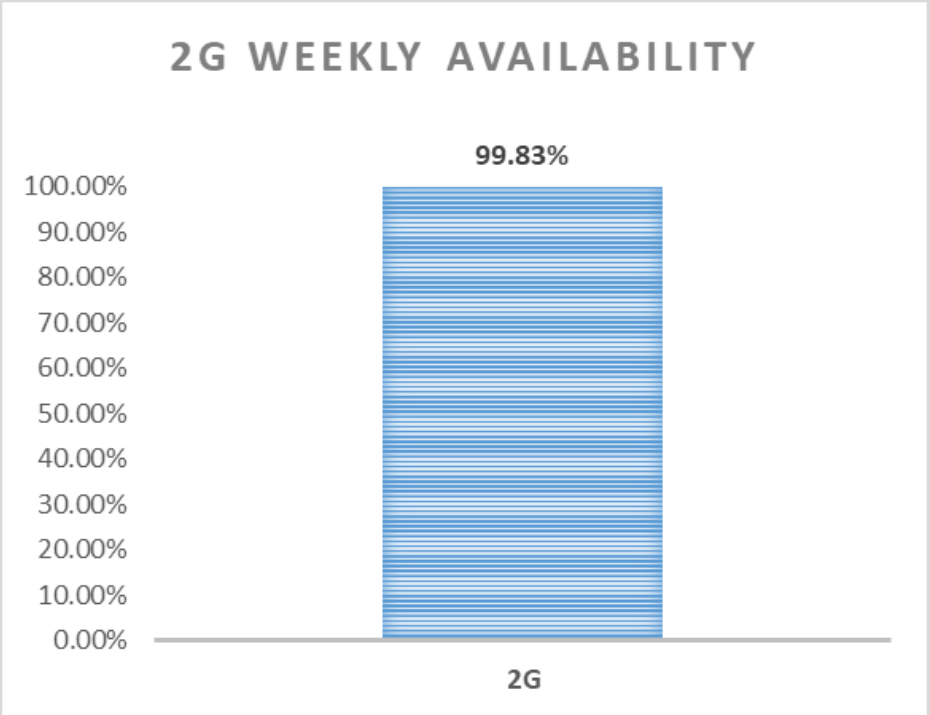

Fig 6.5: Weekly 2G BTS availability graph

6.2.2 3G Availability

– **Down time 24 hours' duration at Date wise**

The Fig 6.6 shows the graph of 3G data down time. The graph presents 3G site daily data down time, which are separate by different color. The period of data collection is 14th to 20th August 2021 from the different zonal offices of Bangladesh. There are 13 zonal offices in all over the country. Mentioned here Dhaka regional zone down time is very high than other zones.

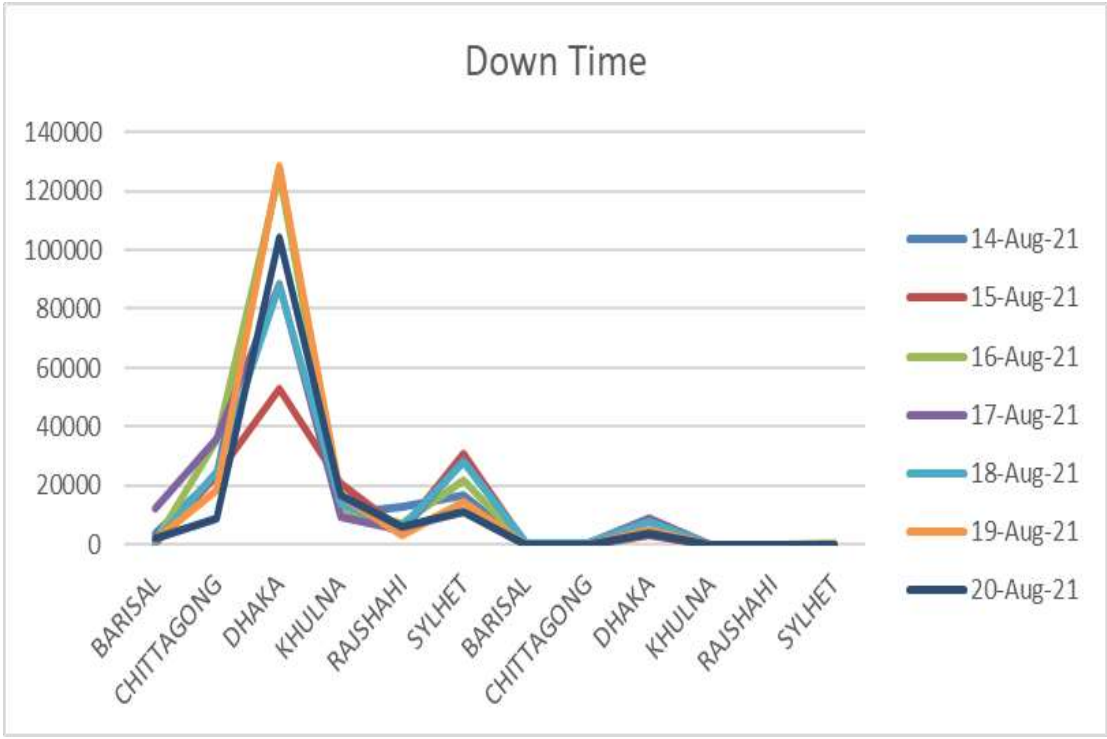

Fig 6.6: 3G BTS down time duration between day and zone wise graph

– **Availability different parameter wise**

Fig 6.7 presents the graph of 3G site weekly network availability where the each day's availability is separate by different color. The period of data collection is 14th to 20th August 2021 from the different zonal offices of Bangladesh. There are 13 zonal offices in all over the country. Mentioned here availability measure on different parameter.

Fig 6.7: 3G parameter based availability into day wise graph

– **Availability different trouble wise**

Fig 6.8 is presenting the graph of 3G network unavailability causes of different category. Herewith all of cause category parameter are showing percentage of effect into network availability in 3G technology.

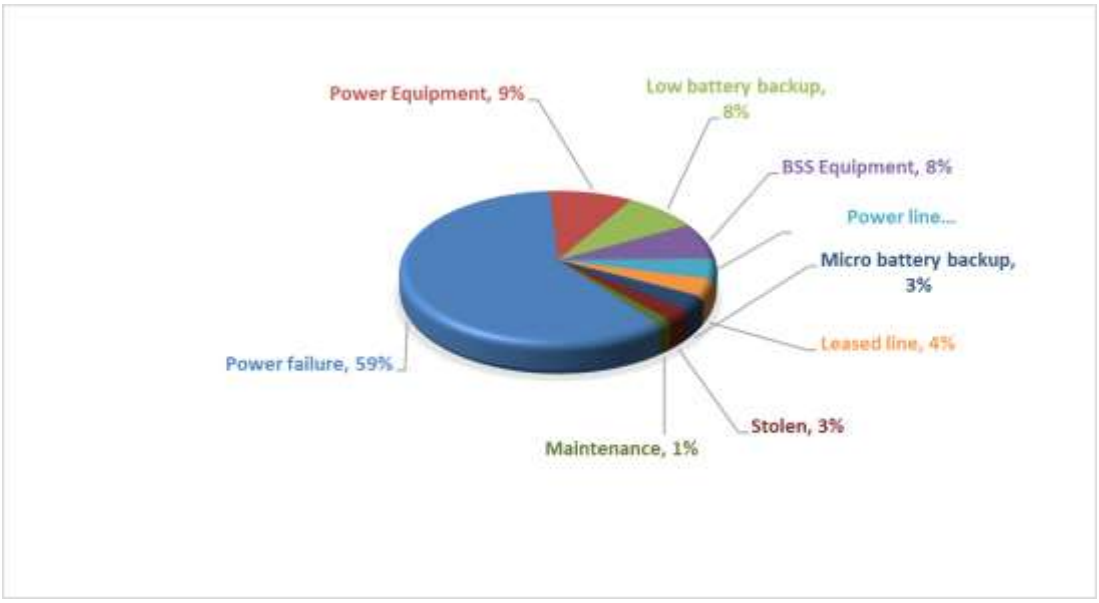

Fig 6.8: 3G BTS data Availability between different down cause wise graph

– **Daily and weekly 3G Availability**

The Fig 6.9 demonstrating the performance of 3G network availability of individual day in a week. Herewith the performance in 15 Aug is maximum 99.85% and 16 is lowest 99.78%.

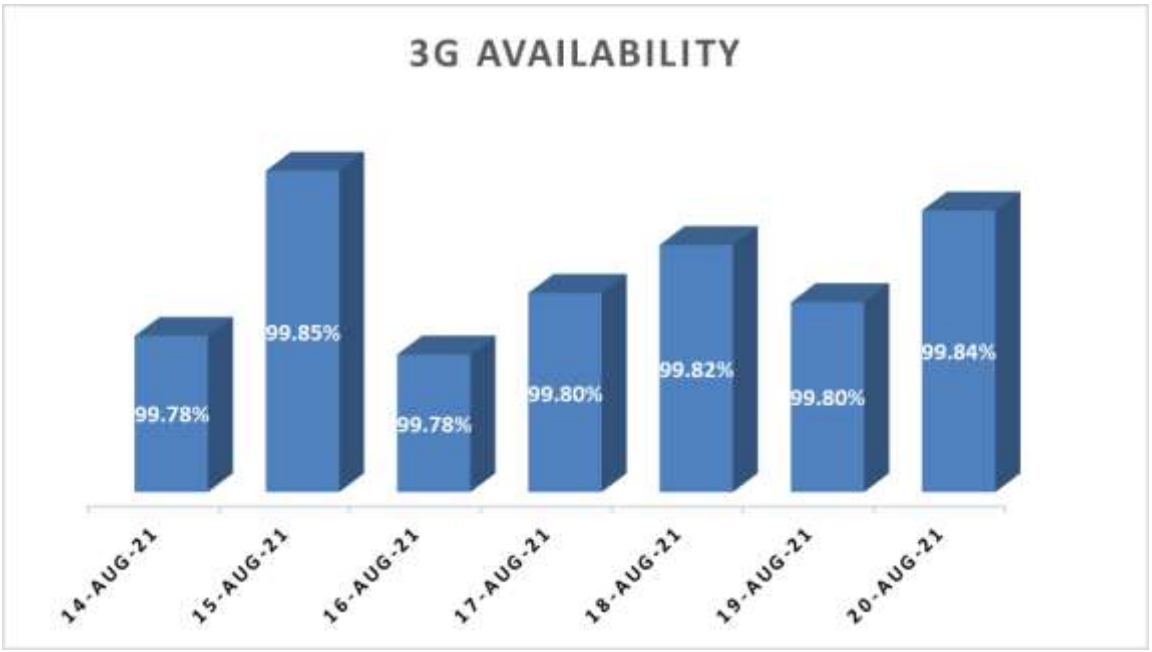

Fig 6.9: Daily 3G BTS Availability graph

Fig 6.10 demonstrating the weekly performance of 3G network availability. Herewith the availability is observing almost 99.81%.

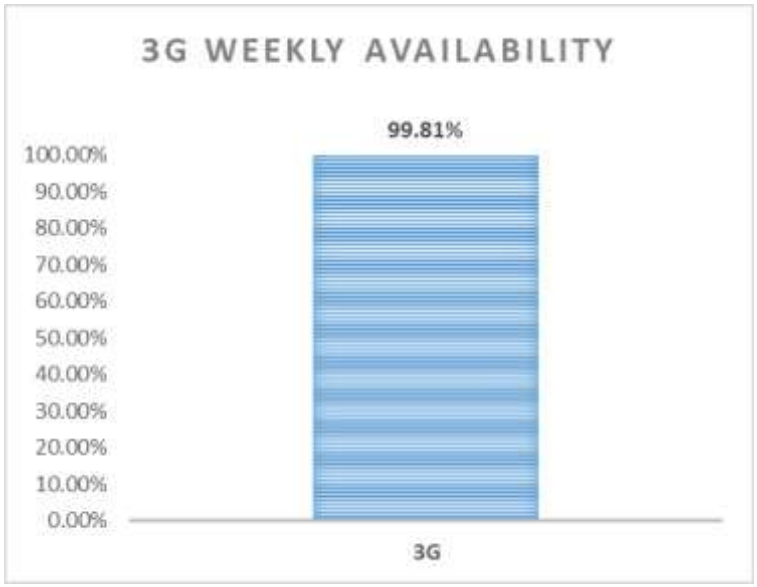

Fig 6.10: Weekly 3G BTS Availability graph

6.2.3 4G Availability

– **Down time 24 hours' duration at Date wise**

The Fig 6.11 shows the graph of 4G data down time. The graph presents the daily performance of 4G site down time, which are separate by different color. The period of data collection is 14th to 20th August 2021 from the different zonal offices of Bangladesh. There are 13 zonal offices in all over the country. Mentioned here Dhaka regional zone down time is very high than other zones.

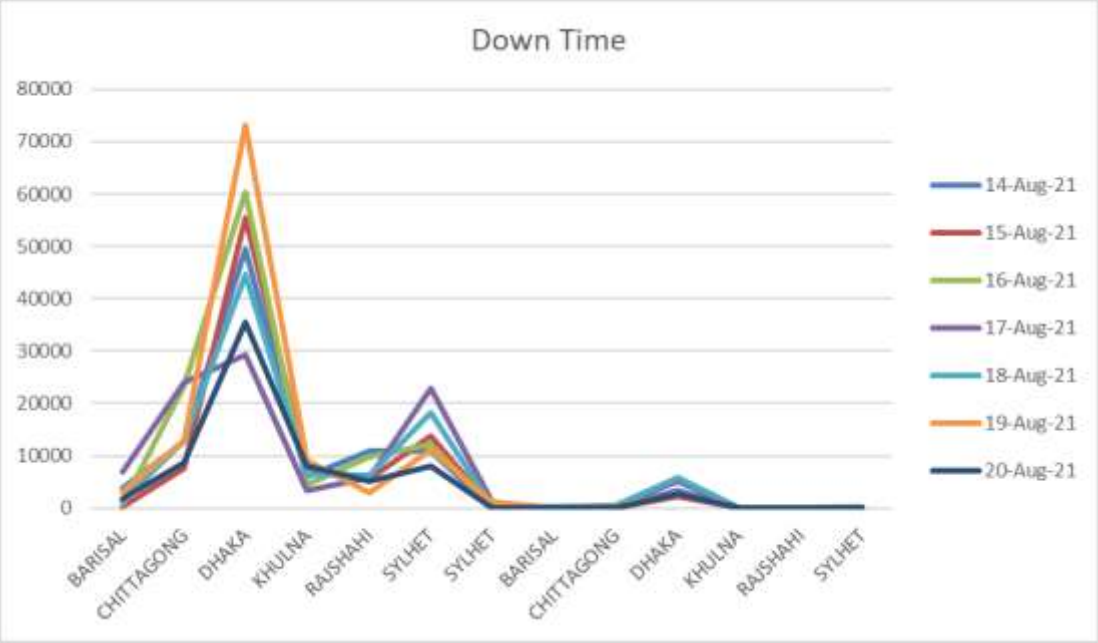

Fig 6.11: 4G BTS down time duration between day and zone wise graph

– **Availability different parameter wise**

Fig 6.12 presents the graph of 4G site weekly network availability where the each day's availability is separate by different color. . The period of data collection is 14th to 20th August 2021 from the different zonal offices of Bangladesh. There are 13 zonal offices in all over the country. Mentioned here availability measure on different parameter.

Fig 6.12: 4G parameter based availability into day wise graph

– **Availability different trouble wise**

Fig 6.13 is presenting the graph of 4G network unavailability causes of different category. Herewith all of cause category parameter are showing percentage of effect into network availability in 4G technology.

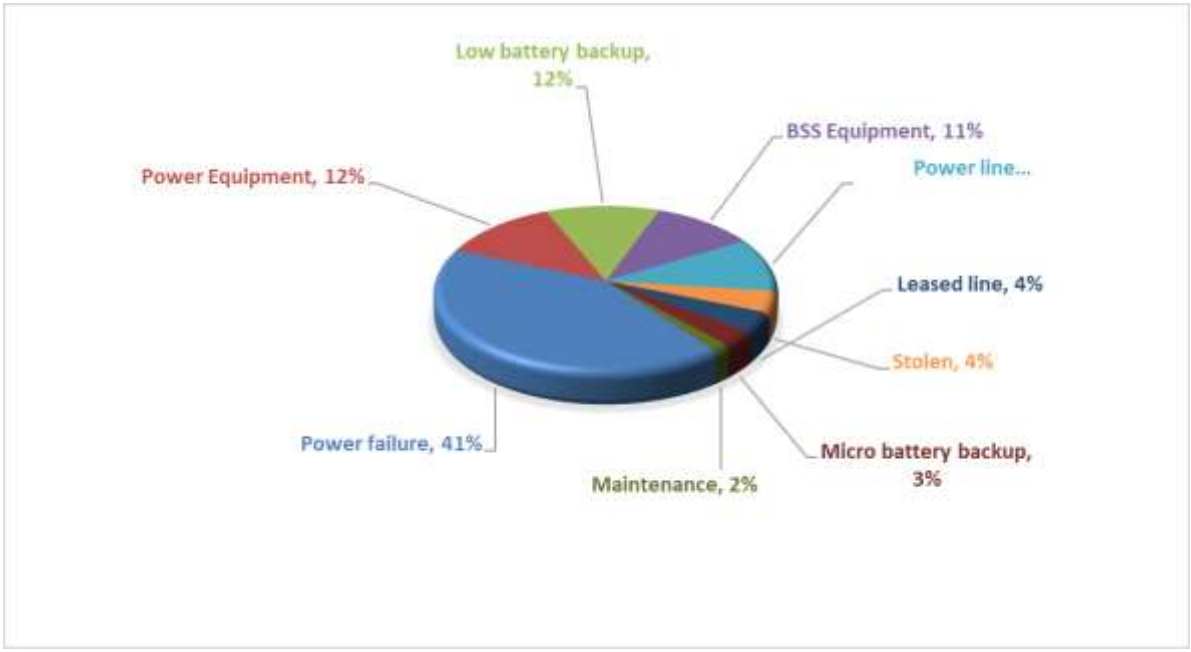

Fig 6.13: 4G BTS data Availability between different down cause wise graph

– **Daily and weekly 4G Availability**

The Fig 6.14 demonstrating the performance of 4G network availability of individual day in a week. Herewith the performance in 20 Aug is maximum 99.89% and 16 & 17 Aug are lowest 99.81%.

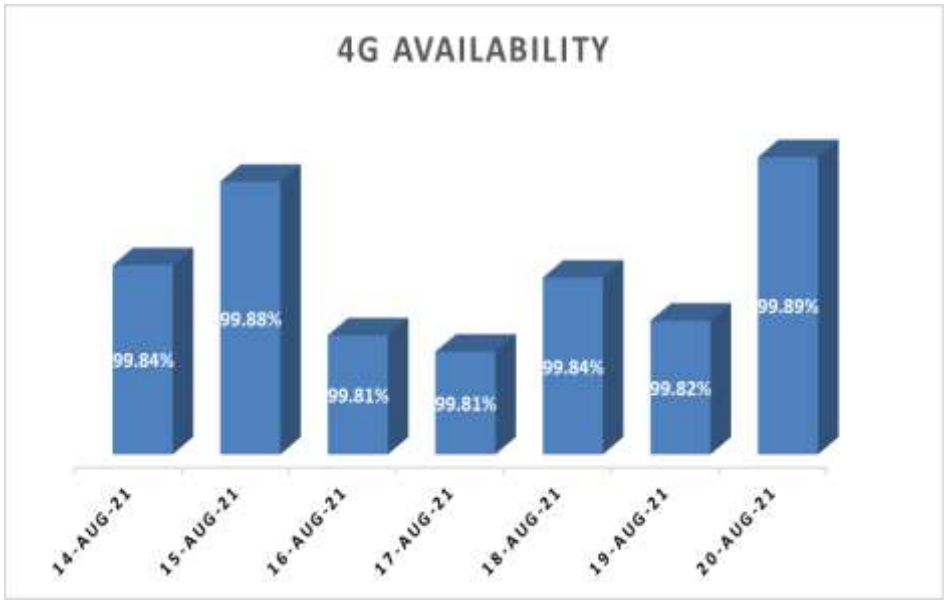

Fig 6.14: Daily 4G availability graph

Fig 6.15 demonstrating the weekly performance of 4G network availability. Herewith the availability is observing almost 99.86%.

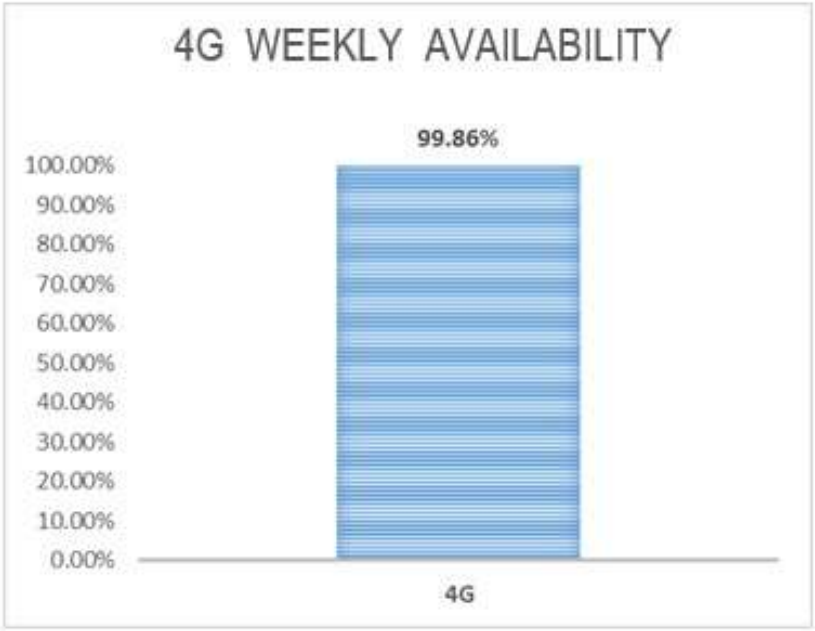

Fig 6.15: Weekly 4G Availability graph

6.3 Availability technology comparison

The Fig 6.16 is presenting the overall daily availability comparison of 2G, 3G & 4G technology from **14-Aug-2021** to **20-Aug-2021**, where the 4G technology gives the better performance than the others are.

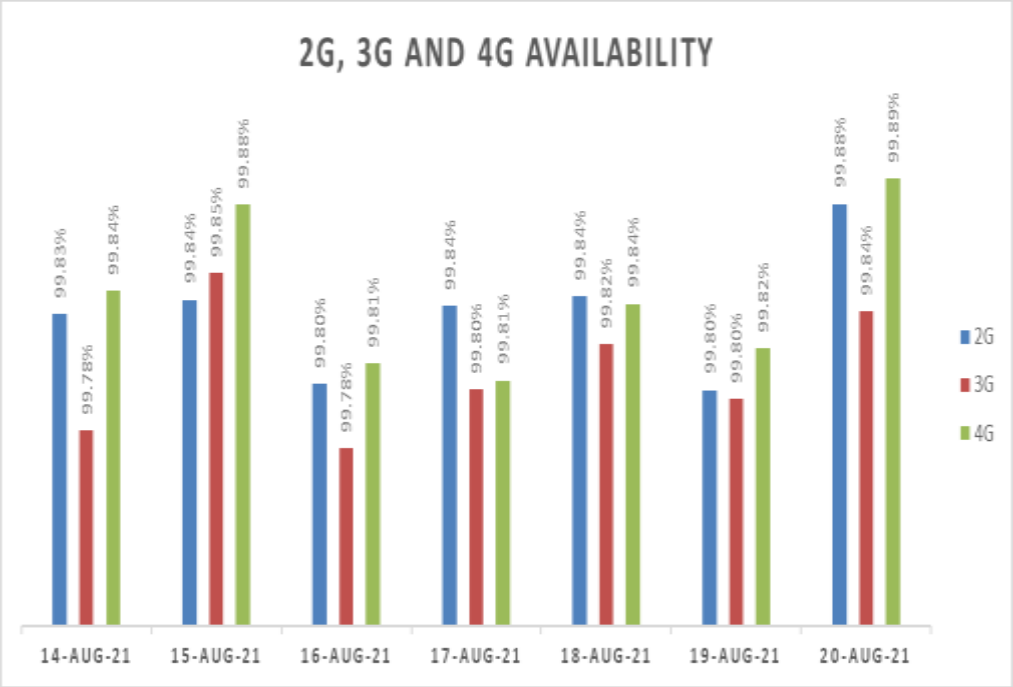

Fig 6.16: Overall daily availability comparison of 2G, 3G & 4G

The Fig 6.17 is presenting the graph of total week 2G, 3G and 4G technology arability all over the country where is 2G is performing 99.83% 3G is network is 99.81% and 4G is 99.86%. Therefore, in this comparison 4G network is best performing in this week then other network.

Fig 6.17: Overall weekly availability

– **Result and observation**

The statistics obtained over the one week shown the results and show the availability level. The network is well availability the desired level is the 99.9% service availability level, which maintains the goals of 2G reaching 99.83, 3G reaching 99.81, and 4G reaching 99.86. Its low-level availability description is some of the major obstacles in the disaster section of the ring and power lines. However, this is forward to a redundant line and does not have a significant impact on transmission.

CHAPTER [7]

CONCLUSIONS

7.1. The purpose of this project is conduct to background research and network availability and future innovation methods for the measuring network availability and applicable to the Bangladesh telecommunications industry.

Background research provides a lot of important information to consider when designing availability measurements. This information may be use to perform future requirements.

To the system implemented to measure the availability, networks has been running for some time and weekly and daily reports has presented to network operations center. The feedbacks are positive allowing both operational and transmission to investigate past trends and availability differences between both different network domains.

One-week combine and individual of statistics in the database. However, different severity failures that can occur to networks known in statistics, indicating that the statistics are working

The investigating availability trends is track networks can instruct resources to look for unit issues. That low availability may pose a future threat to the overall quality of the network. By managing maintenance and investment in new equipment, the company can reduce these spending estimates. In addition, recently highly competitive market, getting availability is high level of can be very important in order to attract and retain customers.

The proposed future task is to develop a way to measure backbone network availability from the customer's perspective. This should include a relational database that also considers network redundancy. In addition, it is interesting to assess how spinal errors affect the distribution layer. For example, short-term failures that occur when switching to an excessive number of routes.

As networks become more complex, in new applications deployed on the network become interference that is more sensitive.

7.2. Future scope of work

For enterprise operators, this is a great opportunity to consider design prerequisites in the light of the new realities of the network. What are the weaknesses reveal based on the transition to telework? What needs to be improve in light of application mix changes and the resulting performance requirements?

In any case, the end user adapts to what you offer. It is also best that the network is more flexible and artificial intelligent meet to new expectations. No one wants to users adapt to a degraded experience enterprise network.

The key to supporting today's needs is to understand the flexibility (or lack) of end-to-end network architectures.

- Implementation of the technology / protocol used,
- Advantages and disadvantages of embedded different platforms
- The main topology can handle application all requests while remaining resilient to failures.

  Each of those affects the user end experience generated, especially in the event of a failure.

CHAPTER [8]

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APPENDIX A

Definition of terms

QoS:	Quality of Service
GSM:	Global System for Mobil-telecommunication
CDMA:	Code Division Multiple Access
MANET:	Mobile Ad Hoc Network
QoE:	Quality of End-user Experience
KPIs:	Key Performance Indicators
BTS:	Base Transciever Station
IP:	Internet Protocol
TCP:	Transmission Control Protocol
iQoS:	Individual Quality of Service
CSSR:	Call Setup Success Ratio
SCCR:	Successful Call Completion Rates
UMTS:	Universal Mobile Telecommunication System
SMS:	Short Message Service
GPS:	Global Positioning System
QoE:	Individual Quality of Experience
SIM:	Subscriber Identification Module
MS:	Mobile Station
BSC:	Base Station Controller
IMEI:	International Mobile Equipment Identity
IMSI:	International Mobile Subscriber Identity
MSC:	Mobile service Switching Center
PSTN:	Public Fixed Network
HLR:	Home Location Register
VLR:	Visitor Location Register
MSRN:	Mobile Station Roaming Number
EIR:	The Equipment Identity Register
GPRS:	General Packet Radio Service
RTT:	Radio Transmission Technology