ANNUAL
REPORT
2020

BdREN

BANGLADESH RESEARCH AND EDUCATION NETWORK
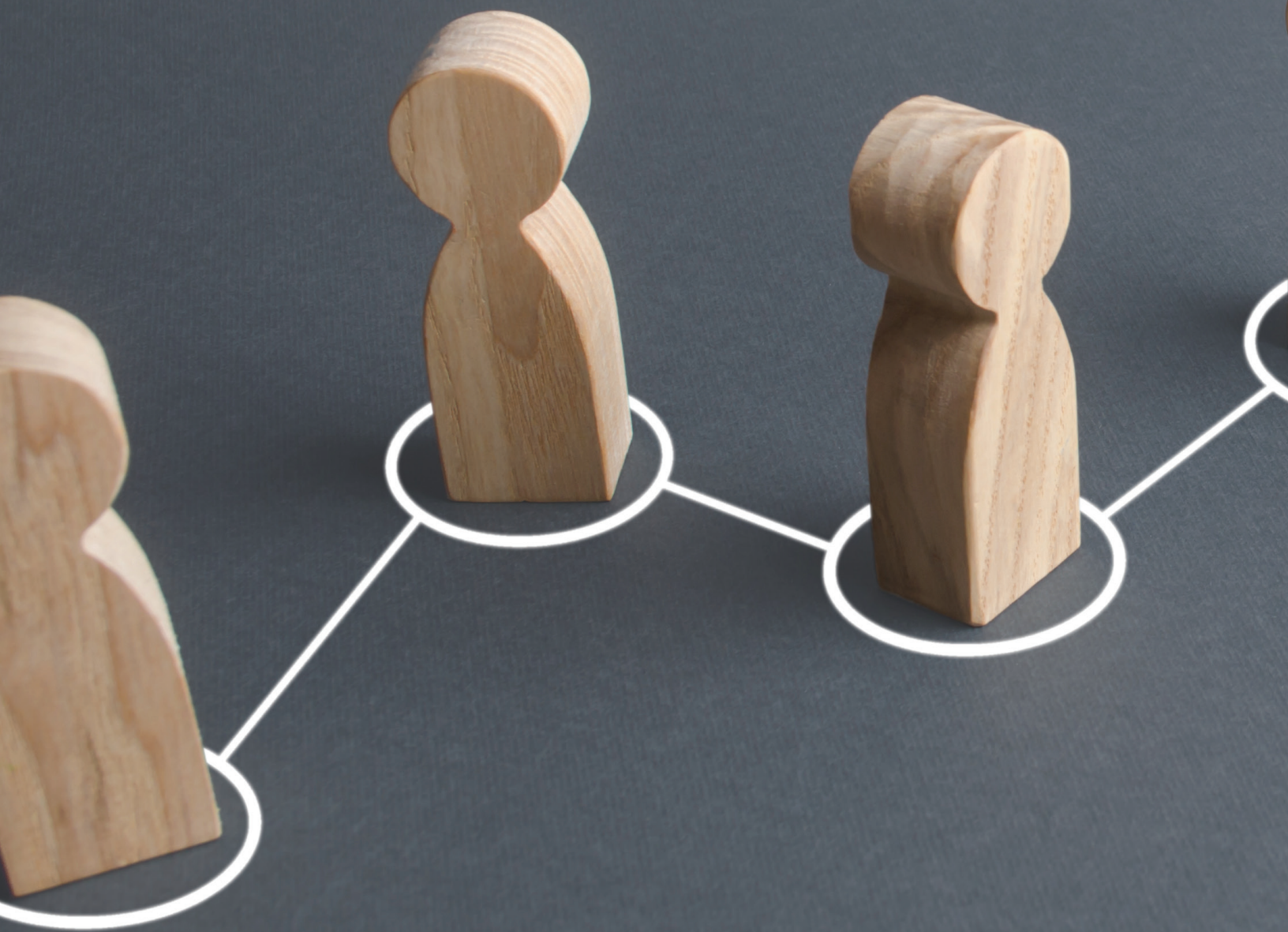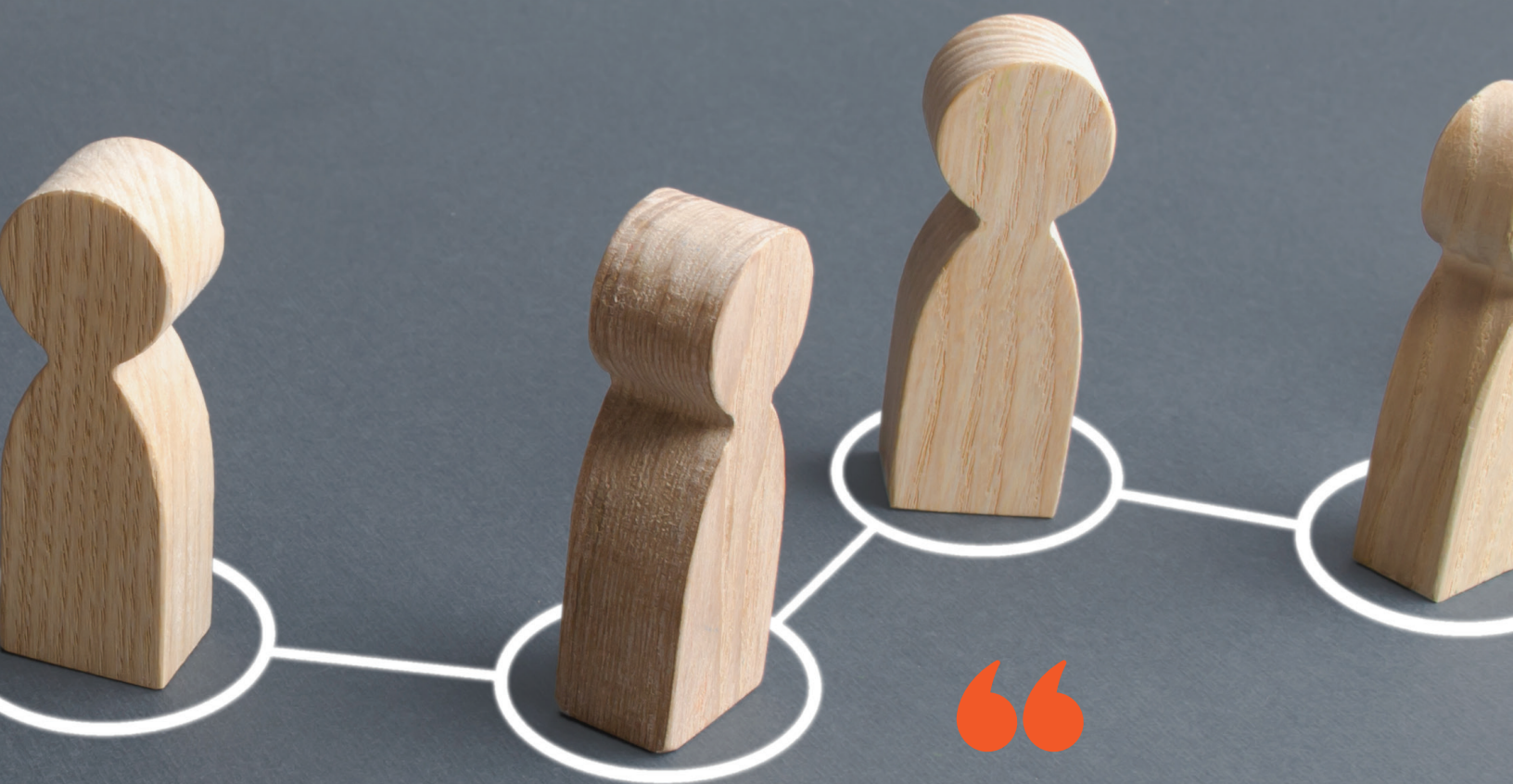
মুজিব
শতবর্ষ MUJIB 100

A humble tribute to the 100th Birth Anniversary of

Father of the Nation
Bangabandhu Sheikh Mujibur Rahman

"

My greatest
strength is the love
for my people, my
greatest weakness
is that I love them
too much...

"Daunting Support from our Member Institutions" and "Our unwavering passion for delivering quality services" are the two pillars on which BdREN is standing tall and high.

MOHAMMAD TAWRIT
CEO, BdREN

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> **"**
>
> The way BdREN tackled the huge load of facilitating conducting online classes, resulting from closure of universities and higher education institutes during the pandemic is truly remarkable and appreciable.

Begining of a Bright Future

It is a matter of delight that BdREN is going for the publication of its first "Annual Report" covering financial year 2019-2020. BdREN is still in its infancy compared to other contemporary NRENs operating in neighboring countries, but its achievements so far are quite enviable. There is no denying the fact that BdREN has already established itself as an emerging NREN in Asia-Pacific community.

Everybody will undoubtedly agree that operating as an NREN is a constant challenge. NRENs need to work in a truly dynamic as well as competitive environment considering the impediments offered by competing service providers and regulatory bodies. Hence, they need to be innovative in introducing new services along with delivery of quality services. BdREN, I strongly believe, is doing quite well in ensuring delivery of its services with highest possible availability while its satisfactory performance is drawing noteworthy appreciation from its member institutions. At the same time, it has been constantly striving to introduce new services namely Learning Management System, Digital Certificate, Plagiarism Checking and Federated Identity in quickest possible time.

It is well understood that both horizontal and vertical expansion are needed in order to survive and sustain as an NREN and also to checkmate its growing competitors. For sure it needs a heavy investment which BdREN is not capable of managing on its own and for which it depends on government assistance or grants from international organizations. Efforts are channelled into maintaining a close relationship with University Grants Commission (UGC) which is BdREN's principal stakeholder and biggest strength. At the same time, very close rapport is being developed with Ministry of Education (MoE) as BdREN needs constant support and assistance from government agencies. However, BdREN is not only banking on the funds to be released by the government or other supporting agencies. With the limited surplus which BdREN is enjoying at the moment after meeting its operational expenses, BdREN is trying to strengthen its computing resources, enrich its cloud service applications and extend its reach to newly established Public Universities and some Private Universities yet to be connected.

We all know that year 2020 was a difficult year in world history. COVID-19 has completely demolished many industries. The shock was equally felt by BdREN in terms of reduction of bandwidth demand which is the main "cash cow" for BdREN. However, BdREN could manage itself survive through its power of adaptability and innovation. The way it tackled the huge load of facilitating conducting online classes, resulting from closure of universities and higher education institutes during the pandemic, is truly remarkable and appreciable. BdREN's "zoom" license and "vSession" application accounts were distributed "free of cost" to the maximum satisfaction of the faculty members and management of the universities.

The coming year might be even more challenging considering the looming threats of lingering of the pandemic and the lowering of interest rates of FDRs which is one of the major revenue streams of BdREN. However, with unwavering support of all our member institutions and dedicated Board of Trustee (BoT) Members, I expect and believe that BdREN will be able to surmount all obstacles and will survive and sustain.

Wishing good days ahead for BdREN.

PROF. DR. KAZI SHAHIDULLAH
Chairperson, BdREN Trust &
Chairman, UGC
DECEMBER 2020

VICE-CHAIRPERSON'S
MESSAGE

❝

I hope that the strong
and substantial support
of the higher education
and research community
for the development of
BdREN will continue.

Keeping **pace** with **Technological** Changes

I am highly delighted to know that BdREN is going for the publication of its first "Annual Report" covering financial year 2019-2020. BdREN has just started its operation under the able guidance of a Board of Trustees led by honorable Chairperson Prof. Dr. Kazi Shahidullah who is our experienced guide, mentor and a source of inspiration. You are aware of the fact that BdREN has been the birth child of Higher Education Quality Enhancement Project (HEQEP) which was implemented by University Grants Commission of Bangladesh (UGC) under Ministry of Education.

Sustainability of National Research and Education Networks (NRENs) in least developed and developing countries is always a challenge. At the moment BdREN's main source of revenue is generated from the serving Universities and Research Organizations. The revenue is further yielded by the interest of the healthy endowment fund BdREN received from HEQEP. The small savings made after the operational and administrative spending are put to spur smaller investments. But, for making a big scale investment like global replacement of existing equipment, once the technology gets obsolete, BdREN needs government funding or other form of grants. BdREN is trying to arrange such financing from the Ministry of Education (MoE) through UGC.

BdREN has been providing full support to the universities and Higher Education Institutes for facilitating online education since March, 2020 when the pandemic hit the country with devastating impact. More than 15,000 faculty members are conducting online classes using BdREN Data Center platform at the moment. By upgrading the limited number of Zoom Licenses, increasing efficiency of Licenses through development of software and maximizing the usage of hardware, BdREN could mitigate the huge demand of the community. Also, BdREN managed procurement of computing resources in shortest possible time in order to support this surging demand. To ensure equal and affordable access to online education, BdREN played a major role in motivating the mobile operators to offer bandwidth at the cheapest rate for the students and the faculty members.

BdREN's future plan is to increase the span of its reach to the newly established Public Universities and to connect more Private Universities. At the same time, it is planning to procure hardware and software for supporting online education on a wider scale. Furthermore, it is planning to introduce Learning Management System (LMS) application, Plagiarism Checker, Federated Identity and other Digital Transformation Services.

It is expected that within a short span of time BdREN will establish itself as a self-sustainable National Research and Education Network and will be a role-model for other NRENs located in the least developed as well as developing countries.

Finally, I hope that the strong and substantial support of the higher education and research community for the development of BdREN will continue. Wishing BdREN a very bright future.

PROF. DR. DIL AFROZA BEGUM
Vice-Chairperson, BdREN Trust &
Member, UGC
DECEMBER 2020

CEO'S
MESSAGE

❝ I have strong belief in the capacity of the young energetic workforce striving constantly and spontaneously with their fullest potential for the cause of BdREN. With such dedicated workforce at our disposal, there is no way BdREN can stay behind.

Striving to rise
Overcoming Challenges

I am privileged and honored to take steps in publishing the first Annual Report of BdREN Trust. BdREN, established as a component of HEQEP over a period of almost 10(ten) years, has been running under full operational and strategic control of the 11(eleven) member Board of Trustee since 2019. I apologize that I couldn't bring the Annual Report for the fractional year 2018-2019 to letters even with my sincere intention to do so. However, this time we have come up with new pledge and renewed vigor. As such, we could thrive at the very end.

The journey for this year was gruelling and challenging as well. The outbreak of COVID-19 in the later part of the financial year shook the world and we were not spared. As a fallout resulting from that disaster, the demand of both Internet and Research Traffic plummeted. However, there was the other side of the coin. During this period of global crisis, we could come forward extending our hand and offering our "Licensed Zoom Application" for the higher education community to pursue online delivery of lectures which was the only solution at a time when all educational institutions were declared closed by the government.

More than 15,000 faculty members have so far registered in the platform. The number of conducted classes skyrocketed from less than 100 in March 2020 to almost 150,000 in the month of June 2020. Many new organizations joined BdREN taking their membership paying nominal fees although the Zoom Service was offered totally "Free of Charge". BdREN, once not that beneficial to many, became the main attraction and to certain extent indispensable. That was the spectacular gain BdREN could reap during this pandemic.

The Revenue Collection was more or less as forecasted. In terms of Operating Revenue, we could meet the speculations with slight increase in Revenue in the Private University category. Development in terms of cutting cost was significant and it was mainly achieved through enhancing our efficiency in operation and maintenance of the equipment.

Meeting the Non-operating Revenue has become a challenge due to the drastic reduction in FDR interest rate by the government. However, maintaining effective communication and using our strong private network we could manage getting the maximum interest rate available in the market and thereby we scraped through and met our target.

As far as value added services are concerned, we could bring 20 campuses under eduroam coverage as of June, 2020. We are now trying to strengthen our position by making ourself available in the eduroam global map and also trying our best to improve the eduroam security. Moreover, we are on the verge of creating the first "Federation" of the country taking help from an Asi@Connect project iFIRE. At the same time, we are putting our efforts to make the installed Applications at our Data Center more secured. We are also working with the latest technologies like Blockchain and Software Defined Networking (SDN).

With no sign of the pandemic letting up, next year might be even more challenging. Under that scenario we must continue keeping the Video Collaboration service up and running. It will entail us focusing our attention more on increasing the computing capacity of our Data Center and at the same time being more focused on arranging the Video Collaboration Application Licenses at the lowest possible cost. We are continuing our drive in maintaining the Zoom Application Licenses. Our tireless effort is being accelerated by our strong collaboration with the Asi@Connect community and NORDUnet with whom we have strategic partnership agreement. Also, we are trying to extend our reach to the newly established Public Universities and to the Research Institutes as

well as Private Universities distributed across the country. Last but not the least, we are planning to leverage on our Data Center resources for our sustainability in the coming days.

I have strong belief in the capacity of the young energetic workforce striving constantly and spontaneously with their fullest potential for the cause of BdREN. With such dedicated workforce at our disposal, there is no way BdREN can stay behind.

At the end, I express my heartfelt thanks and gratitude to all BdREN officials who contributed substantially in framing this Annual Report. My special tribute goes to Dr. Gauranga Chandra Mohanta, ndc ex-Project Director, HEQEP and Additional Secretary for reviewing the report to make it linguistically flawless.

I wish coming year will usher fresh hope and brighter prospect for BdREN.

MOHAMMAD TAWRIT
CEO, BdREN
DECEMBER 2020

EXECUTIVE
SUMMARY

01 BdREN was established with the objectives of facilitating research and higher education in Bangladesh and to work in a way so that they can make a transformation of digital services being offered to the universities, higher education institutes and research institutes of the country . This annual report spans across a period from July 2019 to June 2020. During that period BdREN could earn a Revenue of BDT 200.02m with an Expense amounting to BDT 116.86m sans Financial Expense, Income Tax, Depreciation and Amortization resulting in an EBITDA of BDT 83.16m. The Total Asset value was found to be BDT 2482.92m as on 30 June 2020. The financial status was found to be quite satisfactory and was in line with its long-term sustainability plan.

02 BdREN started its noble journey with an endowment fund of BDT 896.70m from Government of Bangladesh through HEQEP. BdREN, leveraging on its operational, marketing and financial efficiency, could capitalise a net cash inflow of BDT 153.30m since starting its effective commercial operation in 01 January 2018. This cash inflow could add to its cash deposit at Bank which stands at present BDT 1,050.00m in the form of FDR. Interest drawn out of this FDR has resulted in a significant increase in BdREN's non-operating income.

03 In terms of service quality BdREN's overall Network Availability was 99.69% calculated on a yearly average with a total traffic of 29.25 TB Inbound and 6.46 TB outbound. HPC usage in terms of computation surged to a value of 483.15 GHz and the maximum memory usage was 1782.46 GB. The total number of member of institutions rose to 67 of which 36 are Public University, 18 Private University and 13 Research Institution.

04 With the outbreak of COVID-19, BdREN, at the request of UGC, provided support for conducting online education using the Zoom platform. To increase the efficiency of Zoom licenses vSession Application was developed by BdREN Software Team which turned out to be a flagship achievement. The utilization of Zoom Application surged remarkably during the last quarter and could contribute holding 6,82,936 meetings attended by 276,39,319 participants. In total 15,780 faculty members joined BdREN Zoom Platform to conduct classes from 166 institutions, both public and private. On-Prem Zoom Application was installed which allowed mobile operators to come forward with a cheap and affordable data package. Due to "On-prem" mode of operation managing hardware for 1000+ concurrent classes evolved formidable challenge which BdREN engineers could overcome with their innovative ideas and an impressive grasp of advanced technologies. Computation Resource was shared with Nepal REN which became one of the pioneer examples of Data Center Resource Sharing among Asi@Connect Communities and one of the prime examples of high level of collaboration among the Asi@Connect partnering countries.

05 In Introducing innovative activities BdREN was not lagging behind. In total 20 institutions with a total number of 1912 Access Points were brought under eduroam, the global Wi-Fi roaming facility. Identity Federation Service has been tested and it is on the verge of implementation.

06 In terms of connectivity, 45 Mbps BdREN-Singapore global R&E connectivity was upgraded to a 1000 Mbps BdREN-NKN link. The connectivity with Domestic IXP was upgraded to 10Gbps, local Google Cache Server was installed with 4Gbps connectivity which allowed the users enjoy better YouTube videos. New Distribution nodes were installed at BSMRAU and IUBAT for giving member institutions in Gazipur and Ashulia area a stable and reliable service.

07 With regard to planned Activities introducing Learning Management System (LMS) has been found to be the urge of the time and BdREN Engineers are customizing its own LMS application. Along with that Backup & Restoration as a Service at the Data Center is also actively planned. All preparation relating to introduction of Identity Federation services and eduGAIN have been completed and they are going to be introduced soon. This will again bolster BdREN's reputation. The software team is developing eFile system for BdREN and Reporting System for UGC.

08 A good number of Research activities have been performed using BdREN Data Center. The departments and institutes that have actively pursued their research activities are the Department of EEE-DU, Department of Biochemistry and Molecular Biology-DU, Institute of Information Technology-DU, Department of CSE-DU, Department of Physics-DU and Bangladesh Agricultural University.

09 In imparting training and conducting capacity development program 12 such programs, both national and international, have been conducted during this period. These include both virtual and on-site training. They were participated by faculty members, students, network engineers, and other professionals in Bangladesh and countries across Asia. 3 (three) international seminars were conducted involving NREN Policymakers, Networking Experts, as well as Faculty Members.

10 The report has dedicated a separate chapter containing the feedback that have been collected from BdREN's member institutions. The feedback was collated from a survey conducted among the BdREN's members. In the feedback BdREN's Internet Service was reported by most of the members to be either "Good" or "Excellent". Service Availability, 24x7 Support, Single Point of Contact [Help desk] and Technical Resources were rated as strengths by the members which are immensely encouraging for BdREN.

"Organization of trainings/workshops" was ranked as a major weakness. Most of the members were found to be satisfied with the NOC performance. Along with that Internet Bandwidth, Online Education Platform and eduroam were rated as the "Flagship" services of BdREN. 13 out of 17 respondents expressed their satisfaction on BdREN installed campus network which is highly satisfying for BdREN as enormous amount of time and energy were dedicated in installing and commissioning of those campus networks.

It was further revealed that members are using the Public Cloud Services more than that of BdREN offered cloud services. All members were found to be interested in using security services

from BdREN. Most of the members (17/28) particularly in Public University Category (9/14) reported that the services offered by BdREN are better than other vendors which was fascinating to know. 51 out of total 56 respondents agreed that BdREN has a strong impact on Academic and Research Community.

A number of R&D activities were performed by BdREN engineers. Some of the notable research activities were enablement of F-ticks to report eduroam authentication, development of voltage and temperature monitoring software, vSession Application for video conferencing, Zoom Reporting Application and vPresence software.

Also eRecruitment system was introduced by BdREN with which BdREN's present recruitment is being taken place using online portal. Alien wavelength was successfully tested by BdREN Transmission Engineers in collaboration with Tejas Network Engineers.

It's evident from the mentioned activities that BdREN could establish itself as one of the emerging tigers in the global NREN community.

WHO
WE ARE

Since 2015, Bangladesh Research and Education Network (BdREN) has been providing high speed, best quality internet and collaboration services to its member institutions within the Bangladesh research and education sector.

OUR MISSION

Implement, manage and extend self-sustainable e-infrastructure dedicated to be used for research and higher education community of Bangladesh

Boost / Strengthen collaborative research and education among national, regional and international REN communities through state-of-the-art e-infrastructure and e-services.

Ensure global mobility and availability of e-resources through e-infrastructure applications.
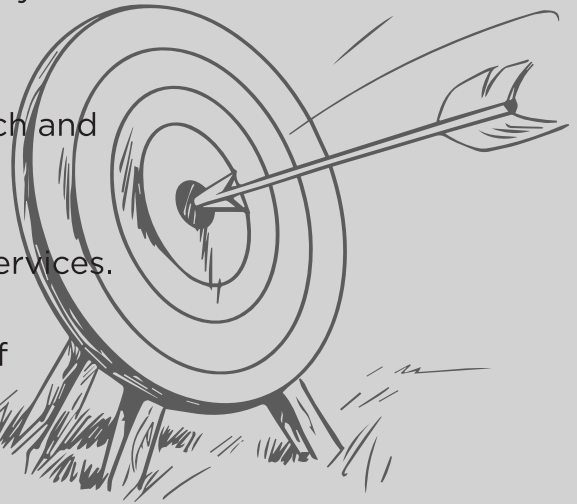
OUR VISION

Develop a self-sustained collaboration platform / gateway for Bangladeshi Researchers and Educators to strengthen and boost science, education, culture and innovation of Bangladesh through high performance advanced e-infrastructure.

Collaboration and Engagement: BdREN will nurture collaboration and sharing of resources among members.

Sustainability: BdREN will endeavor to be self-sustaining in all its operations.

Integrity and Fairness: At all times BdREN will operate in an atmosphere that ensures impartiality, transparency, and accountability in its operations.

Innovation and Creativity: BdREN will actively seek appropriate solutions for continuous improvement.

Excellence: BdREN will be guided by the need to maintain the highest standards in its operations.

ENGAGEMENT

EXCELLENCE

FAIRNESS

INNOVATION

CREATIVITY

SUSTAINABILITY

INTEGRITY

COLLABORATION

OUR **VALUES**

WHAT MAKES
BdREN UNIQUE?

WebRTC BASED COLLABORATION

BdREN provides WebRTC based collaboration platform along with its own developed scheduler application which facilitates its member institutes to conduct online meeting, online classes, online exams at no cost. Agreement with different mobile operators also facilitates the end users enjoy these services at affordable cost.

GLOBAL WI-FI HOTSPOT 'EDUROAM'

Global Wi-Fi hotspot 'eduroam' is deployed at BdREN and also in a number of campuses to enhance the facility to access internet service not only within the campus, but also from anywhere in the world where this service is available. Users having an account at eduroam database can get access to the internet free-of-cost whenever the legitimate user is roaming in the eduroam hotspot without asking credential from local authority.

NRENS ARE INTERCONNECTED

All the NRENs are interconnected through highspeed separate broadband connection around the globe. Users connected to the local NREN are able to collaborate with the researchers of another geographic area using this specialized network and can access the available large database of research data.

ASI@CONNECT

Asi@Connect, a conglomerate of all countries in Asia and Pacific, releases funds for different types of projects. NREN and its Member institutes can submit their project solely or in collaboration to get fund to pursue their dream.

BdREN
HISTORY

2009 — 01 BdREN started under HEQEP

Leased 3200km OPGW
from PGCB 02 — **2011**

2012 — 03 Connectivity with TEIN

BdREN pilot phase
completed (Six Univ.)

Non-Profit BdREN trust formed
HEQEP Second phase started 04 — **2014**

2015 — 05 BdREN first Phase
completed (34 Univ.)

BdREN second phase
completed (25 Ins.) 06 — **2018**

2019 — 07 BdREN trust in operations
TEIN connectivity through NKN

STRATEGIC
PLAN

01
Establish global footprint and
Ensure global connectivity to provide
any to any reachability

02
All services directed to member
institutes will be under single
umbrella

03
Upgrade and uphold the quality
of service in line with global
standard

04
Drive and facilitiate
multicultural research
project

05
Enrich global
collaboration activities

06
Better environment (Green),
better education

07
Ensure low-cost services without
compromising quality

08
Ensure sustainability

09
Ensure transperancy and
accountability

BdREN
ORGANOGRAM

CEO

General Manager
Operations and Planning

General Manager
HR, Admin & Finance

1xManager
Data and Transmission Network

Sr. Network Engineer
Data and NOC

Sr. Network Engineer
Transmission

Network Engineer
Transmission

Sr. Technician
Transimission

5xTechnician
Optical Fiber

7xNetwork Engineer
NOC

Sr. Technician
Data and Facilities

Technician
Data

Technician
Air Conditioner

Technician
Power

1xManager
Data Center

1xSr. System Engineer

1xProgrammer

1xManager
HR, Admin & Finance

Asst. Manager
Finance & Accounts

Asst Manager
HR & Admin

4xDriver

3xOffice Support Staff

1xCleaner

BdREN
IN NUMBERS

Usage statistics and service performance in 2019-2020

1 99.67%
Nationwide

2 99.68%
within Dhaka
>>SLA:99.00%

3 99.66%
Outside Dhaka
>>SLA: 98.00%

NETWORK AVAILIBILITY

Period:
July 2019-June 2020

ZOOM & vSESSION

Period:
Jan - Oct 2020

1 **166** Institutes

2 **15,780** Users

3 **6,82,936** Meetings

4 **6,57,615** Meeting Hours

5 **2,76,39,319** Participants

6 **1000+** Concurrent Meeting

BdREN TOTAL MEMBERS

As at
June 30, 2020

1 **36** Public University

2 **18** Private University

3 **13** Research Institutes and others

BdREN
IN NUMBERS

TOTAL TRAFFIC

Period:
July 2019-June 2020

1 | 29259 TB
INBOUND

2 | 6463 TB
OUTBOUND

1 | 483 GHz
COMPUTE

2 | 1782 GB
MEMORY

MAXIMUM HPC USAGE

Period:
July 2019-June 2020

1 | 20
No. of IdP

2 | 20
No. of SP

3 | 1912
No. of APs

eduroam

Period:
July 2019-June 2020

TOTAL ASSET
BDT
2482.92 m

TOTAL EXPENDITURE
BDT
304.36 m

TOTAL REVENUE
BDT
200.02 m

FLAGSHIP
ACTIVITY

01 vSession

An application software was built by BdREN Software Team at the lowest possible time which acted as a scheduler to create Zoom Meetings on its own collecting demands from the host. This enhanced the efficiency of utilization of Zoom Licenses many a times which could eventually helped BdREN in mitigating the surging demand of holding online classes from the community.

02 On-Prem Zoom Installation

BdREN Engineers could successfully install the "On-Prem" Zoom version with all its paraphernalia which enabled creation of Zoom Meeting within BdREN Data Center. On fulfillment of that condition set by NORDUnet, the allocated Zoom Licenses were increased by an additional 50%. During such a global crisis, the additional licenses helped BdREN in satisfying the burgeoning demand of the faculty members. Moreover, this feature helped the Mobile Operators to go for affordable data packages because in this framework the mobile operators could dispense with costly internet bandwidth.

03 Resource Sharing

At the outbreak of COVID-19, Bangladesh started its journey to provide online classes to its education sectors using Zoom platform. Following similar strategy, Nepal also started its online classes almost at the same time. But, Nepal REN encountered one critical problem due to shortage of their resource capacity in terms of assigning computing resources for installing MMR. BdREN extended its helping hand towards Nepal REN by providing 5 (Five) MMRs which were installed at BdREN Data Center. This ushered a new era of cross-border computing resource sharing which never happened in the community.

04 Identity Federation

On test basis BdREN deployed its Federated Identity Service in its Data Center and integrated Zoom application as a service in this test platform.

05 Eduroam

BdREN commissioned eduroam service way back in 2017. Now, it is in the process of extending this service to its Member Institutions. Very recently F-Ticks parameters have been configured at National Radius server to monitor roaming users' statistics from Global Platform. It will establish BdREN's global footprint in eduroam community.

06 Upgrading Connectivity with Global R&E Network

BdREN upgraded its connectivity with Global R&E Network by expanding its bandwidth from 45Mbps to 1000Mbps. The new connectivity is established with National Knowledge Network (NKN) of India.

07 Commissioning of GGC Node

Global Google Cache servers are installed at BdREN Data Center to provide Google caching service to its esteemed member institutions. This is saving around 4.5Gbps Internet bandwidth.

08 Upgrading Connectivity with IXP

Internet eXchange Point (IXP) was established to connect all local ISPs to route and share traffic among themselves instead of routing through internet. BdREN connected itself to one of these IXPs through 10G redundant connectivity which is giving better experience to its users in terms of delay, jitter and cost.

09 BGP Route Validator

BGP route validator server is installed at BdREN Data Center to validate routed origination or source using Resource Public Key Infrastructure (RPKI) validator.

10 Commissioning of new Virtualization Platform

Apart from proprietary VMware platform, BdREN deployed KVM based ProxmoxVE virtualization platform in its Data Center. This virtualization software could enhance the computing and memory utilization many times facilitating configuration of more than double MMRs which were required for conducting Online Classes using Zoom application.

PLANNED ACTIVITY
FOR FUTURE

With a vision to support our esteemed users, BdREN is planning to deploy new services and service platforms mentioned below:

01 To conduct online academic activities along with storing of its respective contents at least for a period of one year, BdREN is planning to deploy Learning Management System (LMS) and to offer it as LMS as a Service to its member institutions.

02 Currently, BdREN provides Infrastructure as a Service (IaaS) with CPU which is not sufficient for the researchers who work in the area of Artificial Intelligence (AI), Machine Learning (ML), Signal Processing or Image Processing. To support the respective researchers' demand, BdREN is going to deploy GPU based servers and offer them as "GPU as a Service".

03 Having a large capacity of storage (200 TB in DC + 200 TB in DR), BdREN would like to introduce backup and restoration as a service for the university Servers/Data Centers. BdREN is going to create the facility for the universities and other member institutions to back up their applications as well as databases to BdREN storage in the form of block storage or object storage.

04 BdREN has large computing facility (around 600 CPUs and 3 TB of RAM) where users from different sectors mainly run their research activities (simulation, data processing and analysis). Users can use BdREN Infrastructure to store their application backup so that they can use this backup in case of any disaster.

05 Many member institutes don't have enough computer lab environment for their students. BdREN is planning to offer them Desktop as a Service where required number of Desktop configured with required applications will be provided from BdREN Data Center and students will access them from their lightweight terminal and perform their assigned functionalities.

06 BdREN conducts many technical trainings for the engineers of their member institutions. Still there remains a gap between the level of newly graduate students and that desired by the Industry. To mitigate the gap, BdREN is planning to arrange industry grade professional training for the graduate students so that they can produce output within shortest period of time after their recruitment in any industry.

07 Currently, BdREN is providing connectivity to the higher education and research institutions of Bangladesh. But this connectivity should be extended to the remaining higher educational institutions and colleges under National University and Regional Study Centers of Bangladesh Open University. The backbone network should be upgraded accordingly to accommodate such expansion and enhanced traffic capacity.

08 BdREN has deployed the service of "Identity Federation" on test basis. Both Service Providers (SPs) and Users (Identity

Providers, IdPs) will be registered in the Federation. Using this facility, users will be able to enjoy multiple online services using single credential (single sign on – SSO).

09 In the quickest possible time BdREN is also planning to join eduGAIN which is an extension of "Identity Federation" service. By joining eduGAIN BdREN Members will be entitled to have plethora of services distributed globally using their own credential (SSO).

10 Verifying students' record is a challenge in terms of authenticity and time to verify. As a resolution to this difficulty, BdREN is developing a central system where authorized users can verify a particular student's academic record from anywhere in the world.

11 Along with extending the reach of its connectivity BdREN is putting focus to building software which might be helpful for BdREN and its associated community. As an integral support system of "Work-from-Home", BdREN is designing the eFile Application to build a highly efficient File Management system.

12 BdREN is planning to create an interface so that all the universities will be able to key-in their data online which will be stored in a database. The data will be made available in a dashboard which will give a real time picture of the higher education community and will help the policy makers to take their decisions.

13 BdREN believes that it has enough expertise in delivering consultancy service both nationally and internationally. It is planning to participate in different "Open Calls" as initiated by TEIN*CC under Asi@Connect. In doing so BdREN also desires to work in collaboration with other NRENs to bolster its strength.

BdREN'S
GLOBAL FOOTPRINTS

BdREN is providing both Commodity Internet Services and Connectivity to Global Research and Education Network. As such BdREN is connected to both Public Internet and pseudo-public Global Research Network. Moreover, to provide eduroam services BdREN is also logically peered with Top Level Radius (TLR) Servers.

COMMODITY INTERNET

With respect to connectivity to Global Network BdREN is interconnected with International Internet Gateway (IIG) to connect itself to Global Internet. For a significant period of time since providing services to 6 (six) universities on a pilot basis the commodity bandwidth was hovering around 60-100Mbps. At first the primary constraint was less demand from the member institutions since only 6 (six) universities were connected. As soon as BdREN could complete the G.25 project, thereby could establish connectivity to all 34 (thirty-four) public universities, there was an immediate surge in bandwidth in and around the end of 2016 as demonstrated in the Figure 1.

However, even with connectivity to all public universities it only reached to a level of 4000Mbps in the middle of 2017. The main obstacle was further analyzed and it was found that to allure users to use the desired bandwidth it is needed to motivate users to use more by breaking the traditional concept of "use less, pay less". This was in line with the concept which NORDUnet follows for NORDIC NRENs. In the revised Tariff Structure, the universities were grouped under 3(three) different packages with maximum usage defined under each package. The revised tariff structure worked like magic as universities placed under a particular package started trying to reach the maximum allowed limit to reduce their per Mbps bandwidth rate. The Internet Bandwidth surged to a level of around 6000 Mbps and it happened sometime at the beginning of 2018

To start with BdREN had only 1 (one) IIG connectivity (BTCL) where redundancy was missing. Later on BdREN established connectivity with the second IIG (BSCCL) in order to increase the redundancy and could create due confidence in its users. At the moment the usage of commodity bandwidth is around 8000Mbps distributed between two IIGs with BTCL having 75% and AAMRA Technologies having 25% of the share.
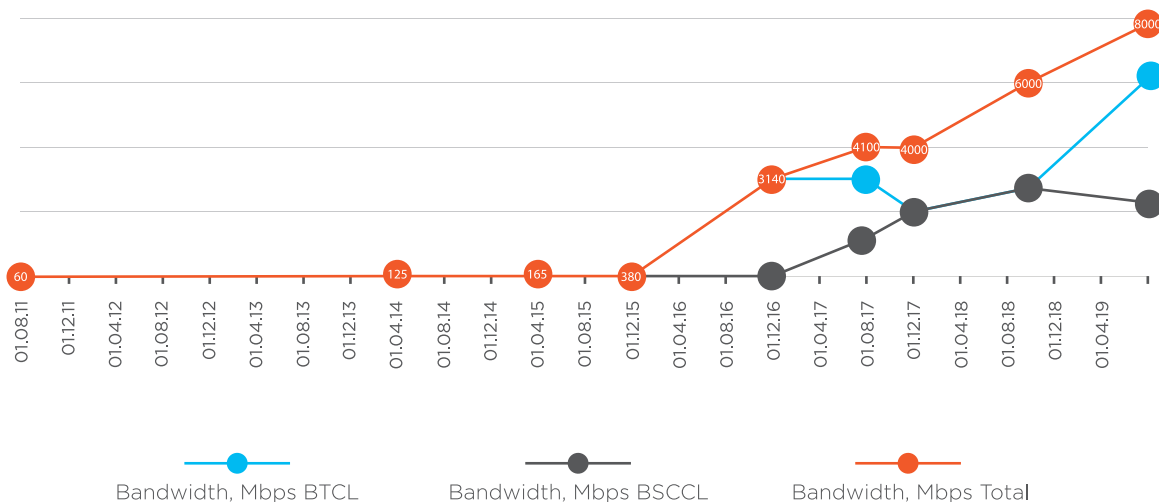
Figure 1: Growth of Commodity Bandwidth

CONNECTIVITY WITH GLOBAL RESEARCH NETWORK

BdREN started its journey with connectivity to global Research and Education Network by connecting its network with a 45Mbps link that terminated in the Mumbai PoP which belonged to the TEIN3 Network. Almost all the countries in Asia and Australia from Pacific zone were connected to TEIN3. Also, TEIN3 was connected with a high-bandwidth pipe to GEANT, the European RREN (Regional Research and Education Network). GEANT being connected to Internet2 in North America and also to the NRENs of Africa, connectivity to TEIN3 could in fact enable BdREN to get connected to any other Research and Educational Network in the world.

Due to the non-optimal availability of the Dhaka-Mumbai Link, the link was shifted to Singapore from Mumbai in November 2018. However, with incorporation of more institutions in the network and with increased traffic generated from each of those institutions there was a surge in traffic in the research network and the 45Mbps Dhaka-

Singapore link was found to be not adequate for carrying this high volume of traffic. In the meantime, NKN, the National Knowledge Network of India, came up with a project to connect Bangladesh, Nepal, Sri Lanka, Bhutan and Myanmar to its hub. NKN, having 10Gbps connectivity with Singapore and GEANT in Europe, offered 1Gbps connectivity to BdREN for a five-year period with all cost with regard to the operation and maintenance of the link to be borne by NKN. It turned out to be a timely and financially viable proposal for BdREN. Also, NKN agreed to provide Google, Microsoft and Facebook Cache Services. BdREN accepted the proposal and the 1Gbps connectivity was inaugurated jointly by honorable Prime Minister of Bangladesh and her counterpart in India on 11 March 2019. BdREN found that the established link with NKN was a highly stable link and eventually got rid of the BdREN-Singapore 45Mbps link which resulted in a huge cost savings for BdREN.
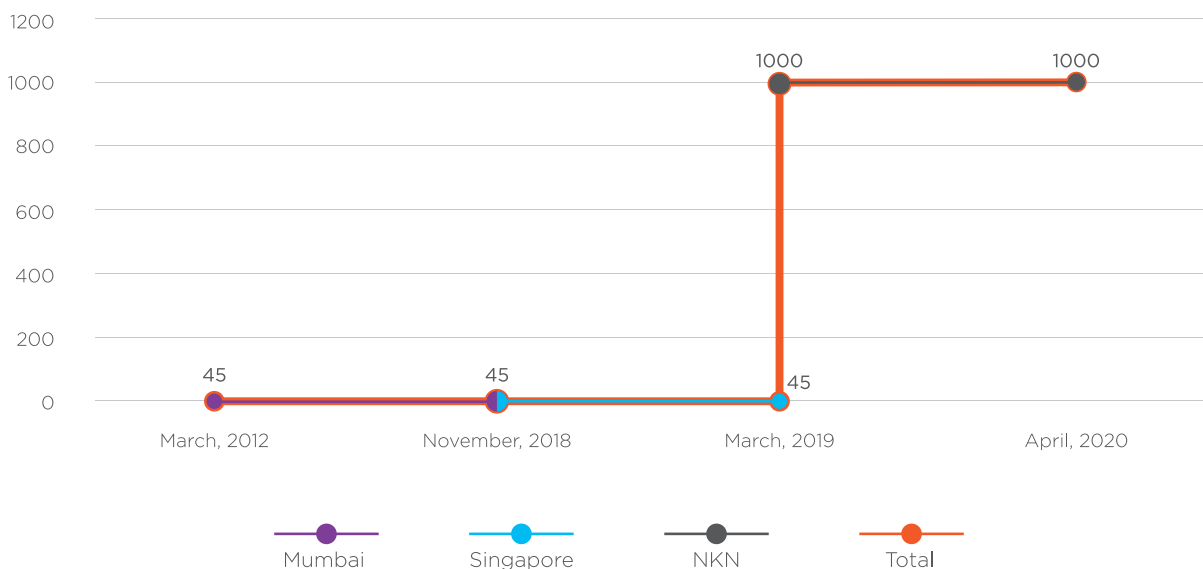
Figure 2: Growth of Research Bandwidth, Mbps

CONNECTIVITY WITH EDUROAM

BdREN configured its National Roaming Operator (NRO) Radius Server in the month of September 2017 and at the same time established connectivity with eTLR (European Top-Level Radius) Server at Denmark in order to provide eduroam services to its member institutions. To start with the service was commissioned and inaugurated with 4 universities namely University of Dhaka (DU), Rajshahi University (RU), Sher-e-Bangla Nagar Agricultural University (SBAU) and Shahjalal University of Science and Technology (SUST) in October 2017. As a prerequisite all institutions had their own Institutional Radius Server (IRS) configured at each individual campus. However, only SBAU and SUST having the structured controller based wireless network, the full campus of those two universities could be covered.

As far as International Connectivity is concerned BdREN established its connectivity with another eTLR at Netherland sometime later to enhance the redundancy. To be candid, the connectivity with eTLRs were not justified because to follow the hierarchy of upstream connectivity for providing eduroam services, BdREN should have established its connectivity with TLRs in Asia Pacific located in HARNET at Hongkong and AARNet at Australia. But, while BdREN went for establishing eduroam expected responses were not available from either HARNET or AARNet. Case being so to expedite the process, BdREN had to bypass designated TLRs and did establish the connectivity from eTLRs. Very recently both HARNET and AARNET have come forward and BdREN has established its eduroam connectivity with both the TLRs located in Hongkong and Australia severing its previous connectivity with eTLRs.

With completion of structured campus network in 19(nineteen) public universities, since the beginning of 2020 altogether 20(twenty) universities have been configured with eduroam services with Institutional Radius Servers (IRSs) configured at each university campus. Also, presence of eduroam services under BdREN is available through official website for demonstrating global eduroam presence at https://monitor.eduroam.org/map_service_loc.php

PERSPECTIVE TO REN COMMUNITY

BdREN's presence in REN Community is quite conspicuous and pervasive. It isn't necessarily limited within Asian boundary rather it has traversed even across Europe. At the end of 2017 BdREN could sign an MoU with NORDUnet under which NORDUnet is supposed to provide technical advice for the uplift and sustainability of BdREN and for establishing BdREN as an emerging REN in the community. The continuation of that MoU, signed with NORDUnet, proved to be a boon for BdREN in winning one of the most successful and prestigious projects allocated under Asi@ Connect titled "facilitating Distance Learning using Video Conferencing facility [fDLuDCf]" which was initiated in September 2018 with a total project value of around 200K Euro. The project was so exciting and successful, particularly after the outbreak of COVID-19, that TEIN*CC allowed

the extension of the project till December 2020 incorporating a few additional activities for the extended time period. The project was initially planned to be completed by April 2020.

Also, BdREN's presence in the APAN community has been noteworthy. The then Chief Technical Officer of BdREN Mohammad Tawrit was invited as a "Guest Speaker" in the APAN45 Asi@Connect Governors' Meeting held in Singapore in March 2018 to present a paper on the "Sustainability of NREN" which is a rare distinction. Subsequently, a group of consultants namely AKM Habibur Rahman, then CEO, BdREN, Mohammad Tawrit, then CTO BdREN and Sayedur Rahman, then TST Consultant, BdREN were engaged as individual consultant to prepare the first "Compendium of Asi@Connect" in 2019. To present their findings the consultants were invited in Asi@Connect Governors' Meeting in APAN47 which was held in Daejeon, South Korea. In addition to the above excellences, BdREN Officials were invited to speak on different occasions in the APAN meetings and international seminars.

Apart from those mentioned above, BdREN organized a good number of International Trainings and Workshops during the year 2019 under various work packages financed by Asi@

Connect. A number of International Distance Learning Courses (DLCs) on state-of-the-art Technologies, International Digital Seminars on burning topics covering REN community and Digital Talk-shows on similar topics were organized under fDLuDCf project. Also, BdREN in collaboration with Bangladesh University of Engineering and Technology (BUET) arranged an international workshop on "Computing and Virtualization" in December 2019.

BdREN has been actively participating in the APAN Medical Working Group (MWG) since 2015. Md. Sajidul Islam, Senior Network Engineer, is working as a trainer of APAN MWG to standardize the telemedicine system and to conduct systematic training programs for local and foreign engineers to enhance their skills and to ameliorate their activities.

Very recently Dr. Mohammad Farooq Ali Tarafder ACMA, BdREN's General Manager (HR, Admin and Finance) has been nominated as one of the Members of Asi@Connect Steering Committee which is a significant distinction.

PHOTO

ALBUM

Figure 3:
The 6th Asi@Connect Meeting in Malaysia
(22-26 Jul 2019)

Figure 4:
BdREN in meeting with NORDUnet and Asi@Connect
in Singapore during APAN45
(25 -29 Mar 2018)

Figure 5:
Group photo of the
Bangladeshi participants at APAN47
(18 - 22 Feb 2019)

Figure 6:
Kick-off Workshop of fDLuDCF in Thailand
(25-28 Sep 2018)

47

Figure 7:
BdREN Officials and Faculty Members at APAN46
(5 - 9 Aug 2018)

Figure 8:
Md. Ariful Islam from BdREN in Secure
Asi@Connect Workshop in Malaysia
(23 - 25 Oct 2017)

Figure 9:
Prof. Dr. Dil Afroza Begum, Governor [BdREN], Asi@
Connect participated in Multilateral Meeting among TEIN,
BdREN, NKN, NREN, LEARN and mmREN
(03 Mar 2020)

Figure 10:
Telemedicine Session at APAN48
(22 - 26 Jul 2019)

TEIN Map

Legend:
- Spectrum
- 100 Gbps
- 50 Gbps
- 10 Gbps
- 2.5 Gbps
- 2 Gbps
- 1 Gbps
- 155 Mbps
- 150 Mbps
- 100 Mbps
- 45 Mbps
- 10 Mbps

TEIN PoPs

TEIN NOC

MN, EU, CN%, KR, AF, PK, NP, BT, IN, BD, MM, HK#, TW, LA, VN, KH, LK, TH, PH, MY, SG^, ID
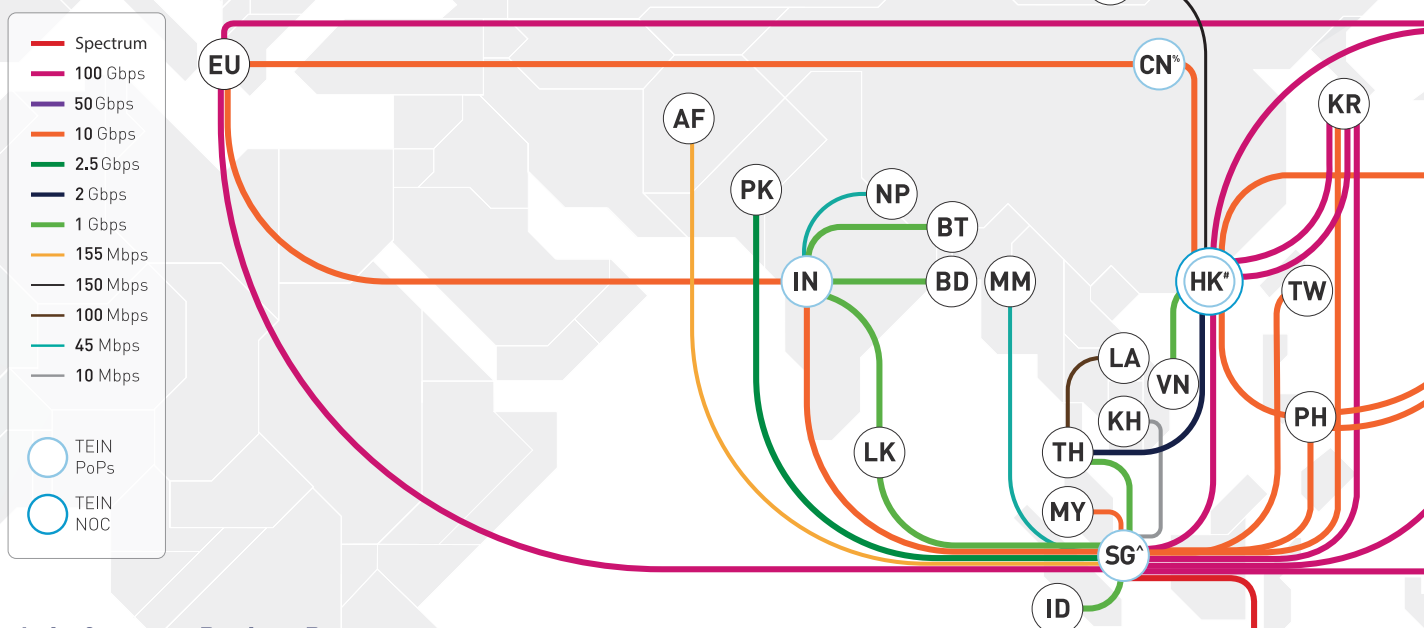
Asi@Connect Project Partners

AF · Afghanistan Research and Education Network (AfgREN)	**LA** · Laos Education and Research Network (LERNet)
AU · Australia's Academic and Research Network (AARNET)	**MY** · Malaysian Research and Education Network (MyREN)
BD · Bangladesh Research and Education Network (BdREN)	**MN** · Mongolian Research and Education Network (ErdemNet)
BT · Department of Information Technology and Telecom (DrukREN)	**MM** · University of Computer Studies Yangon (mmREN)
KH · Institute of Technology of Cambodia (CamREN)	**NP** · Nepal Research and Education Network (NREN)
CN · China Education and Research Network (CERNET) · % CERNET connected to TEIN CN PoP at 10 Gbps · China Science and Technology Network (CSTNET)	**NZ** · Research and Education Advanced Network NZ Ltd. (REANNZ)
HK · The Hong Kong Academic and Research NETwork (HARNET) · The Hong Kong Open Exchange (HKOX) · # HARNET and HKOX connected to TEIN HK PoP at 10 Gbps	**PK** · Pakistan Education and Research Network (PERN)
	PH · Advanced Science and Technology Institute (PREGINET)
IN · National Knowledge Network (NKN)	**SG** · Singapore Advanced Research & Education Network (SingAREN) · ^ SingAREN connected to TEIN SG PoP at 100 Gbps
ID · Indonesia Research and Education Network (IDREN)	
JP · Ministry of Agriculture, Forestry and Fisheries Research Network (MAFFIN) · National Institute of Information and Communications Technology (NICT) · National Institute of Informatics (NII)	**LK** · Lanka Education and Research Network (LEARN)
	TW · Academia Sinica Grid Computing (ASGC)
	TH · Thailand Research Education Network Association (ThaiREN)
KR · National Information Society Agency (KOREN) · Korea Institute of Science and Technology Information (KREONET)	**VN** · National Agency for Science and Technology Information (VinaREN)

* As of December 2020.
** Other regions (Central Asia, Africa and Latin America) can be connected via global R&E networks such as EU(GÉANT) and US(Internet2)

NETWORK

JP — US
AU — NZ

The following links are fully financed/co-financed by the link owners whose support is gratefully acknowledged

A		National Institute of Information and Communications Technology National Supercomputing Centre Singapore Advanced Research & Education Network
B		National Institute of Information and Communications Technology Thailand Research and Education Network
C		National Institute of Informatics
D		Ministry of Agriculture, Forestry and Fisheries Research Network
E		National Information Society Agency
F		China Education and Research Network TEIN Cooperation Center
G		TransPAC/Pacific Wave
H		Co-funded by China and EU
I		Academia Sinica Grid Computing
J		Australia's Academic and Research Network
K		Research and Education Advanced Network New Zealand
L		
M		Lanka Education and Research Network
N		Advanced Science and Technology Institute
O		National Knowledge Network
P		Korea Research Environment Open NETwork
Q		National Supercomputing Centre Internet2 Singapore Advanced Research & Education Network

The EU co-funded Asi@Connect project provides a dedicated regional high capacity and high-quality Internet network, Trans Eurasia Information Network (TEIN), for Research and Education (R&E) communities across Asia-Pacific and Europe, and leverages e-infrastructures developed for innovative and collaborating research projects.

BdREN
NATIONAL NETWORK
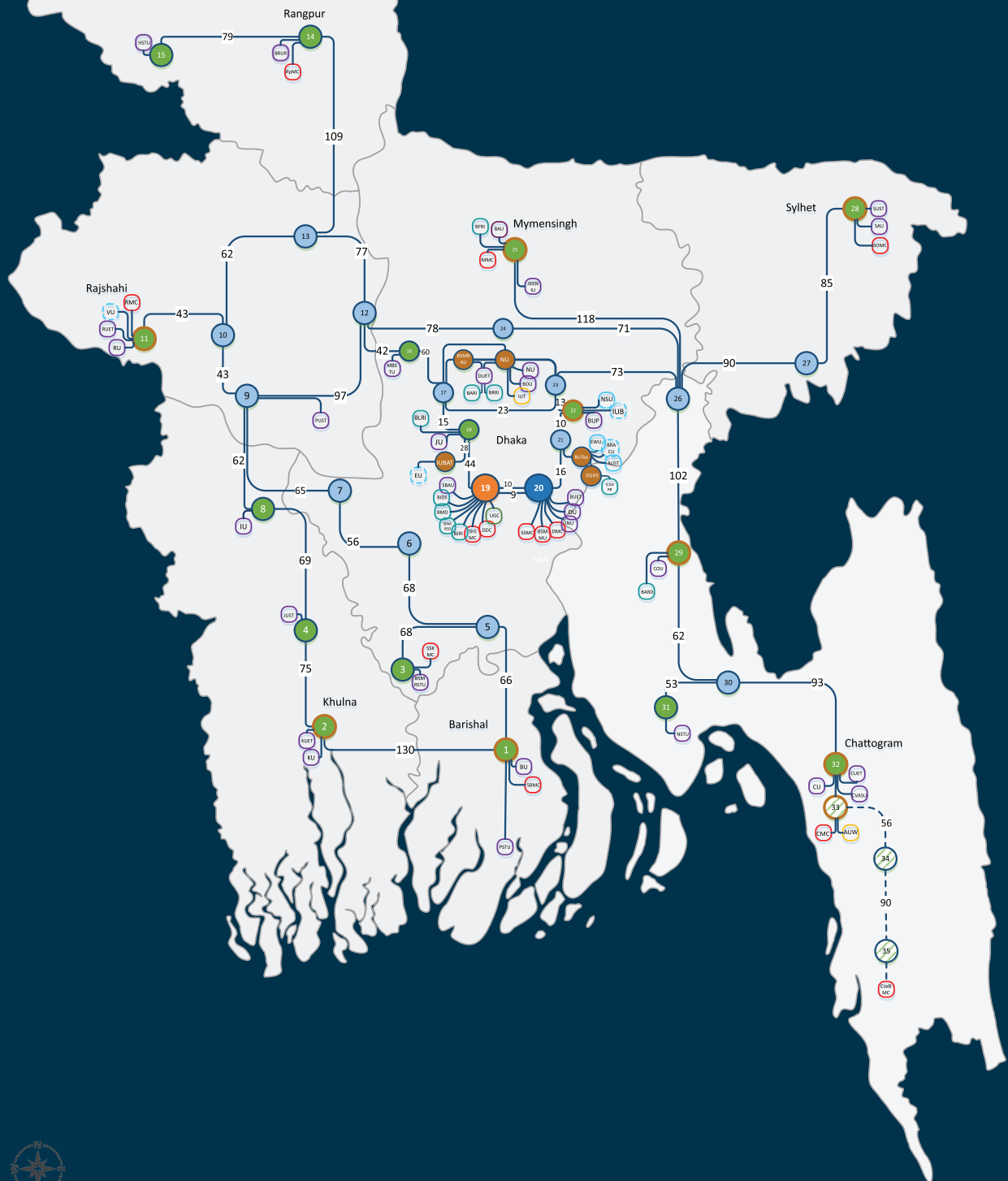
Connected Institutions

Public Universities _____

1. BAU — Bangladesh Agricultural University, Mymensingh
2. BOU — Bangladesh Open University, Gazipur
3. BRUR — Begum Rokeya University, Rangpur
4. BSMRAU — Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur
5. BSMRSTU — Bangabandhu Sheikh Mujibur Rahman Sci. and Tech. University, Gopalganj
6. BSMMU — Bangabandhu Sheikh Mujib Medical University, Dhaka
7. BU — University of Barisal, Barishal
8. BUET — Bangladesh University of Engineering and Technology, Dhaka
9. BUP — Bangladesh University of Professionals, Dhaka
10. BUTEX — Bangladesh University of Textiles, Dhaka
11. CoU — Cumilla University, Cumilla
12. CU — University of Chittagong, Chattogram
13. CUET — Chittagong University of Engineering and Technology, Raozan, Chattogram
14. CVASU — Chittagong Veterinary and Animal Sciences University, Chattogram
15. DU — University of Dhaka, Dhaka
16. DUET — Dhaka University of Engineering and Technology, Gazipur
17. HSTU — Hajee Mohammad Danesh Science & Technology University, Dinajpur
18. IU — Islamic University, Kushtia, Bangladesh
19. JKKNIU — Jatiya Kabi Kazi Nazrul Islam University, Trishal, Mymensingh
20. JNU — Jagannath University, Dhaka
21. JU — Jahangirnagar University, Savar, Dhaka
22. JUST — Jessore University of Science & Technology, Jashore
23. KU — Khulna University, Khulna
24. KUET — Khulna University of Engineering &Technology, Khulna
25. MBSTU — Mawlana Bhashani Science and Technology University, Tangail
26. NSTU — Noakhali Science and Technology University, Noakhali
27. NU — National University, Gazipur
28. PSTU — Patuakhali Science and Technology University, Dumki, Patuakhali
29. PUST — Pabna University of Science & Technology, Pabna
30. RU — University of Rajshahi, Rajshahi
31. RUET — Rajshahi University of Engineering & Technology, Rajshahi
32. SAU — Sylhet Agricultural University, Sylhet
33. SBAU — Sher-e-Bangla Agricultural University, Dhaka
34. SUST — Shahjalal University of Science and Technology, Sylhet

Private Universities _____

1. AUST — Ahsanullah University of Science and Technology, Dhaka
2. BRACU — BRAC University, Dhaka
3. EWU — East West University, Dhaka
4. EU — Eastern University, Dhaka
5. IUB — Independent University, Bangladesh, Dhaka
6. NSU — North South University, Dhaka
7. VU — Varendra University, Rajshahi

International Universities_____

1. AUW — Asian University for Women, Chattogram
2. IUT — Islamic University of Technology, Gazipur

Medical Colleges_____

1. CMC — Chittagong Medical College, Chattogram
2. DDC — Dhaka Dental College, Dhaka
3. DMC — Dhaka Medical College, Dhaka
4. MMC — Mymensingh Medical College, Mymensingh
5. RMC — Rajshahi Medical College, Rajshahi
6. RpMC — Rangpur Medical College, Rangpur
7. SBMC — Sher-E-Bangla Medical College, Barishal
8. ShSMC — Shaheed Suhrawardy Medical College & Hospital, Dhaka
9. SOMC — Osmani Medical College, Sylhet
10. SSKMC — Sheikh Sayera Khatun Medical College, Gopalganj
11. SSMC — Sir Salimullah Medical College, Dhaka
12. CoxBMC — Cox's Bazar Medical College, Cox's Bazar

Research Institutions_____

1. BARD — Bangladesh Academy for Rural Development, Cumilla
2. BARI — Bangladesh Agricultural Research Institute, Gazipur
3. BFRI — Bangladesh Fisheries Research Institute, Mymensingh
4. BIDS — Bangladesh Institute of Development Studies, Dhaka
5. BJRI — Bangladesh Jute Research Institute, Dhaka
6. BLRI — Bangladesh Livestock Research Institute, Savar, Dhaka
7. BMD — Bangladesh Meteorological Department, Dhaka
8. BRRI — Bangladesh Rice Research Institute, Gazipur
9. DGHS — Directorate General of Health, Dhaka
10. ICDDR'B — International Centre for Diarrhoeal Disease Research, Bangladesh, Dhaka
11. SPARRSO — Space Research and Remote Sensing Organization, Dhaka

Government Organizations_____

1. UGC — University Grants Commission of Bangladesh

DWDM Transmission Nodes

1. BU, Barishal
2. KUET, Khulna
3. BSMRSTU, Gopalganj
4. JUST, Jashore
5. PGCB-SS, Madaripur
6. PGCB-SS, Faridpur
7. Rental House, Pangsha
8. IU, Kushtia
9. PGCB-SS, Ishwardi
10. PGCB-SS, Natore
11. RU, Rajshahi
12. PGCB-SS, Shirajganj
13. PGCB-SS 230KV, Bogura
14. BRUR, Rangpur
15. HSTU, Dinajpur
16. MBSTU, Tangail
17. PGCB-SS, Kabirpur
18. JU, Savar
19. UGC, Dhaka
20. BUET, Dhaka
21. PGCB-SS, Rampura
22. NSU, Bashundhara
23. PGCB-SS, Tongi
24. BTCL Office, Mawna
25. BAU, Mymensingh
26. APSCL, Ashuganj
27. PGCB-SS, Sreemangal
28. SUST, Sylhet
29. CoU, Cumilla
30. PGCB-SS, Feni
31. NSTU, Noakhali
32. CU, Chattogram
33. CMC, Chattogram
34. PGCB-SS, Dohazari
35. PGCB-SS, Cox's Bazar

BOARD OF
TRUSTEES
As on 30.06.2020

BdREN is being operated as a Non-profit Trust organization with 11-member board of trustees consisting of representatives from the UGC, Universities, MoE and other members co-opted for their expertise and position in relevant industries.

Prof. Dr. Kazi Shahidullah
Chairman
University Grants Commission of Bangladesh &
Chairperson, BdREN Trust

Prof. Dr. Dil Afroza Begum
Member
University Grants Commission of Bangladesh &
Vice-Chairperson, BdREN Trust

Trustees (Not according to seniority)

Inductee Trustees

BdREN
TEAM

BdREN team led by Chief Executive Officer and operated by skilled engineers and administrators. Together they are responsible for the day-to-day operation and maintenance of the network and are accountable to the Board of Trustees.

Mohammad Tawrit
Chief Executive Officer
Field of Expertise: Communication Technology

Dr. Mohammad Farooq Ali Tarafder ACMA
General Manager (HR, ADMIN & FINANCE)
Field of Expertise: Finance, Accounting and Taxation

Md. Ariful Islam
Manager (Data & Transmission Network)
Field of Expertise: Data and Transmission Network

Khandakar Rashedul Arefin
Manager (Data Center)
Field of Expertise: Data Center and Virtualization

Md. Sajidul Islam
Sr. Network Engineer (Data and NOC)
Field of Expertise: Communication System

Alam Ahamed
Sr. Network Engineer (Transmission)
Field of Expertise: DWDM & Transmission System

G.M. Salman A Mehbub
Network Engineer (NOC)
Field of Expertise: System Admin and Federated Identity

Abu Naser Md. Nafew
Network Engineer (NOC)
Field of Expertise: Network and Server System

Shamim Ahmed
Network Engineer (NOC)
Field of Expertise: Data Network System

Jamilur Rahman
Network Engineer (NOC)
Field of Expertise: System Admin & Virtualization

Kamrul Hasan Shakil
Network Engineer (NOC)
Field of Expertise: Network Operation and Monitoring

Md. Ariful Islam Arman
Network Engineer (NOC)
Field of Expertise: NOC Operation
 VMware & System Admin

Md. Sajal Biswas
Network Engineer (Transmission)
Field of Expertise: DWDM, Transmission System

H. M. Mohidul Islam
Programmer
Field of Expertise: Software Engineering and Database

Md. Abdul Jalil
Sr. Technician (Data & Facilities)
Field of Expertise: Power System

Md. Asaf-Ud-Dowla Shamrat
Sr. Technician (Transmission)
Field of Expertise: Optical Fiber

Md. Kawsar
Technician (Optical Fiber)
Field of Expertise: Optical Fiber

Md. Aminul Islam Amin
Technician (AC)
Field of Expertise: Air Conditioning System

Md. Atiqur Rahman
Technician (Data)
Field of Expertise: Data and Optical Fiber

Md. Masudur Rahman
Technician (Optical Fiber)
Field of Expertise: Power System

Md. Mamun Hossain
Technician (Optical Fiber)
Field of Expertise: Optical Fiber

Md. Sohel Chowdhury
Technician (Optical Fiber)
Field of Expertise: Optical Fiber

Md. Nesaruddin
Technician (Power)
Field of Expertise: Power System

Biplob Rahman
Technician (Optical Fiber)
Field of Expertise: Optical Fiber

BdREN HR, Admin & Finance Team

Biplab Chandra Mahanta
Manager (HR, Admin & Finance)
Field of Expertise: HR, Admin & Finance

Khadizatul Kubra
Asst. Manager (Finance & Accounts)
Field of Expertise: Finance and Accounting

Mohammad Imam Hosen
Asst. Manager (HR & Admin)
Field of Expertise: HR and Admin

BdREN
STANDOUT
PERFORMER

MD. SAJIDUL ISLAM
Sr. Network Engineer (Data and NOC)

Md. Sajidul Islam was the main architect in implementing the "On-prem" Zoom Licensing platform which enabled BdREN enjoy the full capacity of 7500 Zoom Licenses on "Production" mode.
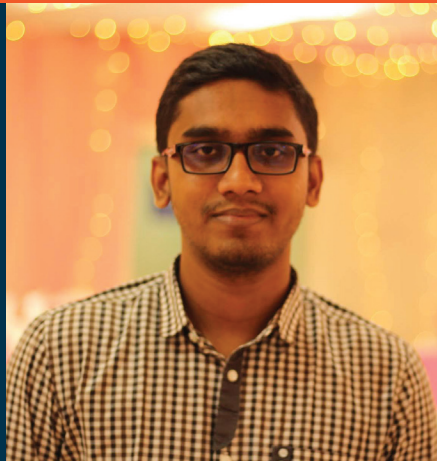
H. M. MOHIDUL ISLAM
Programmer

H. M. Mohidul Islam was the leader of the application development team of "vSession" application which facilitated a front-end interface for faculty members to schedule their online classes. It increased the Zoom Licensing efficiency many a time. Also, he developed the customized Zoom Usage reporting system.

G.M. SALMAN A MEHBUB
Network Engineer, NOC

G.M. Salman implemented the architecture for providing "Zoom as a Service" using Identity and Access Management (IAM) platform in BdREN. He is also the premier person in implementing Trust, Identity and Group management for Education and Research Federation (TIGERfed), the first of its kind in Bangladesh.

JAMILUR RAHMAN
Network Engineer, NOC

Jamilur Rahman introduced ProxmoxVE virtualization platform at BdREN Data Center which could enable BdREN enhance the efficiency of the platform in hosting the Multi-Media Record application of Zoom. Jamil also implemented eMail Security Gateway and eduroam statistics reporting for BdREN.

BdREN
INITIATIVES

Facilitating and Advancing Bangladesh's Research and Education Channel

EXPANDING INTERNATIONAL CAPACITY AND COLLABORATION

To be an enabler for excellence in Research and Education by strengthening the quality of research, education, innovation and strategic collaboration at home and abroad, BdREN has been trying to promote national research and education channel among the globe.

BdREN with its multi-gigabit capability aims to connect all universities, research institutions, medical colleges, libraries, laboratories, healthcare and agricultural institutions across the country and to support geographically dispersed academics, medical professionals, scientists and researchers with reliable access to high-end computing, simulation tools and datasets. With a view to implementing the BdREN backbone, UGC signed an IRU contract with Power Grid Company of Bangladesh (PGCB) Ltd. for using 2(two) core from its country-wide distributed OPGW network. Backbone network of BdREN is designed using these leased optical fiber cores as well as using its self-laid fiber cable.

2019 was a year of many milestones in international connectivity for BdREN. The establishment of redundant TEIN Connectivity Through NKN marked a significant milestone for national research and education community.

BdREN is connected to other regional and trans-continental Research and Education Networks (RENs) (e.g. TEIN, GEANT, Internet2 and others). It has interlinked the faculties and students of Bangladesh with the global academic community and learning resources. It also facilitates international collaborative research and stimulates innovations in the country. Link between Singapore PoP and BdREN, which is accessed by Bangladeshi Researchers, to reach the global community. European and North American community is accessed using

Singapore to London link, known as CAE-1 (Collaboration Asia Europe) which is an exponent of international collaboration and aggregation of financial resources by the global NREN community. This modality of shared financing may work as a future model to optimize global resources.

BdREN is also beneficiary and proactive partner of Asi@Connect project, which was ensued from Trans-Eurasia Information Network (TEIN). Asi@Connect is the historical global project working with the European Union and 28 national research and education network partners from 24 Asia-pacific countries and economies. Value of NRENs to researchers and academicians will further increase with the addition of advanced Application and Services to the network. Such services will promote increasing use of NRENs by the researchers and educationists. This process will be further accelerated by knowledge transfer from advanced European R&E networks.

BdREN is becoming more and more popular to the community because of its support in fostering research and collaboration. The primary objective of BdREN was to connect all the universities and research Institutes to single platform and also to interconnect them with the global R&E networks like GÉANT (Europe), Internet2 and others. Implementation of BdREN has undoubtedly fulfilled that objective. At the same time, it has contributed immensely in abating the digital divide within our REN community.

EXPANDING CAPACITY AND REACHABILITY IN BANGLADESH

BdREN has established its country-wide network to provide nationwide academic network among the universities. Universities can collaborate with each other using BdREN without accessing commercial Internet. Our customers increasingly value the reliability of the BdREN network, particularly for accessing cloud services and research traffic that are worthwhile

contribution to research, teaching and learning. To improve the performance and availability of these services for BdREN customers, BdREN increased the bandwidth capacity of both its backbone and access channel as and when it was felt necessary.

Throughout 2019 BdREN continued expanding its network footprint further into regional areas across Bangladesh in order to improve access to reliable high-speed Internet services by the marginalized research and education community.

During the year, customers across the sectors of the country, including universities, medical colleges and research institutes, upgraded their connections to meet their growing bandwidth needs. To meet the requirements, we ameliorated upstream bandwidth capacity, by establishing a number of 1Gbps/10Gbps connectivity with

Bangladesh Internet Exchange (BDIX), Teletalk and aamra IX. In the downstream, BdREN already had numerous 10Gbps links between Dhaka and other regional centers namely Rajshahi, Chittagong, Khulna, Barishal, Gazipur, Sylhet, Mymensingh and Cumilla.

COLLABORATION WITH UGC IN STUDYING FEASIBILITY OF ONLINE EDUCATION

At the outbreak of the pandemic when all institutions were declared closed by Ministry of Education (MoE), University Grants Commission of Bangladesh approved the delivery of Online lectures for the university students. Subsequently the question was raised about the present requirement of facilities and resources for seamless delivery of this new mode of pedagogy. As such, it was planned to identify the requirements of the Higher Education Institutes (HEIs) of the country with regard to "Online Education" and to explore the role of University Grants Commission of Bangladesh (UGC) as

well as Ministry of Education (MoE) in fulfilling those necessities. The HEIs include - both the Public and Private Universities, Medical Colleges, Polytechnic Institutes, Colleges and Madrassas offering Honors and Masters degrees respectively under the National University and Islamic Arabic University.

To identify the requirements of the HEIs, survey questionnaire was set for both the faculty members and the students, the questionnaire was floated in the portal and responses were collected and analyzed. Moreover, direct feedback

was officially collected from the honorable Vice-Chancellors of the universities. BdREN helped UGC in the whole process starting from preparing the questionnaire up to collection of the feedback from the respondents and also to analyze the feedback.

Through the requirement exploration process many of the obstacles of online education could be unearthed. Preliminary impediments were revealed as the unavailability of the devices to the end user such as Laptop or Desktop for both students and the faculties, Internet Bandwidth not being supportive particularly in the remote and rural areas, cost of Mobile Internet bandwidth being a big burden for the students, the digitized content not being ready for making the online delivery fascinating and effective, questionable authenticity of online assessment, nonchalance of both students and the teachers about the mode of delivery itself and the unavailability of any out-of-the-box solution for conducting laboratory activities online.

After receiving the responses from the stakeholders and analyzing them critically, the requirements of the software as well as the hardware were identified in order to create the right environment for implementation of online education platform on a limited scale. A full-fledged report defining different options with varying scopes along with their cost of implementation was prepared by UGC in which BdREN provided full support and collaboration.

Moreover, UGC developed another proposal which was forwarded to Asian Developement Bank (ADB) in order to build a platform for delivery of online education for the Higher Education community on a smaller scale. BdREN did provide full-fledged support to UGC for preparing that proposal also.

DISTANCE LEARNING
USING VIDEO CONFERENCE FACILITY

BdREN has established Distance Learning Theater (DLT) at 34 Public Universities, 12 Medical Colleges and 3 Private Universities and Distance Collaboration Center (DCC) at 10 Research Institutes which are fully equipped with state-of-the-art video conferencing technology.

Figure 11:
Distance Learnning Theater at Public University
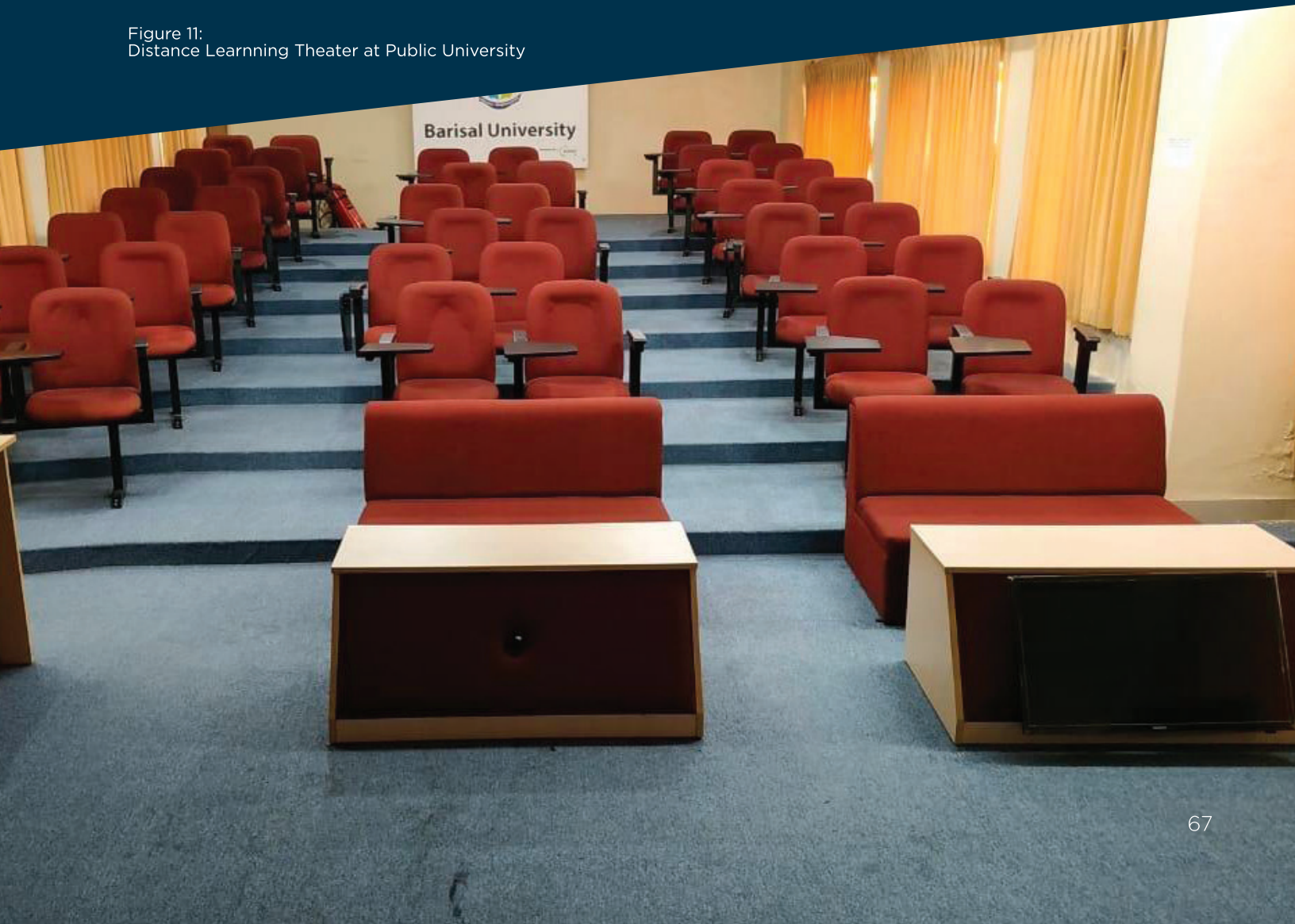
Figure 12:
Distance Learning Theater at Medical College

In this pandemic situation, BdREN is helping online education in Bangladesh through its Zoom platform. All these DLTs and DCCs can be connected with the Zoom platform to organize blended conferences.

Figure 13:
Distance Collaboration Center at Research Institution

CONTRIBUTION IN

PROMOTING
RESEARCH & EDUCATION

> **❝** 2019-2020 was an exciting year for BdREN. Here's a closer look at some of the sensational stories in the research and education community enabled by our powerful network and collaboration services.

BdREN was established to enhance facility to the researchers of Bangladesh by establishing connectivity with global research community and by extending this connectivity to its member institutions. Most of the Higher Education Institutions, don't have enough resources to run the simulations or analyze the collected data. In that respect, BdREN provided higher capacity computing facility to support the researchers. Utilizing these facilities, different researchers from different sectors (Computer Science and Engineering Department, Department of Physics, Electrical and Electronic Engineering Department, Biochemistry, Molecular Biology, Fisheries Department, Image Processing and similar others) did perform their research activities. Some of the researchers published their works in the form of books and some proceeded on patenting their works as well.

A. DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING, UNIVERSITY OF DHAKA:
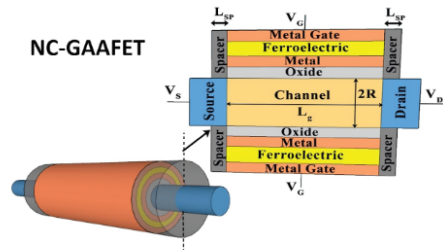
EMERGING NEGATIVE CAPACITANCE FET

As Moore`s law continue to reach its scaling limit, power consumption becomes an issue since supply voltage reduction becomes challenging, keeping in demand with higher drive current for faster computing. The sub-threshold characteristics in MOSFETs, which determines power dissipation, suffer from the Boltzmann tyranny which limits sub-threshold swing to 60 mV/decade. A new class of devices, known as negative capacitance FETs, using ferroelectric materials, have been shown to achieve sub-60 mV/decade subthreshold behavior, opening up plethora of opportunities for ultra-low power computing. We use TCAD simulations to explore how the phenomenon of negative capacitance manifests into emerging device architectures (FinFET, Nanowire and Nanosheets).
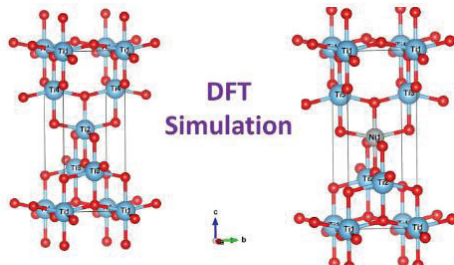
FIRST PRINCIPLE CALCULATIONS

Collaboration: Portland State University (PSU), USA and Department of Physics, University of Dhaka, Bangladesh

We use first principle-based Density Functional Theory (DFT) calculations to study the optoelectronic properties, density of states and band structures in TiO2 for use in perovskite solar cells.A myriad of dopants and co-dopants are studied to find suitable members of the periodic table that will improve the optical properties such as light absorption for solar cell applications.
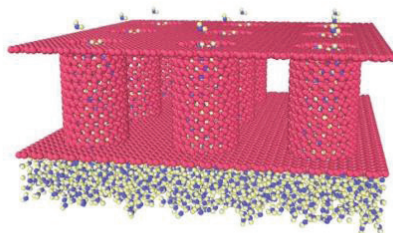
MOLECULAR DYNAMICS: CNT WATER FILTER

Carbon nanotubes (CNT) have shown much promise as filters that can produce ultra-pure water with a considerably high filtration rate. CNT filters have outperformed the latest technology of aqua porins (protein based membranes) as CNT-porins show greater water flow rate. Previous experimental and simulation studies have indicated that water can permeate through relatively narrow CNTs. We plan to use Molecular Dynamics to study the performance of novel CNT water filters!
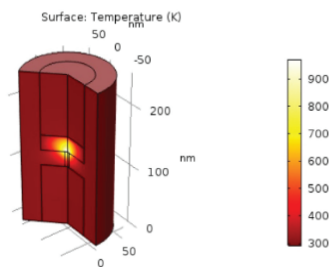
PHASE CHANGE MEMORY (PCM)

Collaboration: United International University (UIU), North South University (NSU), Bangladesh

Phase-Change Random-Access Memory (PCRAM) is one of the emerging non-volatile memory technologies based on a chalcogenide alloy (combination of Germanium, Antimony and Tellurium) materials, where the data is stored depending on the amorphous (high resistance, logic = 0) or crystalline (low resistance, logic = 1) of the material. We use finite element modeling (FEM) to comprehensively develop thermoelectric models for the phase change behavior of these emerging devices.

B. DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY, UNIVERSITY OF DHAKA:

Understand the genomic organization of endophytic basidiomycetes with a potential for producing numerous commercially important enzymes and secondary metabolites taking G. lineata as a model.

Genome of *Tenualosa ilisha* from the river Padma, Bangladesh

Objective:

Hilsa shad (Tenualosa ilisha), is a popular fish of Bangladesh belonging to the Clupeidae family. An anadromous species, like the salmon and many other migratory fish, it is a unique species that lives in the sea and travels to freshwater rivers for spawning. During its entire life, Tenualosa ilisha migrates both from sea to freshwater and vice versa.

Data description:

The genome of Tenualosa ilisha collected from the river Padma of Rajshahi, Bangladesh has been sequenced and its de novo hybrid assembly and structural annotations are being reported here. Illumina and PacBio sequencing platforms were used for high depth sequencing and the draft genome assembly was found to be 816 MB with N50 size of 188 kb. MAKER gene annotation tool predicted 31,254 gene models. Benchmarking Universal Single-Copy Orthologs refer 95% completeness of the assembled genome.

Hilsa proteome database

The molecular dynamics simulation to unravel the structural dynamics of the taxadiene synthase of Taxus baccata and its corresponding putative homolog in *Grammothele lineata*
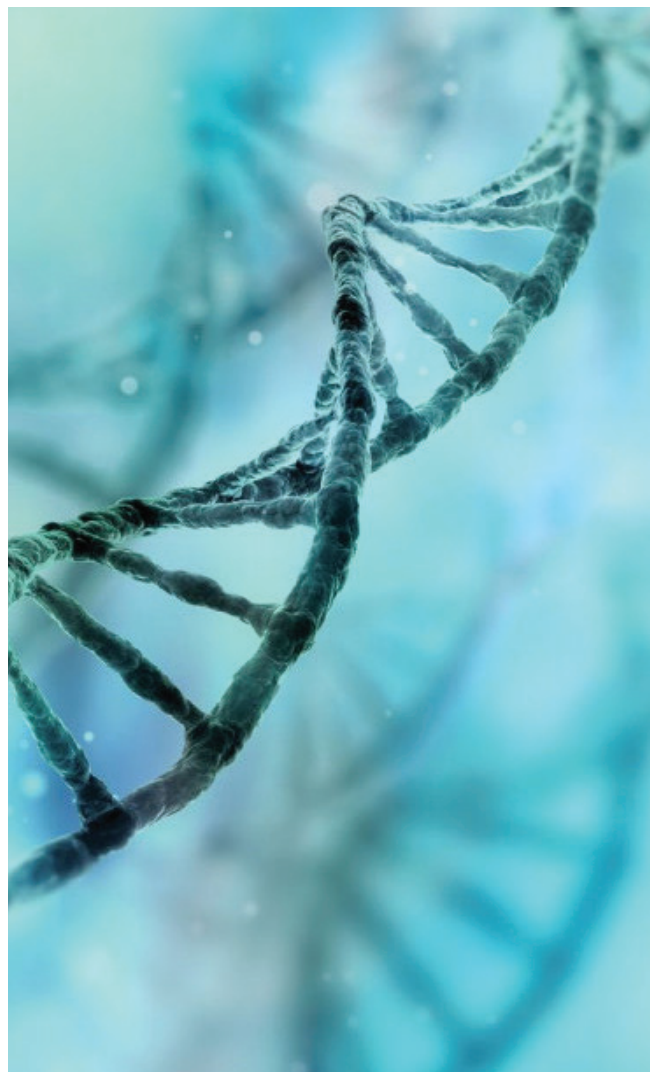
C. INSTITUTE OF INFORMATION TECHNOLOGY, UNIVERSITY OF DHAKA:

Understanding the Effect of Developer Sentiment on Fix-Inducing Changes: An Exploratory Study on GitHub Pull Requests

Developer emotion or sentiment in a software development environment has the potential to affect performance, and consequently, the software itself. Sentiment analysis, conducted to analyze online collaborative artifacts, can derive effects of developer sentiment. This study aims to understand how developer sentiment is related to bugs, by analyzing the difference of sentiment between regular and Fix-Inducing Changes (FIC) – changes to code that introduce bugs in the system. To do so, sentiment is extracted from Pull Requests of 6 well known GitHub repositories, which contain both code and contributor discussion. Sentiment is calculated using a tool specializing in the software engineering domain: SentiStrength-SE, Next, FICs are detected from Commits by filtering the ones that fix bugs and tracking the origin of the code these remove. Commits are categorized based on FICs and assigned separate sentiment scores (-4 to +4) based on different preceding artifacts – Commits, Comments and Reviews from Pull Requests. The statistical result shows that FICs, compared to regular Commits, contain more positive Comments and Reviews. Commits that precede an FIC have more negative messages. Similarly, all the Pull Request artifacts combined are more negative for FICs than regular Commits.

Impact of Combining Syntactic and Semantic Similarities on Patch Prioritization

Patch prioritization means sorting candidate patches based on the probability of correctness.

It helps to minimize the bug fixing time and maximize the precision of an automated program repair technique by ranking the correct solution before incorrect one. Recent program repair approaches have used either syntactic or semantic similarity between faulty code and fixing ingredient to prioritize patches. However, the impact of combined approach on patch prioritization has not been analyzed yet. For this purpose, two patch prioritization methods are proposed in this paper. Genealogical and variable similarity are used to measure semantic similarity since these are good at differentiating between correct and incorrect patches. Two popular metrics namely normalized longest common subsequence and token similarity are considered individually for capturing syntactic similarity. To observe the combined impact of similarities, the proposed approaches are compared with patch prioritization techniques that use either semantic or syntactic similarity. For comparison, 246 replacement mutation bugs from historical bug fixes dataset are used. Both methods outperform semantic and syntactic similarity-based approaches, in terms of median rank of the correct patch and search space reduction. In 11.79% and 10.16% cases, the combined approaches rank the correct solution at first position.

Finding Erroneous Components from Change Coupled Relations at Fix-inducing Changes

During the gradual process of software evolution, errors appear in different components of a software system. These errors are later on fixed by developers as part of corrective maintenance activities. However, if errors appear continuously from a particular component, that may indicate

design flaws or code smells. Maintenance cost will greatly reduce if design flaws are treated as early as possible. To find out such flaws it may require time-consuming manual inspections. This paper tries to find out such components using the information of change coupled cluster of files or Java classes at fix-inducing changes. In this proposed approach, information (like class, method, parameter of method and variable names) from change coupled relation of a class at Fix-Inducing Changes (FICs) are used to provide information about erroneous components. Then the error history, of software components, is found by using cosine similarity of information from change coupled cluster of classes found in FICs to see with the architectural information found from authenticated sources. Finally, the error history of components is shown as the percentage of change coupled cluster of a class found in FICs of each 100 commits in the version control system.

Is Developer Sentiment Related to Software Bugs: An Exploratory Study on GitHub Commits

The outcome of software products primarily depends on the developers, including their emotion or sentiment in a software development environment. Developer emotions have been observed to be correlated to several patterns, for instance, task resolution time, developer turnover, etc. by conducting sentiment analysis on software collaborative artifacts like Commits. This study aims to quantify the impact of those patterns by finding a relation between developer sentiment and software bugs. To do so, Fix-Inducing Changes — changes that introduce bugs to the system — are detected, along with changes that precede or fix those bugs. Sentiment of these changes are determined from their Commit messages using Senti4SD. It is statistically observed that Commits that introduce, precede or fix bugs are significantly more negative than regular Commits, with a higher proportion of emotional (non-neutral) messages. It is also found that a distinction between buggy and correct fixes exists based on the message's neutrality.

Impact of Similarity on Repairing Small Programs: A Case Study on QuixBugs Benchmark

Similarity analysis plays an important role in automated program repair by finding the correct solution earlier. However, the effectiveness of similarity is mostly validated using common benchmark Defects4J which consists of 6 large projects. To mitigate the threat of generalizability, this study examines the performance of similarity in repairing small programs. For this purpose, existing syntactic and semantic similarity based approaches, as well as a new technique of combining both similarities, are used. These approaches are evaluated using QuixBugs, a dataset of diverse type bugs from 40 small programs. These techniques fix bugs faster by validating fewer patches than random patch selection based approach. Thus, it proves the effectiveness of similarity in repairing small programs.

Impact Analysis of Syntactic and Semantic Similarities on Patch Prioritization in Automated Program Repair

Patch prioritization means sorting candidate patches based on probability of correctness. It helps to minimize the bug fixing time and maximize the precision of an automated program repairing technique. Approaches in the literature use either syntactic or semantic similarity between faulty code and fixing element to prioritize patches. Unlike others, this paper aims at analyzing the impact of combining syntactic and semantic similarities on patch prioritization. As a pilot study, it uses genealogical and variable similarity to measure semantic similarity, and normalized longest common subsequence

to capture syntactic similarity. For evaluating the approach, 22 replacement mutation bugs from IntroClassJava benchmark were used. The approach repairs all the 22 bugs and achieves a precision of 100%.

Combined Similarity Based Automated Program Repair Approaches for Expression Level Bugs

Automated program repair aims at finding the correct patch of a bug using a specification such as test cases. Expanding the search space of a program repair technique increases the probability of generating the correct patch. However, it also increases the chance of finding incorrect plausible patches before the correct one. To prevent these problems, existing program repair approaches either avoid or limitedly focus on expression level bugs such as method invocation or assignment expression. Nevertheless, it is found that almost 82.40% repair actions are associated with expressions. Therefore, this study proposes two automated program repair approaches that extensively deals with expression level bugs. The devised techniques combine syntactic and semantic similarities to handle the enlarged search space and rank the correct patch higher. Genealogical and variable similarities are used to measure semantic similarity since these are good at differentiating between correct and incorrect patches. Two popular metrics namely normalized longest common subsequence and token similarity are considered individually for capturing syntactic similarity. To evaluate the proposed techniques, these are compared with baseline versions of the proposed approaches that use either semantic or syntactic similarity. For comparison, single line bugs from Defects4J and QuixBugs benchmark are used. Result reveals that the proposed techniques can correctly repair 22 and 21 expression level bugs which are higher than approaches using only semantic or syntactic similarity. Furthermore, the devised approaches obtain 64.71% and 61.76% precision and outperform the baseline techniques.

D. DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING, UNIVERSITY OF DHAKA:

An artificial bee colony based algorithm for continuous distributed constrained optimization problems.

Accelerating recursive partition-based causal structure learning using an improved structure refinement approach.

An adaptive agent-specific sub-optimal bounding approach for multi-agent path finding

E. DEPARTMENT OF PHYSICS, UNIVERSITY OF DHAKA:

Fractal Patterns in Nonlinear Dynamics and Applications

Most books on fractals focus on deterministic fractals as the impact of incorporating randomnes and time is almost absent. Further, most review on fractals do not explain what scaling and self-similarity mean. This article introduces the idea of scaling, self-similarity, scale-invariance and their role in the dimensional analysis. For the first time, fractals emphasizing mostly on stochastic fractal, and multifractals which evolve with time instead of scale-free self-similarity, are discussed. Moreover, it looks at power laws and dynamic scaling laws in some detail and provides an overview of modern statistical tools for calculating fractal dimension and multifractal spectrum.

Dynamic scaling, data-collapse and self-similarity in mediation-driven attachment networks

Recently, we have shown that if the ith node of the Barabási-Albert (BA) network is characterized by the generalized degree $q_i(t)=k_i(t)t_i^\beta/m$, where $k_i(t) \sim t^\beta$ and m are its degree at current time t and at birth time t_i, then the corresponding distribution function $F(q, t)$ exhibits dynamic scaling. Applying the same idea to our recently proposed mediation-driven attachment (MDA) network, we find that it too exhibits dynamic scaling but, unlike the BA model where $\beta=1/2$, the exponent β of the MDA model assumes a spectrum of value $1/2 \leq \beta \leq 1$. Moreover, we find that the scaling curves for small m are significantly different from those of the larger m and the same is true for the BA networks albeit in a lesser extent. We use the idea of the distribution of inverse harmonic mean (IHM) of the neighbours of each node and show that the number of data points that follow the power-law degree distribution which increases as the skewness of the IHM distribution decreases. Finally, we show that both MDA and BA models become almost identical for large m.

Effects of competition between random sequential nucleation of point-sized seeds and island growth by adsorption of finite-sized grains

We study random sequential adsorption of particles from a pool onto a one-dimensional

substrate following ballistic deposition rules with separate nucleation and growth processes occurring simultaneously. Nucleation describes the formation of point-sized seeds, and after a seed is sown, it acts as an attractor and grows in size by the addition of grains of a fixed size. At each time step either an already-nucleated seed can increase in size, or a new seed may be nucleated. We incorporate a parameter m to describe the relative rates of growth to nucleation. We solve the model analytically to obtain a gap size distribution function and a general expression for the jamming coverage as a function of m. We show that the jamming coverage $\theta(m)$ reaches its maximum value of $\theta(m)=1$ in the limit $m\to\infty$ following a power-law $\theta(\infty)-\theta(m) \sim Km^{-1/2}$ for some constant K. We also perform an extensive Monte Carlo simulation and find good agreement between analytic and numerical results.

Redefinition of site percolation in light of entropy and the second law of thermodynamics

In this article, we revisit random site and bond percolation in a square lattice, focusing primarily on the behavior of entropy and the order parameter. In the case of traditional site percolation, we find that both the quantities are zero at p=0, revealing that the system is in the perfectly ordered and in the disordered state at the same time. Moreover, we find that entropy with 1−p, which is the equivalent counterpart of temperature, first increases and then

decreases again, but we know that entropy with temperature cannot decrease. However, bond percolation does not suffer from either

of these two problems. To overcome this, we propose an alternative definition for site percolation where we occupy sites to connect bonds and we measure cluster size by the number of bonds connected by occupied sites. This resolves all the problems without affecting any of the existing known results.

Universality class of explosive percolation in Barabási-Albert networks

In this work, we study explosive percolation (EP) in Barabási-Albert (BA) network, in which nodes are born with degree $k=m$, for both product rule (PR) and sum rule (SR) of the Achlioptas process. For $m=1$ we find that the critical point $t_c=1$ which is the maximum possible value of the relative link density t; Hence we cannot have access to the other phase like percolation in one dimension. However, for $m>1$ we find that t_c decreases with increasing m and the critical exponents ν, α, β and γ for $m>1$ are found to be independent not only of the value of m but also of PR and SR. It implies that they all belong to the same universality class like EP in the Erdös-Rényi network. Besides, the critical exponents obey the Rushbrooke inequality $\alpha+2\beta+\gamma\geq2$ but always close to equality.

F. BANGLADESH AGRICULTURAL UNIVERSITY:

First draft genome assembly and identification of SNPs from hilsa shad (Tenualosa ilisha) of the Bay of Bengal

Background:

Hilsa shad (Tenualosa ilisha), a widely distributed migratory fish, contributes substantially to the economy of Bangladesh. The harvest of hilsa from inland waters has been fluctuating due to anthropological and climate change-induced degradation of the riverine habitats. The whole genome sequence of this valuable fish could provide genomic tools for sustainable harvest, conservation and productivity cycle maintenance. Here, we report the first draft genome of T. ilisha from the Bay of Bengal, the largest reservoir of the migratory fish.

Methods:

A live specimen of T. ilisha was collected from the Bay of Bengal. The whole genome sequencing was performed by the Illumina HiSeqX platform (2 × 150 paired end configuration). We assembled the short reads using SOAPdenovo2 genome assembler and predicted protein coding genes by AUGUSTUS. The completeness of the T. ilisha genome assembly was evaluated by BUSCO (Benchmarking Universal Single Copy Orthologs). We identified single nucleotide polymorphisms (SNPs) by calling them directly from unassembled sequence reads using discoSnp++.

Result:

We assembled the draft genome of 710.28 Mb having an N50 scaffold length of 64157 bp and GC content of 42.95%. A total of 37,450 protein coding genes were predicted of which 29,339 (78.34%) were annotated with other vertebrate genomes. We also identified 792,939 isolated SNPs with transversion:transition ratio of 1:1.8. The BUSCO evaluation showed 78.1% completeness of this genome.

Conclusions:

The genomic data generated in this study could be used as a reference to identify genes associated with physiological and ecological adaptations, population connectivity, and migration behaviour of this biologically and economically important anadromous fish species of the Clupeidae family.

Whole genome sequence and genome-wide distributed single nucleotide polymorphisms (SNPs) of the Black Bengal goat

The Black Bengal goat (BBG) is a dwarf sized heritage goat (Capra hircus) breed from Bangladesh, and is well known for its high fertility, excellent meat and skin quality. Here we present the first whole genome sequence and genome-wide distributed single nucleotide polymorphisms (SNPs) of the BBG. A total of 833,469,900 raw reads consisting of 125,020,485,000 bases were obtained by sequencing one male BBG sample. The reads were aligned to the San Clemente and

the Yunnan black goat genome which resulted in 98.65% (properly paired, 94.81%) and 98.50% (properly paired, 97.10%) of the reads aligning, respectively. Notably, the estimated sequencing coverages were 48.22X and 44.28X compared to published San Clemente and the Yunnan black goat genomes respectively. On the other hand, a total of 9,497,875 high quality SNPs (Q ≥ 20) along with 1,023,359 indels, and 8,746,849 high quality SNPs along with 842,706 indels were identified in BBG against the San Clemente and Yunnan black goat genomes respectively. The dataset is publicly available from NCBI BioSample (SAMN10391846), Sequence Read Archive (SRR8182317, SRR8549413 and SRR8549904), with BioProject ID PRJNA504436. These data might be useful genomic resources in conducting genome wide association studies, identification of quantitative trait loci (QTLs) and functional genomic analysis of the Black Bengal goat.

BdREN

ACTIVITIES

IN 2019-2020
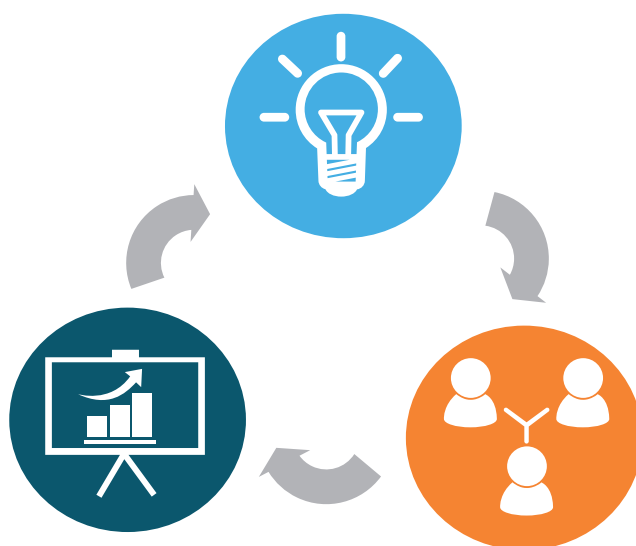
BOARD OF TRUSTEES MEETINGS:

Table 1: Board of Trustees meetings

NAME OF THE EVENT	DATE
20th Board of Trustees Meeting	06.08.2019
21st Board of Trustees Meeting	06.10.2019
22nd Board of Trustees Meeting	30.10.2019
23rd Board of Trustees Meeting	12.12.2019
24th Board of Trustees Meeting	09.03.2020
25th Board of Trustees Meeting	22.06.2020

AWARENESS PROGRAMS:

Table 2: Awareness Programs

NAME OF THE EVENT	DATE
Awareness Program- Meeting with Delegates from Medical Colleges/Research Institutes	29.09.2019
Students from Islamic University, Kushtia visited BdREN as a part of Study-Tour Program	16.11.2019
Awareness Program - UGC meeting with Vice Chancellors of all public universities on online education	25.06.2019

TRAININGS, WORKSHOPS AND SEMINARS:

Table 3: Trainings, Workshops and Seminars Organized by BdREN

NAME OF THE EVENT	TYPE OF EVENT	DURATION	LOCATION
DigiNar-1: Competitive Edge of NRENs and Financial Sustainability	Seminar	26/06/2019 and 02/07/2019	BdREN Zoom
DLE Course – 1: "Cyber Security"	Training	16 hours, 09/07/2019-10/08/2019	BdREN Zoom
Workshop on Performance Evaluation of the System	Workshop	27/08/2019 - 28/08/2019	BdREN Zoom
DLE Course – 2: "Ethical Hacking"	Training	16 hours, 09/09/2019-02/10/2019	BdREN Zoom
eduroam IRS Configuration – Batch - 1	Workshop	27/09/2019 – 28/09/2019	UGC Auditorium
eduroam IRS Configuration – Batch - 2	Workshop	06/11/2019 – 07/11/2019	IUB
Virtualization and Cloud Computing for NREN Engineers	Workshop	25/11/2019 – 28/11/2019	UGC Auditorium
Train the Trainers Workshop II	Workshop	03/12/2019 – 05/12/2019	Kathmandu, Nepal
Advanced Network/System Administration and Security	Workshop	10/12/2019 – 12/12/2019	BUET
DigiNar – 2: Progress and Challenges In Introducing eduroam and Federated Identity	Seminar	18/12/2019 – 19/12/2019	BdREN Zoom
DLE Course – 3: "Practical Cryptography"	Training	16 hours, 11/01/2020-29/02/2020	BdREN Zoom
Online Training on VAT	Training	6 hours, 21/04/2020	BdREN Zoom
IP Routing and IPv6 Addressing	Workshop	14 hours, 03/05/2020-15/05/2020	BdREN Zoom
DLE Course – 4: "Introduction to Big Data and Hadoop"	Training	16 hours, 21/03/2020-09/05/2020	BdREN Zoom
DigiNar – 3: Challenges at the outbreak of Covid-19 and the initiatives taken by NRENs	Seminar	07/05/2020	BdREN Zoom

PHOTO
ALBUM

Figure 14:
23rd BoT Meeting
(12 Dec 2019)

BOARD OF TRUSTEES MEETING

Figure 15:
24th BoT Meeting
(9 Mar 2020)
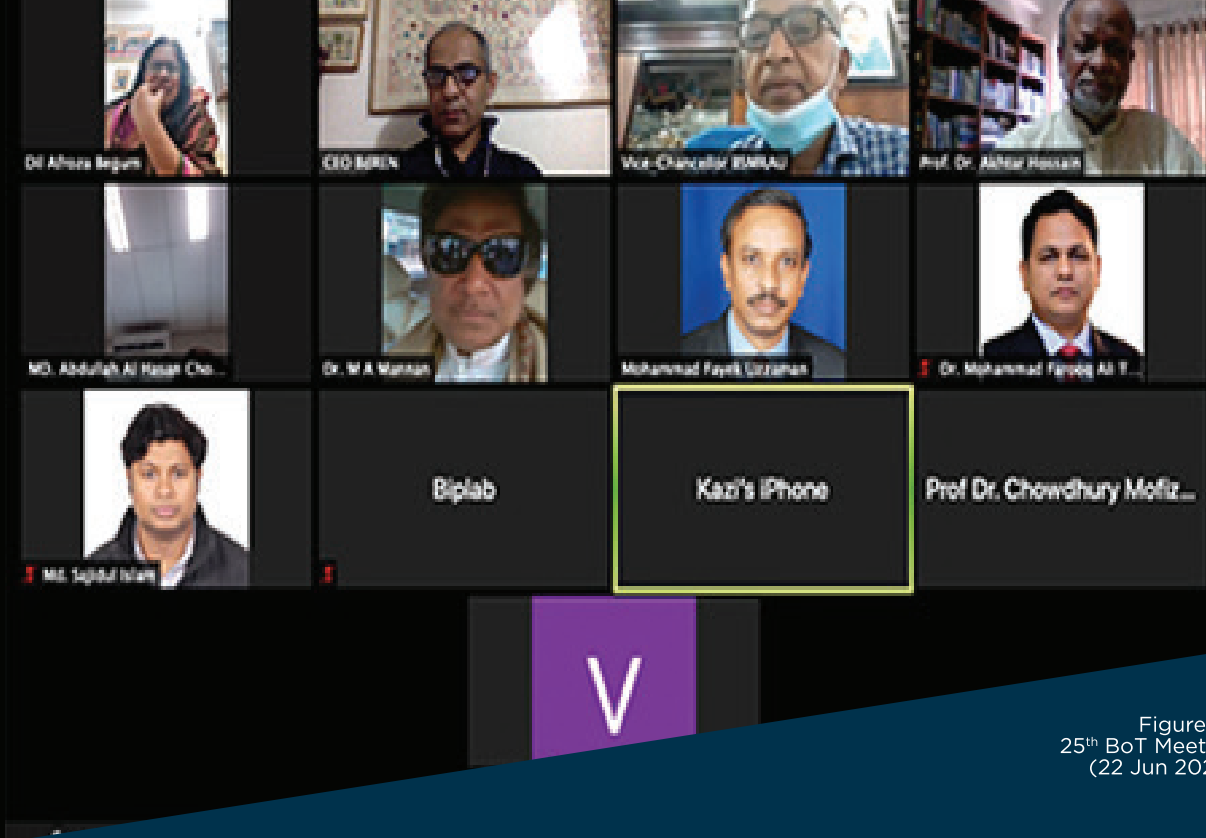
Figure 16:
25th BoT Meeting
(22 Jun 2020)

BOARD OF TRUSTEES MEETING

Figure 17:
Prof. Dr. Kazi Shahidullah, honorable Chairperson speaking in the Awareness Program to the delegates from Medical Colleges and Research Institutes (29 Sep 2019)

AWARENESS PROGRAM

Figure 18:
Awareness Program- Meeting with Delegates from Medical Colleges/Research Institutes
(29 Sep 2019)

Figure 19:
Students from Islamic University, Kushtia visited
BdREN as a part of Study Tour Program
(16 Nov 2019)

AWARENESS PROGRAM

Figure 20:
Meeting between UGC and Vice Chancellors of
all public universities on online education
(25 Jun 2019)

Figure 21:
Farewell of Prof. Atique Islam, honorable Member, BoT
(12 Dec 2019)

OTHER PROGRAMS

Figure 22:
Farewell of Prof. Dr. Md. Akhtar Hossain, ex-Vice Chairperson
(13 Jan 2020)

Figure 23:
Train The Trainer Workshop-I at Negombo, Sri Lanka, under fDLuDCf project financed by Asi@Connect (23 - 25 Apr 2019)

TRAINING, WORKSHOP AND SEMINAR

Figure 24:
Prof. Dr. Javed I. Khan speaking in DigiNar-1 on "Competitive Edge of NRENs and Financial Sustainability" under fDLuDCf project financed by Asi@Connect (03 Jul 2019)
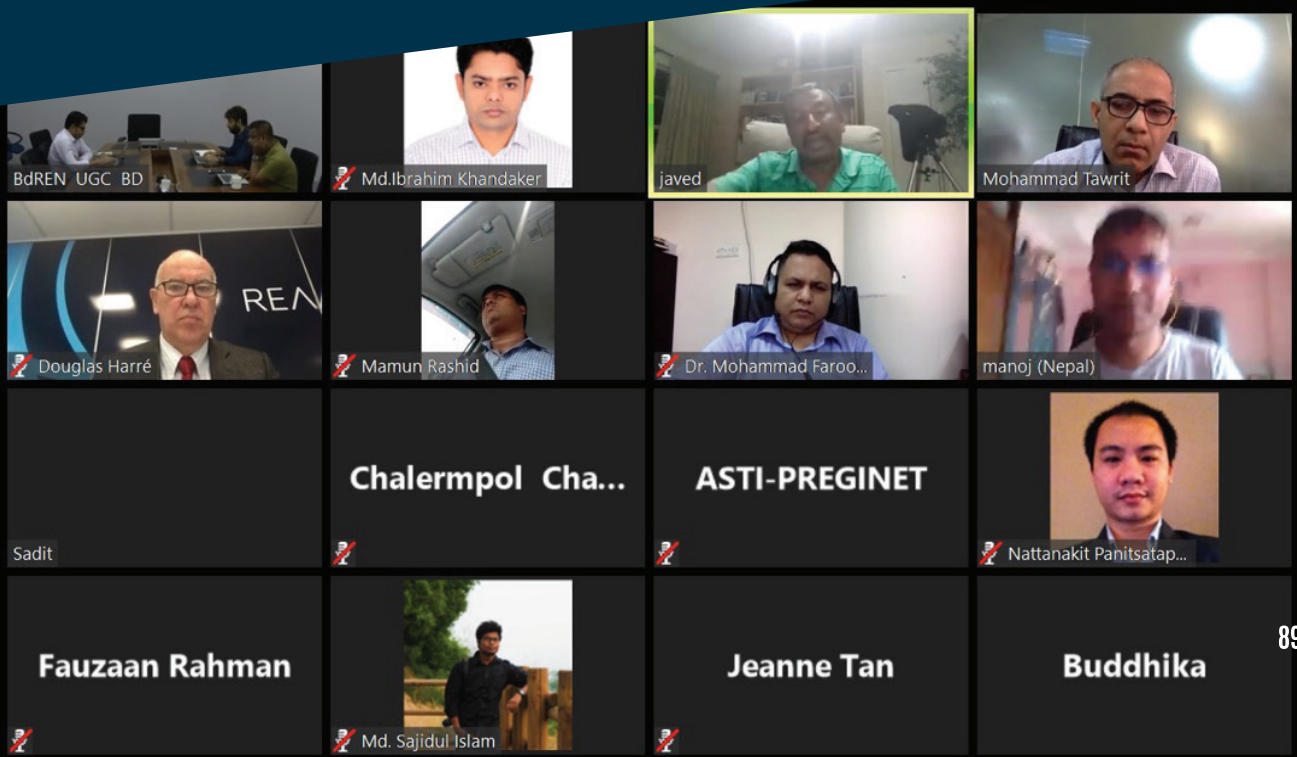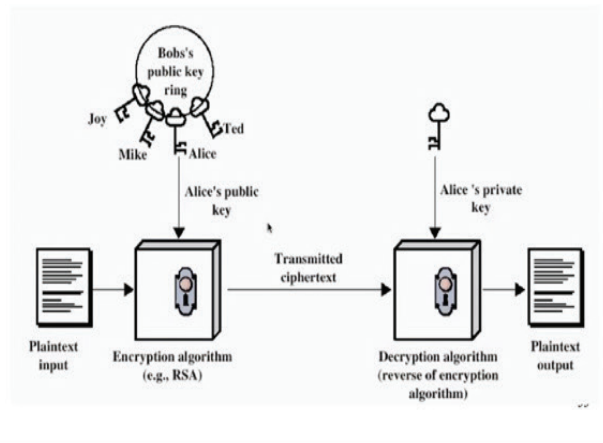
Figure 25:
Prof. Dr. Kasun De Zoysa, Sri Lanka conducting DLE Course-1 on "Cyber Security" under fDLuDCf project financed by Asi@Connect
(09 Jul - 03 Aug 2019)

TRAINING, WORKSHOP AND SEMINAR

Figure 26:
Workshop on "Performance Evaluation of the Application System" under fDLuDCf project financed by Asi@Connect
(27 - 28 Aug 2019)

Figure 27:
Prof. Dr. M Ameer Ali of BUBT conducting DLE Course-2 on "Ethical Hacking" under fDLuDCf project financed by Asi@Connect
(09 Sep - 02 Oct 2019)

TRAINING, WORKSHOP AND SEMINAR

Figure 28:
eduroam IRS Configuration – Batch - 1,
UGC Bhaban, Dhaka.
(27 - 28 Sep 2019)

Figure 29:
eduroam IRS Configuration – Batch - 2
IUB, Dhaka.
(06 - 07 Nov 2019)

TRAINING, WORKSHOP AND SEMINAR

Figure 30:
Training on "Virtualization and Cloud Computing for NREN Engineers" at UGC Bhaban, Dhaka.
Financed by Asi@Connect.
(25 - 28 Nov 2019)
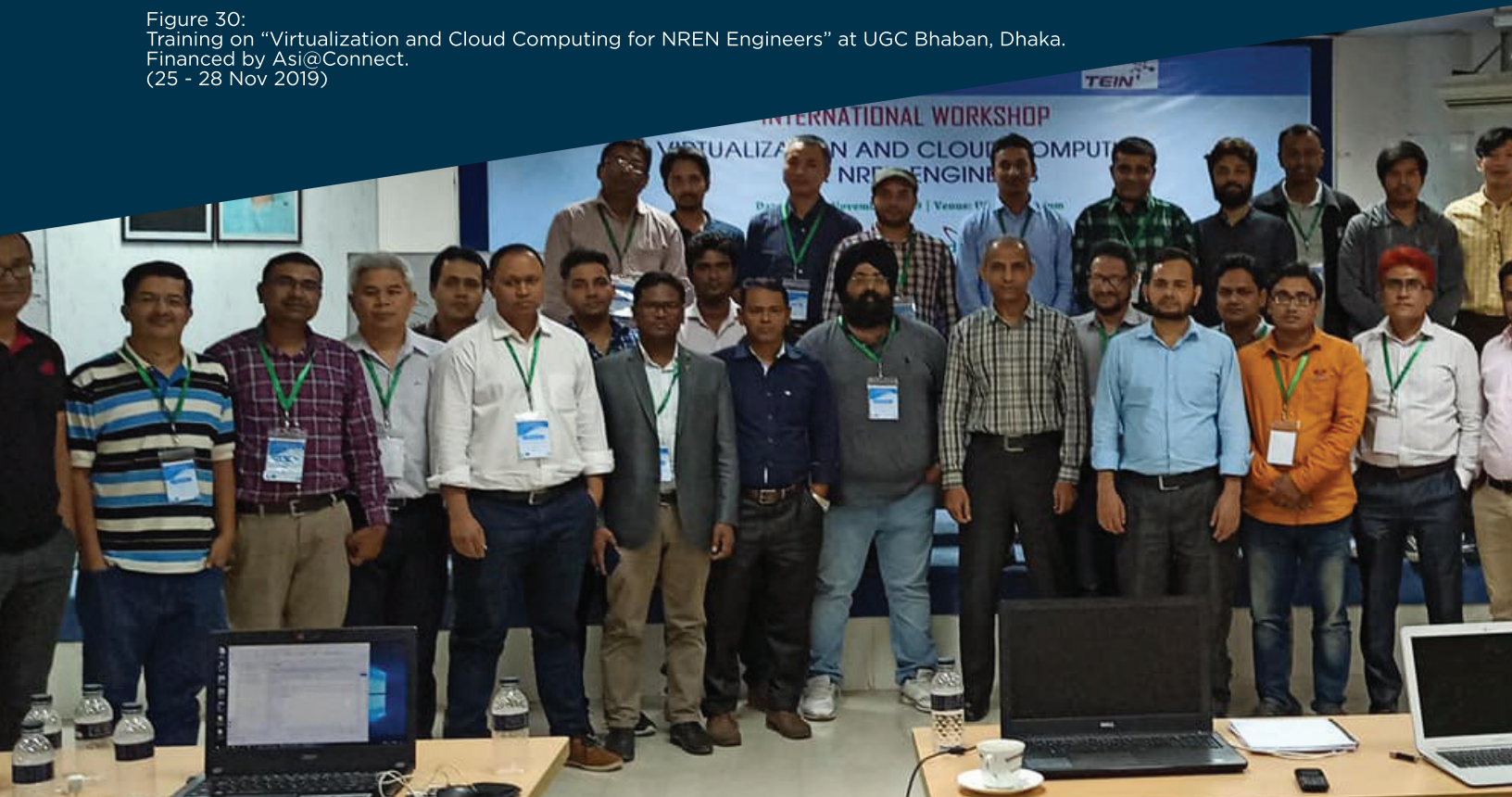
Figure 31:
Pål Axelsson of SUNET speaking in Diginar-2: "Progress and Challenges In Introducing eduroam and Federated Identity under Asi@Connect/GEANT", under fDLuDCf project financed by Asi@Connect
(18 - 19 Dec 2019)

TRAINING, WORKSHOP AND SEMINAR

Figure 32:
Train The Trainer Workshop-II at
Kathmandu, Nepal.
under fDLuDCf project financed by Asi@Connect
(03 - 05 Dec 2019)
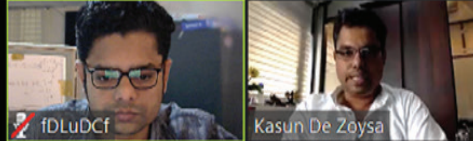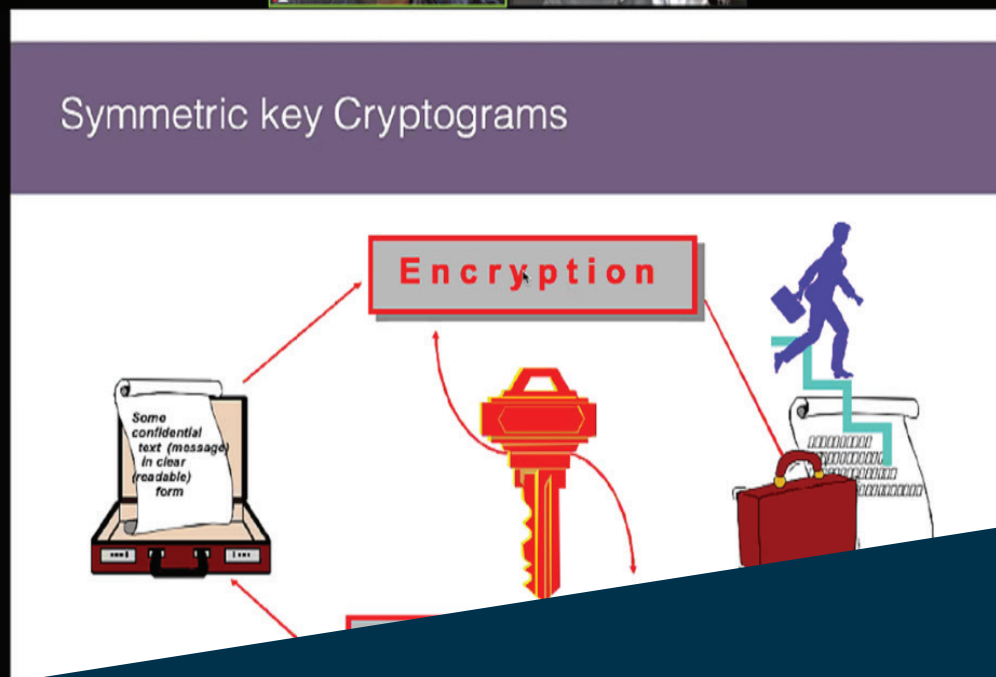
Figure 33:
Prof. Dr. Kasun De Zoysa, Sri Lanka conducting DLE Course – 3 on "Practical Cryptography"
under fDLuDCf project financed by Asi@Connect
(11 Jan - 29 Feb 2020)

TRAINING, WORKSHOP AND SEMINAR

Figure 34:
Engr. Palash Gupta conducting DLE Course-4 on "Introduction to Big Data and Hadoop"
under fDLuDCf project financed by Asi@Connect
(21 Mar - 09 May 2020)

Figure 35:
Asif Shahid Khan of PERN speaking in DigiNar-III on "Challenges at the outbreak of COVID-19 and the initiatives taken by NREN" under fDLuDCf project financed by Asi@Connect (07 May 2020)

TRAINING, WORKSHOP AND SEMINAR

BdREN

INFRASTRUCTURE

State-of-the-Art Service Infrastructure to Maximize the Service Availability and Reliability

OPGW AND DWDM CHANNEL
ALL OVER THE COUNTRY

BdREN Transmission network is built using an IP/MPLS data network on top of DWDM Transmission Network leasing Optical Ground Wire (OPGW) from PGCB for connecting the Universities/HEIs of the country.

The scope of transmission network system is as follows:

Install DWDM equipment in the Universities and PGCB Substations.

Provide reliable connectivity to University Routers using 1GE and 10GE user interface of DWDM network

Provide NMS System for DWDM network management.

TRANSMISSION SYSTEM PROVIDES

Reliability
Network Reliability has been ensured establishing multiple Rings in the Network. However, due to limitations of Fiber Network, reliability is reduced in some of the spans.

Transparency
DWDM is a physical layer architecture which transparently supports both TDM and multiple data formats such as ATM, Gigabit Ethernet, ESCON, and Fiber Channel with open interfaces over a common physical layer. BdREN Transmission network is focused on Gigabit Ethernet.

Scalability
Installed DWDM network leverages country-wide dark fiber to quickly meet demand for capacity on point-to-point links. BdREN Transmission network can support 40 Channels per Lambda.

Dynamic provisioning
BdREN utilizes the fast, simple, and dynamic provisioning of the network to establish high-bandwidth services in minutes rather than spending days.

BdREN
TRANSMISSION NETWORK

BANGLADESH RESEARCH AND EDUCATION NETWORK
DWDM Transmission Backbone
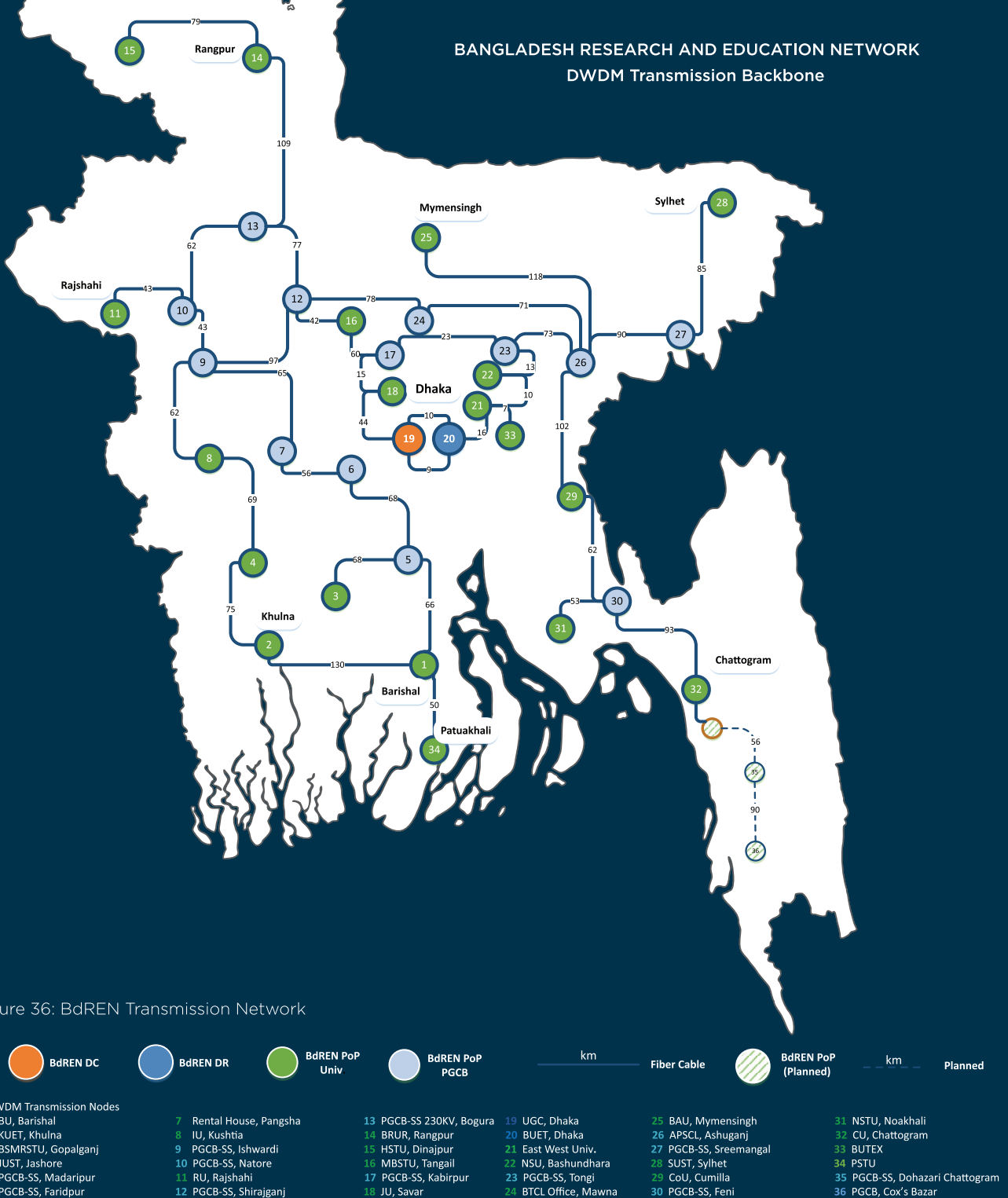
Figure 36: BdREN Transmission Network

● BdREN DC	● BdREN DR	● BdREN PoP Univ	● BdREN PoP PGCB	─── km ─── Fiber Cable	◉ BdREN PoP (Planned) ‑ ‑ km ‑ ‑ Planned

DWDM Transmission Nodes

1 BU, Barishal	7 Rental House, Pangsha	13 PGCB-SS 230KV, Bogura	19 UGC, Dhaka
2 KUET, Khulna	8 IU, Kushtia	14 BRUR, Rangpur	20 BUET, Dhaka
3 BSMRSTU, Gopalganj	9 PGCB-SS, Ishwardi	15 HSTU, Dinajpur	21 East West Univ.
4 JUST, Jashore	10 PGCB-SS, Natore	16 MBSTU, Tangail	22 NSU, Bashundhara
5 PGCB-SS, Madaripur	11 RU, Rajshahi	17 PGCB-SS, Kabirpur	23 PGCB-SS, Tongi
6 PGCB-SS, Faridpur	12 PGCB-SS, Shirajganj	18 JU, Savar	24 BTCL Office, Mawna

25 BAU, Mymensingh	31 NSTU, Noakhali
26 APSCL, Ashuganj	32 CU, Chattogram
27 PGCB-SS, Sreemangal	33 BUTEX
28 SUST, Sylhet	34 PSTU
29 CoU, Cumilla	35 PGCB-SS, Dohazari Chattogram
30 PGCB-SS, Feni	36 PGCB, Cox's Bazar

ESTABLISHED POINT-TO-POINT 1G CHANNELS

Appendix3.4 Channel Route
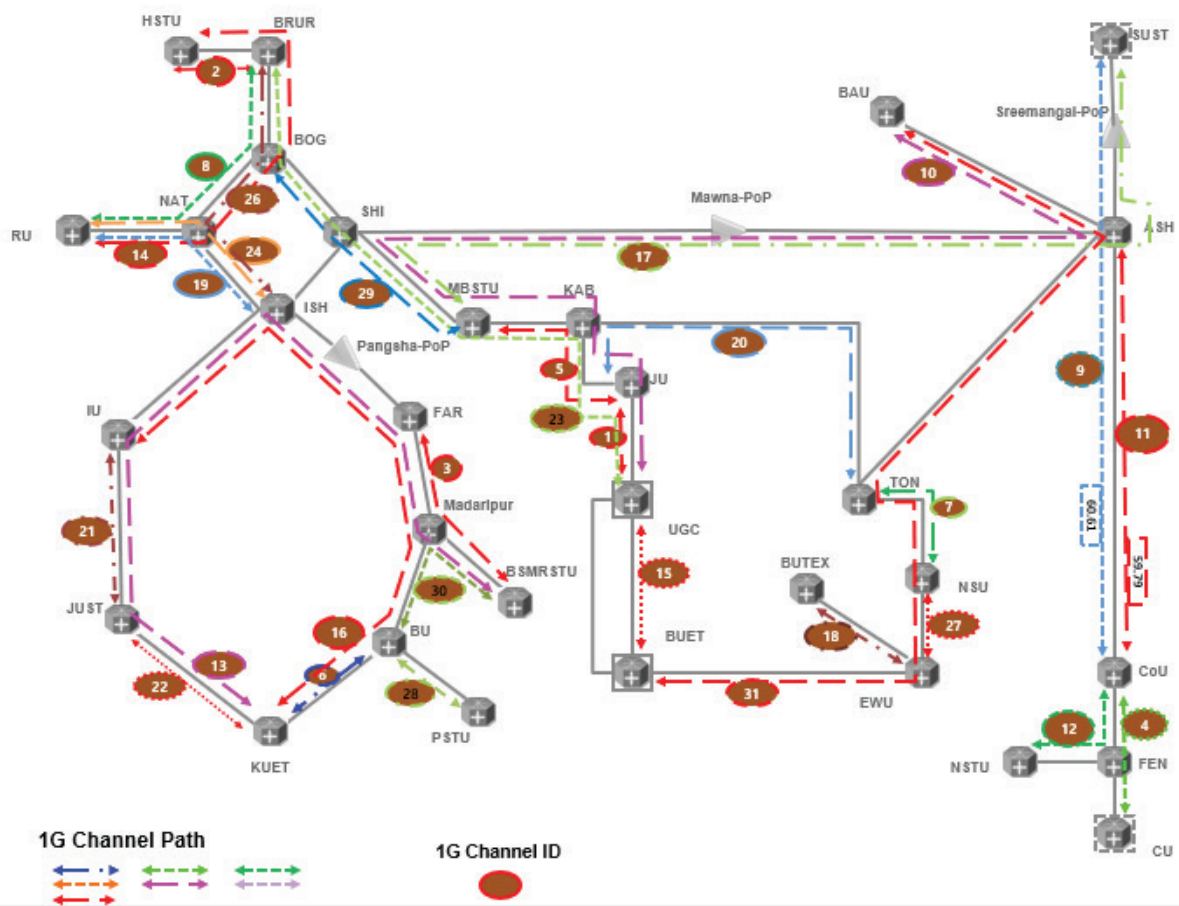
ESTABLISHED POINT-TO-POINT 10G CHANNELS

Appendix3.4 Channel Route
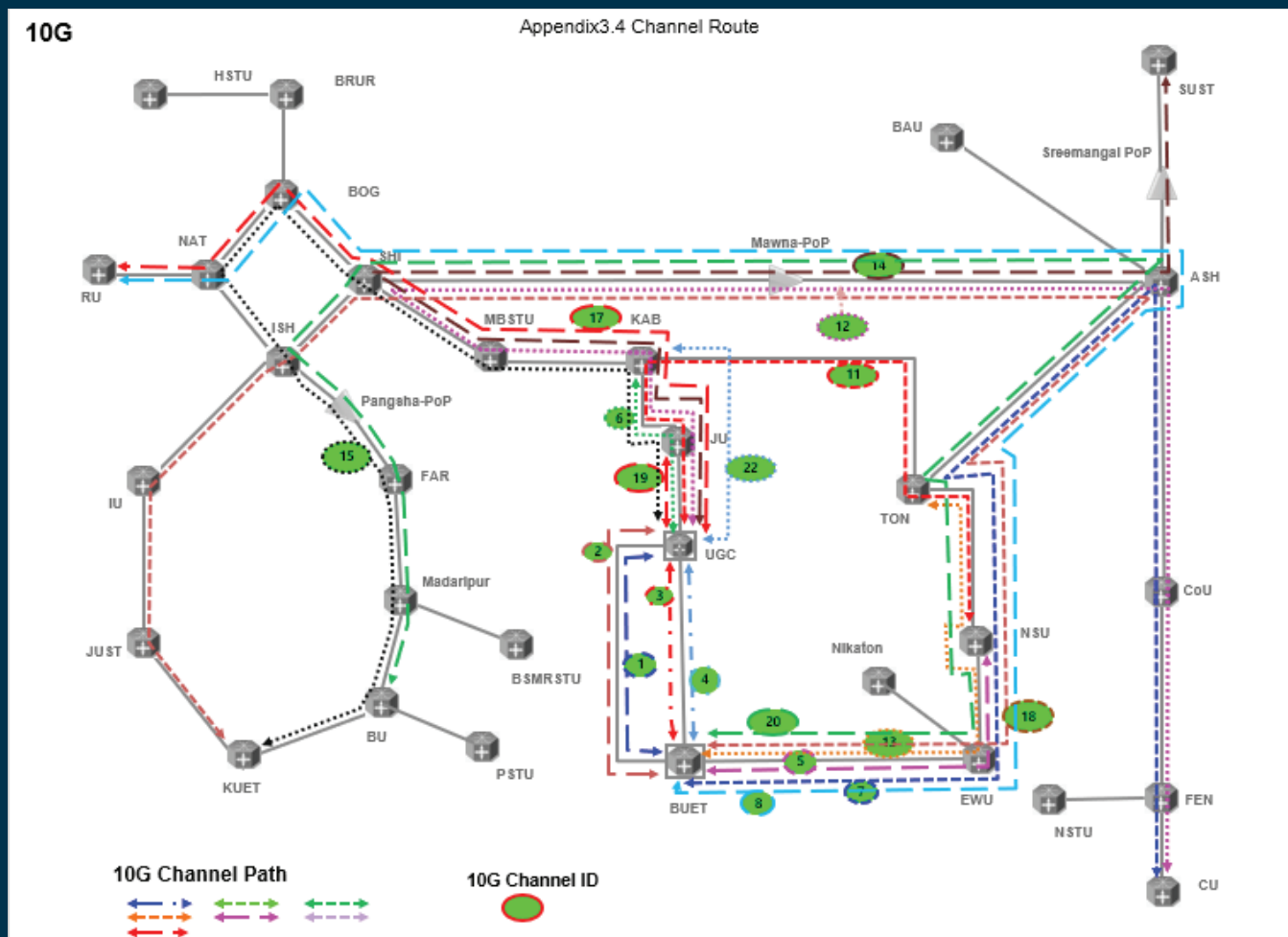
BDREN
DATA NETWORK INFRASTRUCTURE

BdREN is a multi-tier hierarchical network, where Layer based architecture (Core-Distribution-Edge) has been implemented. Data backbone typically have 3 Core Routers at Dhaka (two at UGC Building and the other at BUET ECE Building) and total 13(thirteen) Distribution Zones namely UGC, BUET, NSU, NU, IUBAT, BSMRAU, BAU, CU, CoU, KUET, BU, RU and SUST. It followed the hierarchical model to design the dual stack (IPv4 & IPv6) MPLS backbone to communicate between Edges and Cores (Figure 37).

There are 69 (Sixty-Nine) Edge routers installed in different Universities, Medical Colleges and Research Institutions. The traffic model between Distribution-to-Distribution Router is 10G and Distribution to Edge Router is either 1G or 10G based on the demand of the Member Institutions.
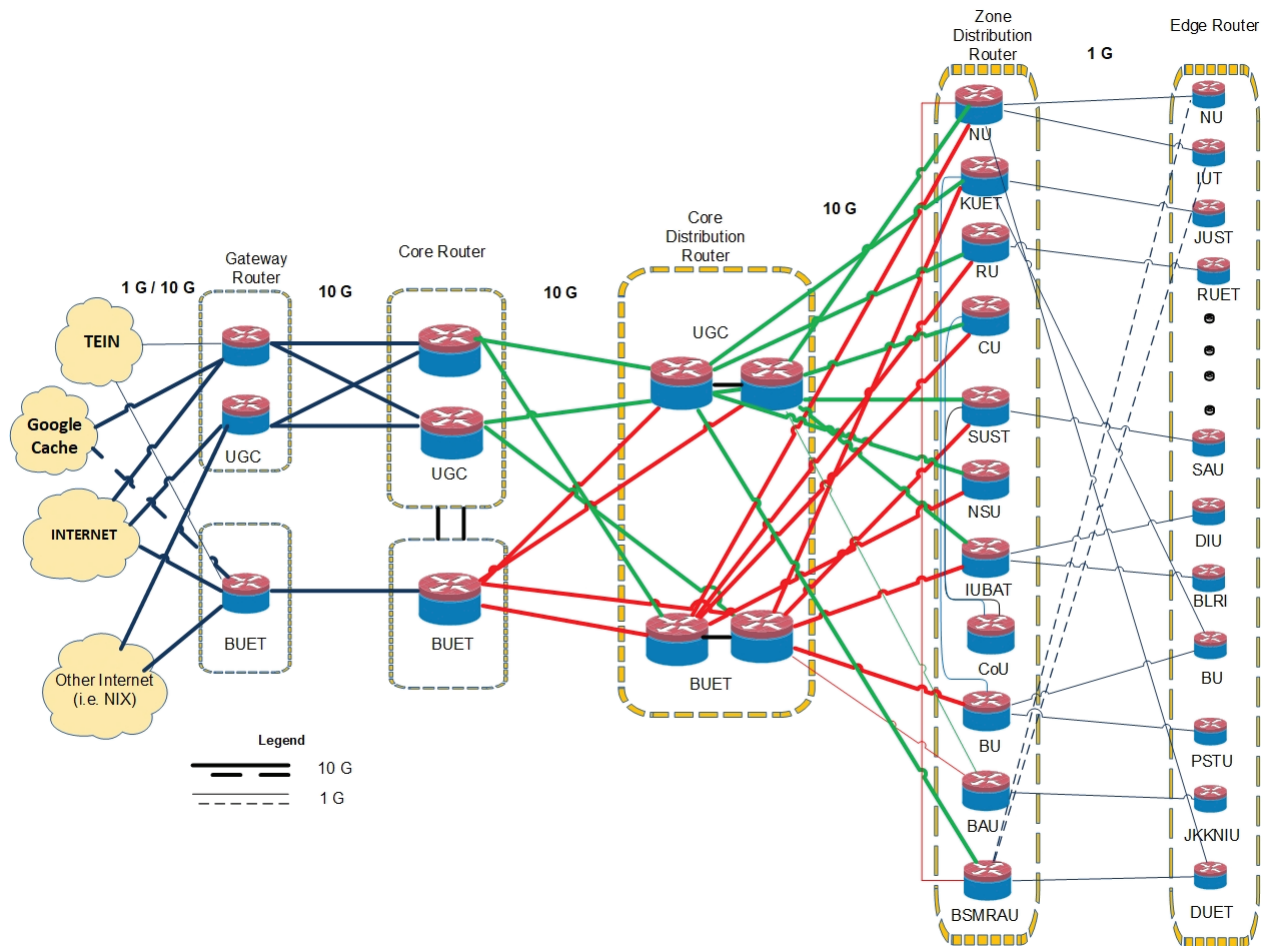
Figure 37: BdREN Data Network System

In the backbone, traffic is forwarded using MPLS Label switching. Each of the Distribution Router is considered as "P: Provider" Router and the Edge Routers are considered as "PE: Provider Edge" Routers. The Member Institution Gateway Router at each university or other institutes are considered as "CE: Customer Edge" Router. The CE Routers are connected to PE Routers using traditional IP Technology. Distribution routers are distributed across the country to connect all the universities and other institutes located in different parts of the country over DWDM Transport Backbone. Each Distribution zone locally holds the entire routing information for that particular zone. These Distribution Routers located at different parts of the country then either connect with Central Distribution Routers located in DC & DRC to interchange traffic among different zones or get connected with the Core Routers to get to the Internet through Internet Router (Gateway Router) or to get to the Server Farm through Core Switch.

In addition to MPLS backbone (Figure 38) there are Data Center (DC) and Disaster Recovery (DR) Center, where central equipment like Core Router, Firewall, Core switch, Internet Routers are deployed to
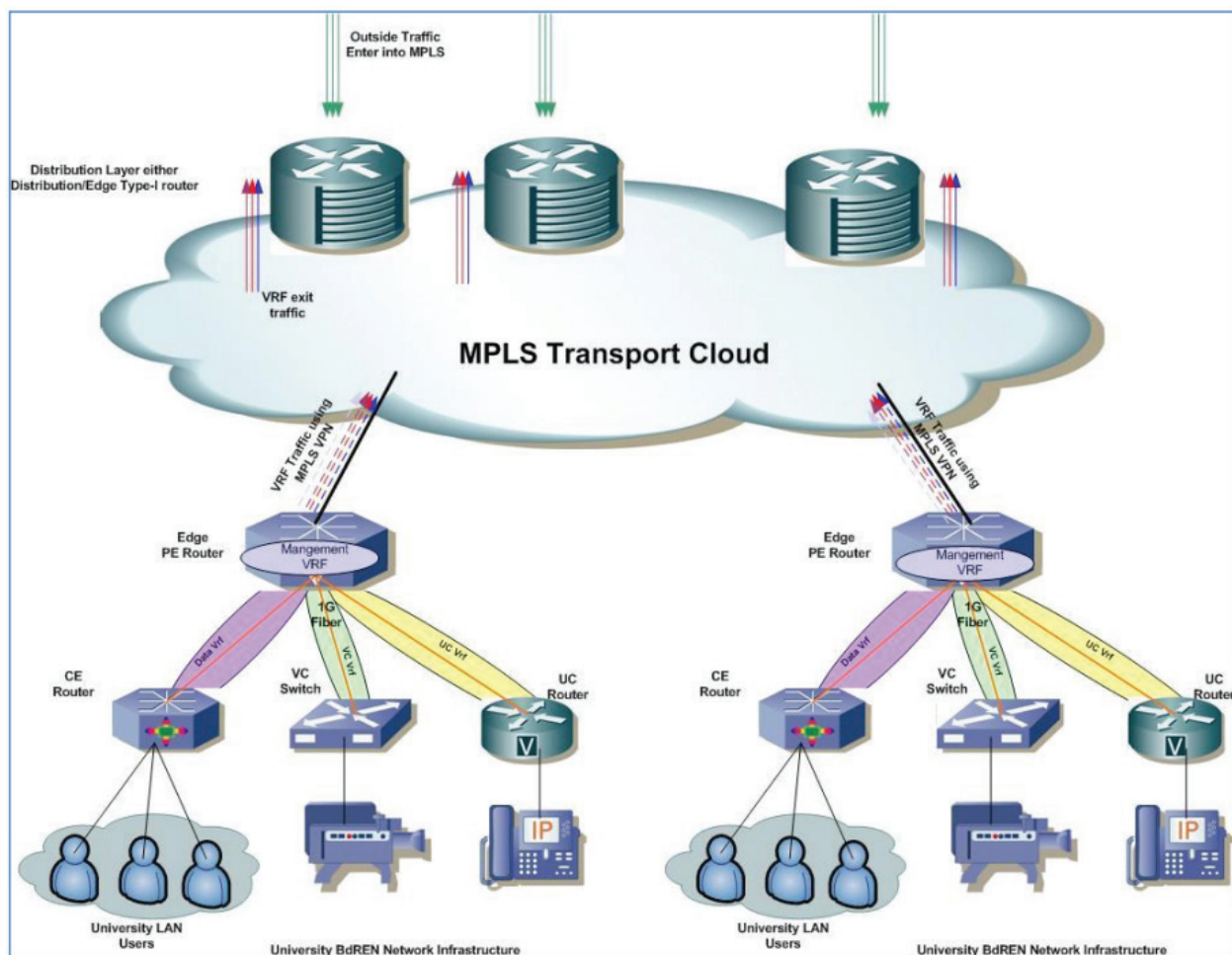
Figure 38: BdREN MPLS Backbone

manage, monitor, maintain, troubleshoot and enforce policies on whole infrastructure. These DC and DRC are holding central management equipment to catch and change flow of traffic and perform redundancy during fail-over. Services like Internet and Academic bandwidth are provided through Internet Router located at DC and DRC. At the same time different hosted applications are provided through computing servers located at DC and DRC. Google Global Cache (GGC) Server is connected with the Internet Router at UGC. Also connected with these Internet Routers are the two Internet eXchange Points (IXPs) of BDIX and AIX.

Hierarchical routing is performed across the MPLS domain. All Zonal Distribution Routers are connected with DC & DRC Distribution routers, so that MPLS VPN routes can be interchanged among different zones. DC-DRC distribution routers perform the second-tier route reflector to perform the MP-BGP route exchange. DC-DRC Distribution router then connects with DC-DRC Core routers for getting Application access at Server Farm or Internet/ TEIN connectivity. In MPLS domain IGP (IS-IS) is used to provide Layer-3 routing between hops and populate MPLS labels for those connectivity. This IGP also provides information required for upstream connectivity to get connected outside BdREN and internal VRFs.

In normal case all traffic generated from or destined to the users are routed through Data Center. If DC is down, DRC will be in action with minimum downtime and will route user traffic in the same way as it would have been if DC was active. The transition will be seamless so that from users' point of view, there will be no impact encountered from rerouting of traffic.

BdREN
DATA CENTER

   With a view to enhancing and empowering the quality of education at higher education sector, BdREN provides different services to its member organizations. Among those, Internet bandwidth, cloud service (IaaS and PaaS), hosting service, web security, unified collaboration and video conference are prominent. As a central repository of data, BdREN deployed its Data Center at UGC Bhaban and Disaster Recovery Center at BUET where cloud system is implemented with data backup system to ensure data loss prevention.
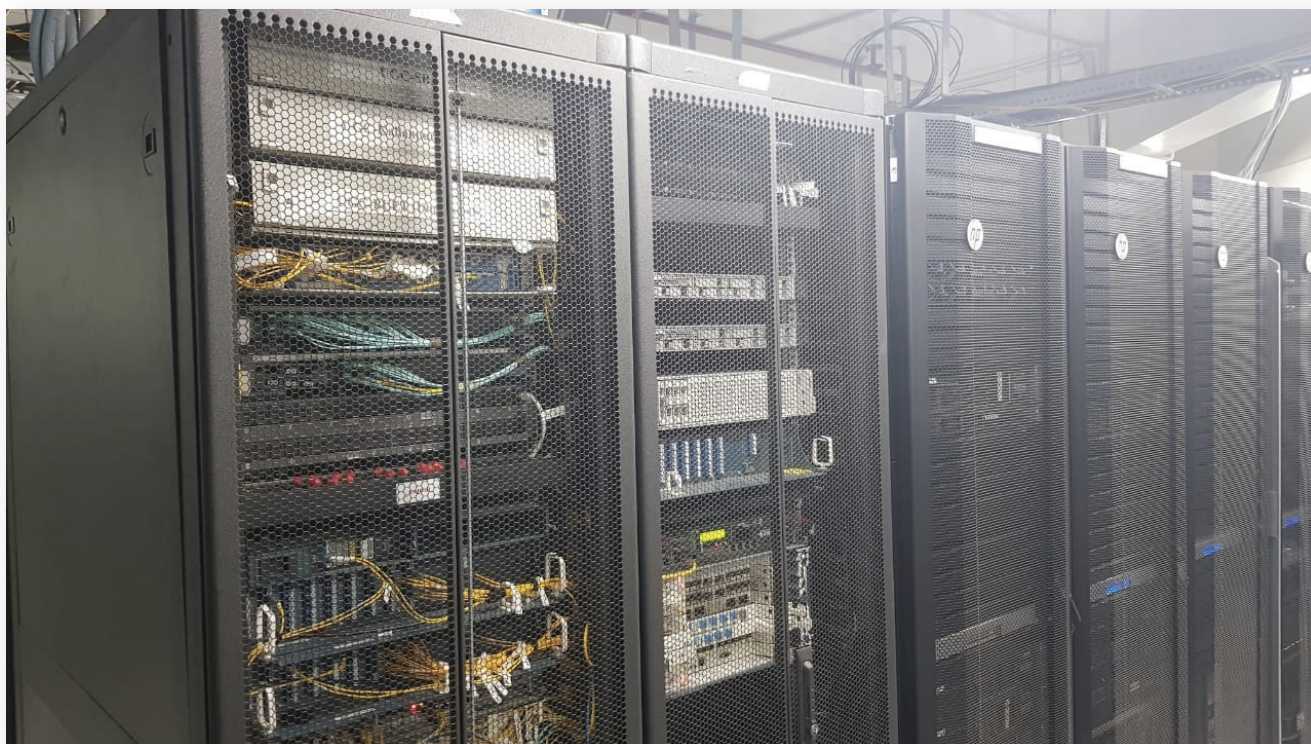
Figure 39: BdREN Data Center

BdREN'S
DATA CENTER CAPABILITY

Computing Capacity:

BdREN installed 24 Generation-8 Blade Servers of HPE and each of the server's capacity is 20 CPUs with 96 GB Memory. There are other servers from Dell with 16 CPUs and 32 GB of Memory. Recently, BdREN procured two high performance servers from Dell with each one having a capacity of 96 CPUs and 512 GB of Memory. The huge infrastructure is serving the research and higher education community by providing both Infrastructure as a Service (IaaS) and Platform as a Service (PaaS).

Storage Capacity:

BdREN has deployed enterprise grade storage from HPE 3PAR at real time both DC and DRC. The total capacity is around 400 TB. The storage is replicated at real time at both DC and DRC.

Electrical Power Supply:

BdREN Data Center facility is served by a permanent 3 phase 200KVA sub-station powered by DESCO. One 80 KVA and one 40KVA UPSs are running in series mode and another 40KVA UPS is running standalone to provide dual source backup power to individual rack. Moreover, 2(two) 32KW Rectifiers are installed to provide -48V DC power supply to the Data and Transmission Network equipment. As a backup to this UPS and Rectifier power source, two 100KVA diesel generators are installed between UPS and sub-station operated by ATS. Similarly, one 80 KVA UPS is installed at DRC for providing AC power supply and 2(two) 32 KW rectifiers are installed to provide DC power to the installed equipment.

Air Conditioning:

4(Four) PACs, each having a capacity of 8 Refrigerating Tons, are serving the Data Center facility operating in N+1 mode. Cool air flows under the raised flow and racks are placed maintaining hot-aisle and cold-aisle. At the DRC, 2(two) PACs, each having a capacity of 8 Refrigerating Tons, are installed to provide controlled cool environment.

Network Infrastructure and Security:

BdREN DWDM transmission network, WAN and Data Center Network are fully Cisco powered using Nexus 7000 as the core switch, ASA 5585-X as Server farm firewall and several ASR 9000 series routers at the upper layer from Data Center towards Internet. VPN server along with TACACS+ is installed to securely access the server for management.

Physical Security:

BdREN Data Center access is restricted by biometric access control system. The perimeter (inside and outside) is monitored by CCTV system.

Fire Suppression:

Automatic Fire Fighting System along with smoke detector is installed at Server room and power room where power system is also installed. Moreover, zone-based water detection system is also installed under raised floor.

BdREN
INFRASTRUCTURE FOR ONLINE EDUCATION

DISTANCE LEARNING THEATER

BdREN has built a state-of-the-art video conferencing system to enable the students, teachers and researchers to share and participate in remote live and recorded lectures, classes and conferences to disseminate knowledge and experience both within the country and abroad. Each University has one classroom with modern video conferencing facilities known as "Distance Learning Theater (DLT)" and in each research institution one meeting room is installed which is known as "Distance Collaboration Center (DCC)".

BdREN DLT is equipped with open standard based, state-of-the-art, flexible and high-quality video conferencing devices.

SYSTEM ARCHITECTURE

Video Conference Management Servers (VC infra) including MCU has been deployed in Data Center and Disaster Recovery Center. The central VC infra (Management Servers) controls, monitors, and manage all endpoint Codecs remotely.
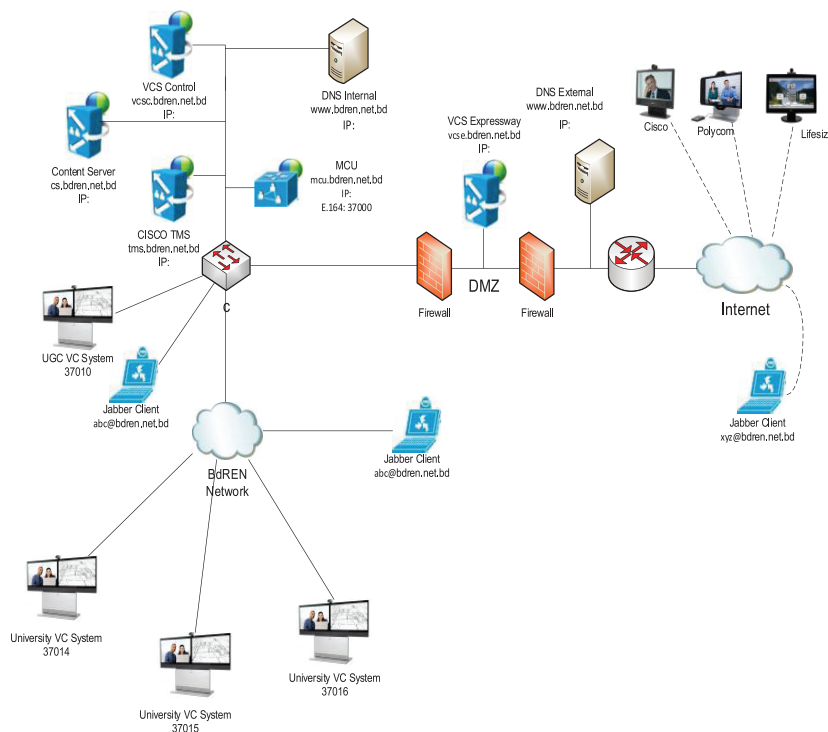
Figure 40: BdREN Video Conference System Architecture

LIST OF EQUIPMENT

Cisco Video conferencing endpoints (codec) have been installed at 34 public universities, 12 medical colleges, 2 private universities, 1 international university and 10 research institutes with necessary audio & visual systems. Video conferencing infrastructure including MCU (Multipoint Control Unit), Video Conference Management System, Video Content Server, and Video Communication Server have been installed at BdREN Data Center to control, monitor, and manage each video conference room as well as supporting multipoint connections. Also, every room has necessary furniture, air conditioning system, power backup system and other accessories for the interior.

SYSTEM PLACEMENT

Each system has been placed in such a position that the overall performance of the video conference and local presentation can be optimized. The picture below depicts the designed position of each system in the room.
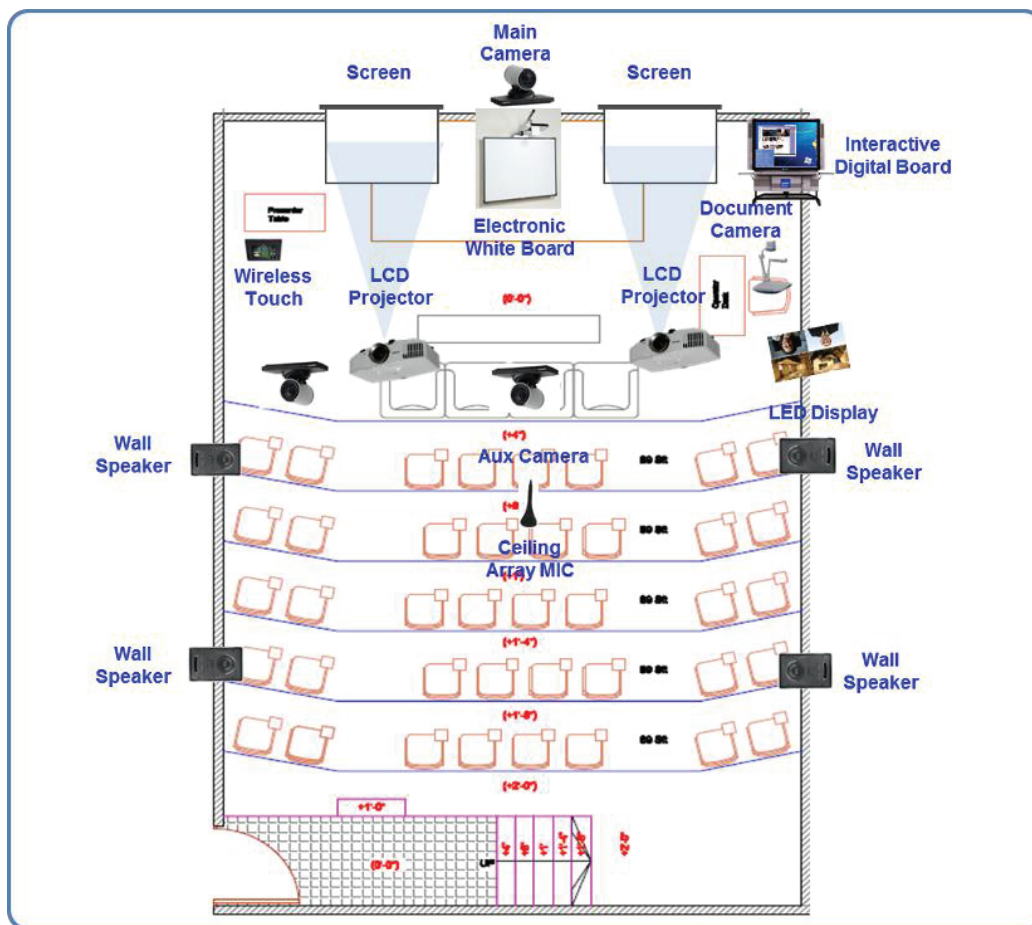
Figure 41: System Placement Layout

BdREN
WEB CONFERENCING INFRASTRUCTURE

To eliminate geographic barriers of all kinds BdREN is providing zoom license to its member institutions. Zoom provides seamless and reliable video and web meetings for up to 300 participants (500 for large meeting also available in limited number), who can join, share and record content using PC, Mac, Linux, Chrome OS, iOS, Android or BlackBerry devices.

Zoom leverages the ultra-high bandwidth and low-latency of BdREN network to deliver a high-quality user experience while supporting potentially thousands of simultaneous meetings.

Guests without accounts can easily join meetings at no cost, making Zoom a game-changing collaboration platform for researchers working with partners in different organizations.

BdREN Zoom is a secure, fully private cloud (on-premises) web conferencing system. At present BdREN has 230 Zoom Multi-Media Routers (MMRs) that supports around 1000 concurrent meetings.

BdREN
INFRASTRUCTURE FOR IP TELEPHONY SERVICE

BdREN is capable of providing IP Telephony service to member institutes. Presently users in each public university connected to BdREN can use and manage IP phones in an integrated way through Cisco Unified Communication Systems/Fortinet Telephone Gateway that helps to improve the productivity of individuals as well as the universities. BdREN's inter-university IP telephony calling facility provides outstanding voice quality with no cost and gives the university a smart work environment. Moreover, if a university wants, it can call outside, of the BdREN network through an IPTSP connection. BdREN also provides DID/DOD service based on the requirement placed by the university. The present architecture enables the university to use BdREN's network for both voice and video calls. The detailed system architecture is described in the following diagram.
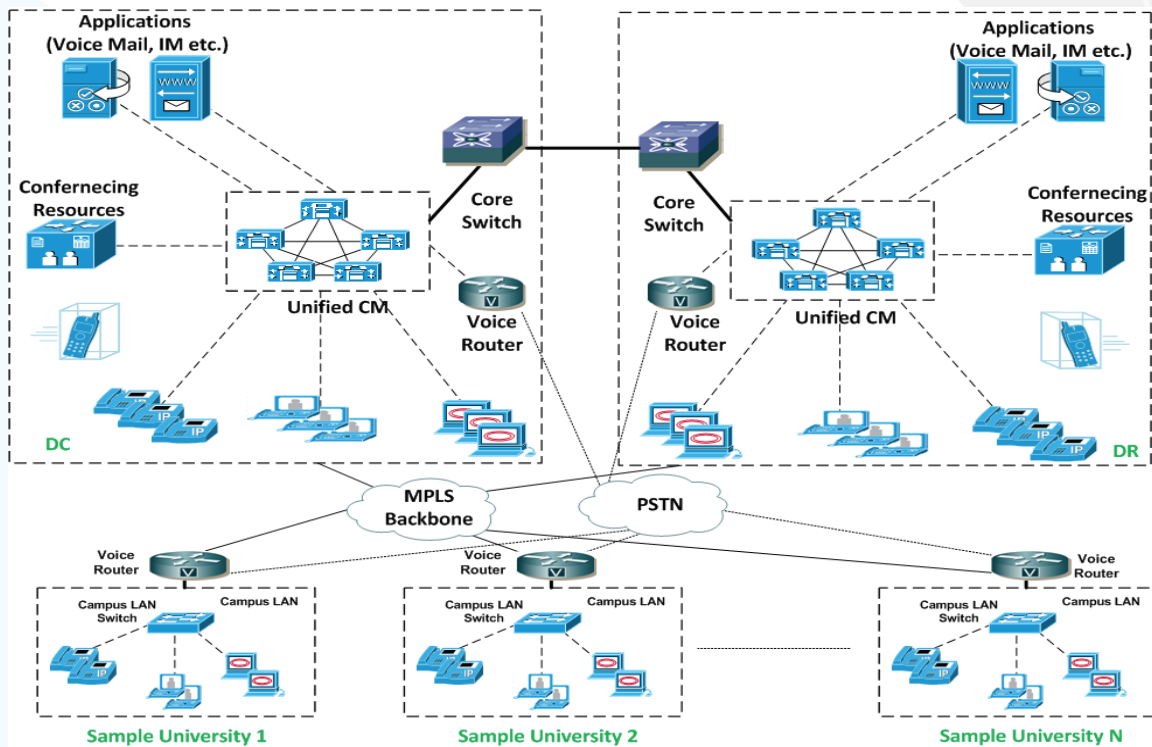
Figure 42: Network Architecture of IP Telephony System

Figure 42 shows the logical connectivity of UC system with CUCM (Unified CM) Cluster placed at DC for call processing with its backup installed at DRC. Other Applications like Unified Messaging, Conferencing, etc. are hosted in DC & backup of these servers are placed at DRC. The central voice gateway routers at the DC and DRC are connected to the MPLS network and the voice gateway at DC is connected to the IPTSP service provider. Any communication to PSTN and PLMN subscribers is established through the IPTSP network. Each university hosts a voice gateway too which is connected to the MPLS network and at the same time, it is connected to the IPTSP network (where available). University to University communication will take place through the MPLS network and outside calls towards PSTN and PLMN take place through IPTSP connection.

BdREN'S
POP PASSIVE FACILITY

Power Supply
In total 74 Rectifiers are installed to provide -48V DC power supply to the Data and Transmission Network equipment at each BdREN PoP site. As a backup to the Rectifier power source, 32 generators are installed in BdREN's PoP sites operated by ATS.

Air Conditioning
625 Air-conditioners, having capacity of 1.5 or 2 Refrigerating Tons each, are installed at the PoPs, DLTs and DCCs with n+1 mode of redundancy.

Physical Security
BdREN's PoP access is restricted by the manual lock and key system. Automatized CCTV monitoring is going to be implemented shortly.

Fire Suppression
Manual Fire Fighting System has been installed at each BdREN PoP site.

BdREN Data Center cooling system concept   *Images source: https://journal.uptimeinstitute.com*

BdREN

STATISTICAL OVERVIEW

IN 2019-2020

UPSTREAM BW USAGE

   BdREN had 8 upstreams in Financial Year 2019-2020. NKN, Google Cache, Aamra-IIG and Aamra-IX have been added as upstream in the beginning of 2020. Using BTCL as an upstream provider is a highly economical option for BdREN. Hence, majority of the commodity Internet is served using BTCL as evident from its major share of traffic in the Figure 43 and Figure 44.
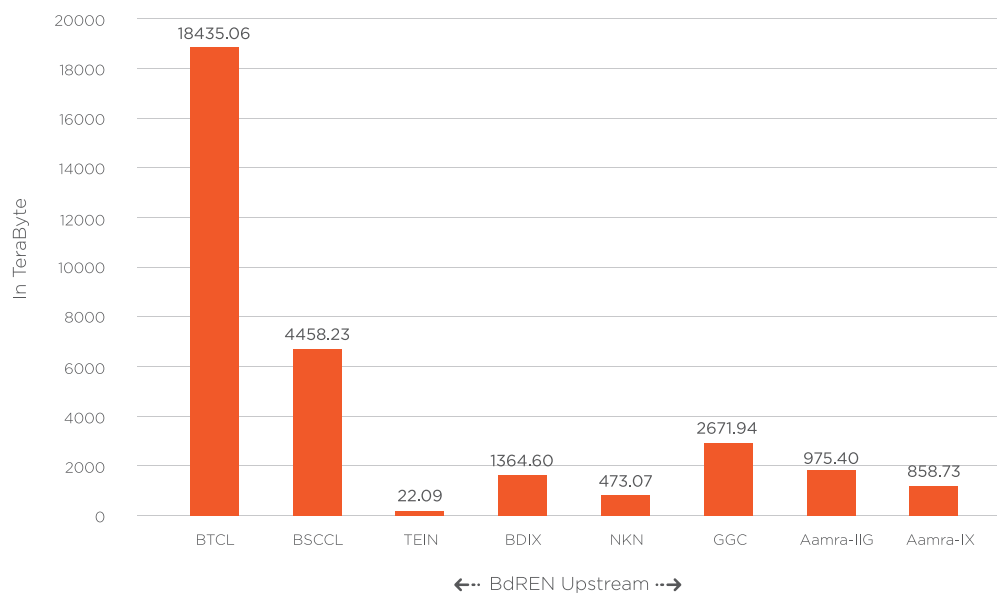
Figure 43: Total Download Traffic (2019-2020)
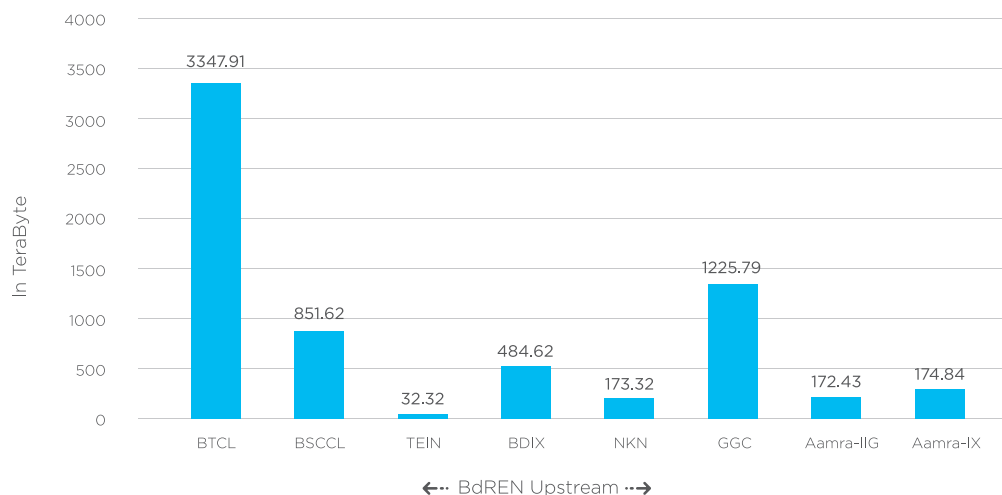
Figure 44: Total Upload Traffic (2019-2020)

REGION-WISE NETWORK AVAILABILITY

In compliance with the Service Level Agreement (SLA) with its member institutions BdREN is supposed to maintain a network availability of 99.00% or more inside Dhaka and 98.00% or more outside Dhaka. BdREN has provided 99.68% network availability inside Dhaka and 99.66% network availability outside Dhaka in the last one year and never went below 99.00% in any month. Figure 45 validates the above claim.
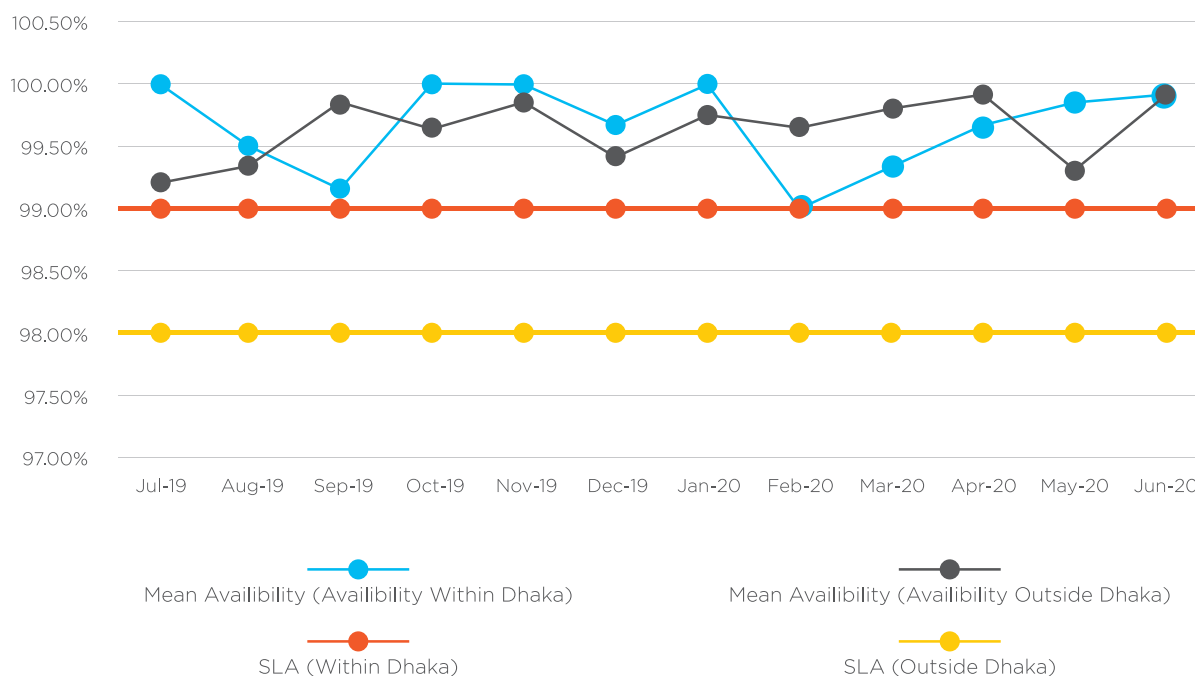
Figure 45: Network Availability (2019-2020)

BdREN
NETWORK AVAILABILITY

Butterfly graph in Figure 46 juxtaposes BdREN network availability in the year 2018-2019 and 2019-2020 which demonstrates BdREN network availability inside Dhaka which is almost same across the year in month-to-month comparison and which is more efficacious than that mentioned in Service Level Agreement.

2018-2019		2019-2020
99.71%	JULY	99.97%
99.30%	AUGUST	99.49%
97.04%	SEPTEMBER	99.03%
96.06%	OCTOBER	100.00%
99.84%	NOVEMBER	100.00%
98.65%	DECEMBER	99.69%
99.99%	JANUARY	99.98%
100.00%	FEBRUARY	99.02%
99.12%	MARCH	99.58%
100.00%	APRIL	99.87%
100.00%	MAY	99.88%
100.00%	JUNE	99.91%
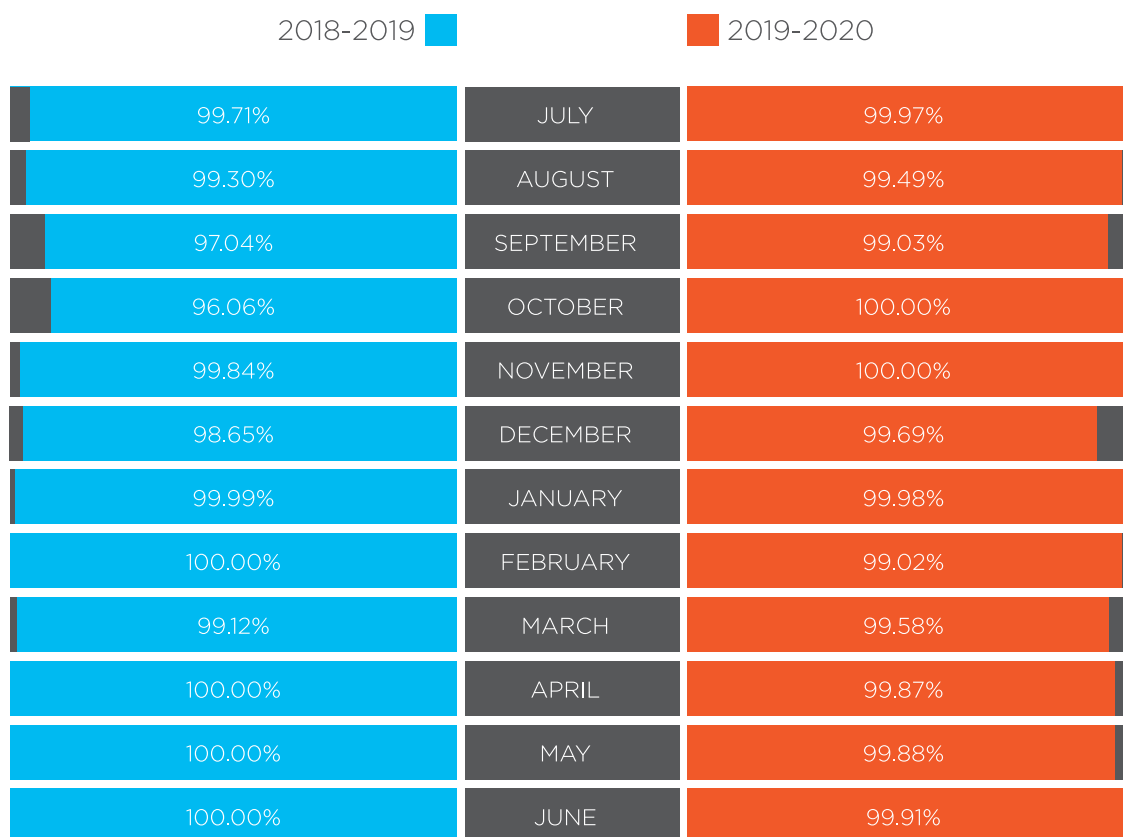
Figure 46: Network Availability inside Dhaka

Similarly, butterfly graph in Figure 47 juxtaposes BdREN network availability in the year 2018-2019 and 2019-2020 demonstrating BdREN network availability outside Dhaka. It is vivid that the network availability is increased significantly in the year 2020 (Jan-June) in month-to-month comparison across the year.

2018-2019		2019-2020
98.69%	JULY	99.06%
97.30%	AUGUST	99.26%
97.98%	SEPTEMBER	99.78%
99.46%	OCTOBER	99.61%
98.97%	NOVEMBER	99.83%
98.08%	DECEMBER	99.42%
99.70%	JANUARY	99.73%
99.06%	FEBRUARY	99.65%
97.37%	MARCH	99.76%
99.24%	APRIL	99.87%
98.26%	MAY	99.41%
99.57%	JUNE	99.88%
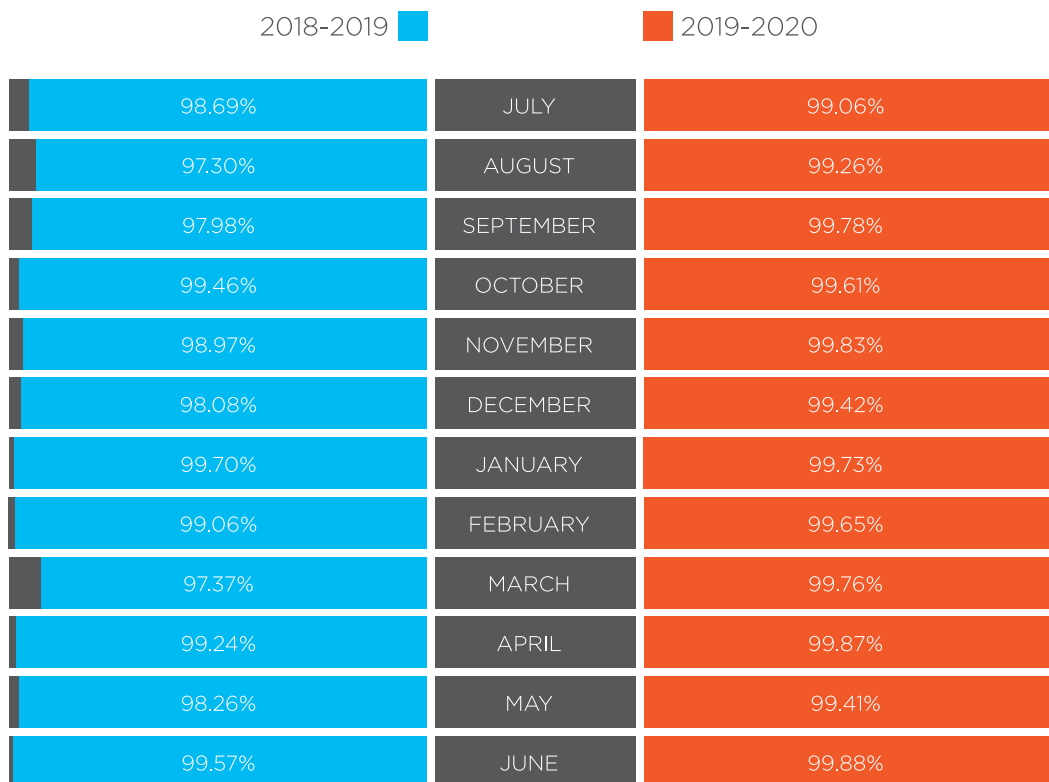
Figure 47: Network Availability Outside Dhaka

BDREN NETWORK UPSTREAM USAGE

Figure 48 gives a month-to-month comparison of Upstream usage in TB between year 2018-2019 and 2019-2020.

2018-2019   2019-2020

2018-2019	MONTH	2019-2020
2007.88	JUNE	2504.71
1811.23	MAY	2319.74
1650.82	APRIL	2264.95
1714.13	MARCH	4242.53
1616.40	FEBRUARY	3452.08
1633.78	JANUARY	3008.95
1182.70	DECEMBER	3026.44
535.95	NOVEMBER	2837.81
411.15	OCTOBER	2499.10
147.77	SEPTEMBER	2945.17
86.22	AUGUST	2271.93
79.92	JULY	2209.23
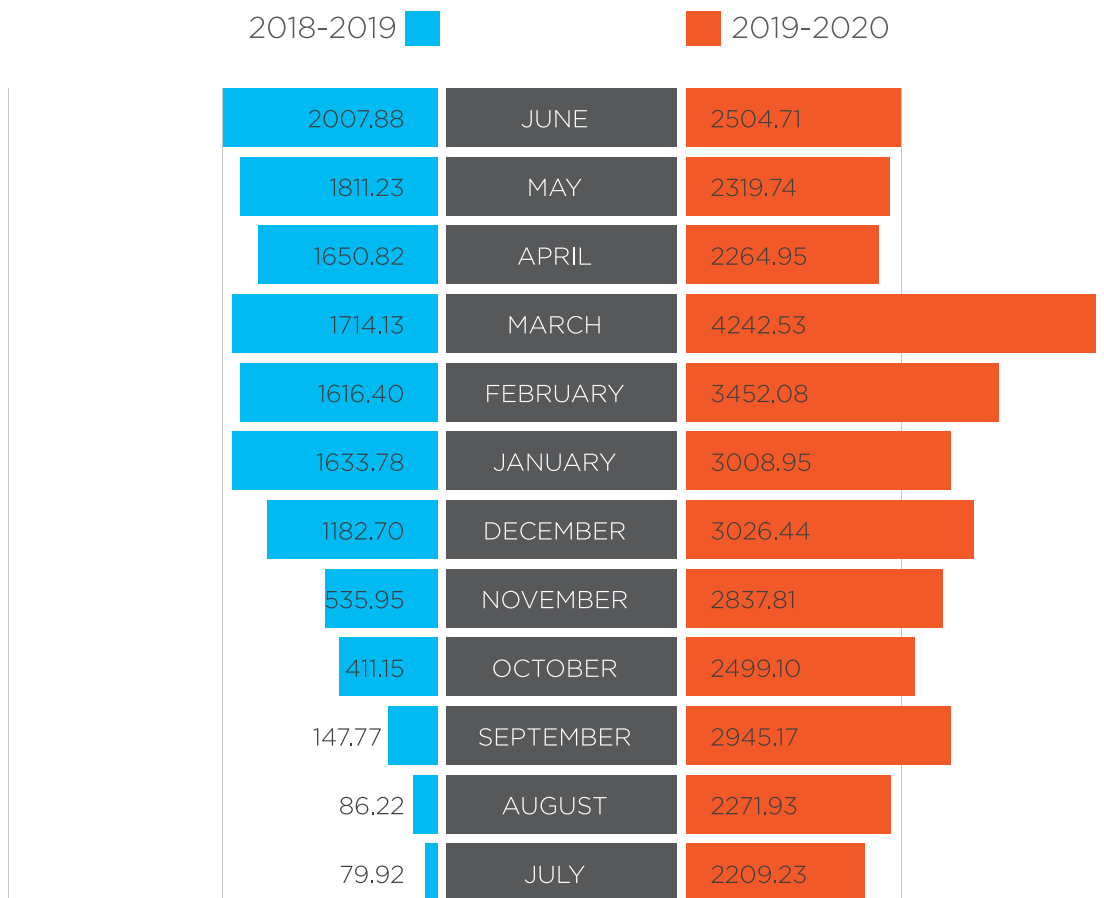
Figure 48: Upstream [Commodity + Research] Usage (in TB)

BdREN NETWORK UPSTREAM USAGE

The R&E traffic (Figure 49) increased in the later part of 2019 and hit its maximum on November, 2019 which was 33.07TB. The fall in R&E Traffic in early 2020 was mostly due to the commissioning of on-prem GGC Server. Previously, this traffic was being fed through BdREN-NKN link.

BdREN commodity Internet traffic (Figure 50))soared significantly over the last two years. The traffic increased almost exponentially till March, 2020 with a plunge from April, 2020 because of closure of universities due to Covid 19 pandemic. Recorded highest commodity traffic in a month was 4219.04TB in March, 2020.
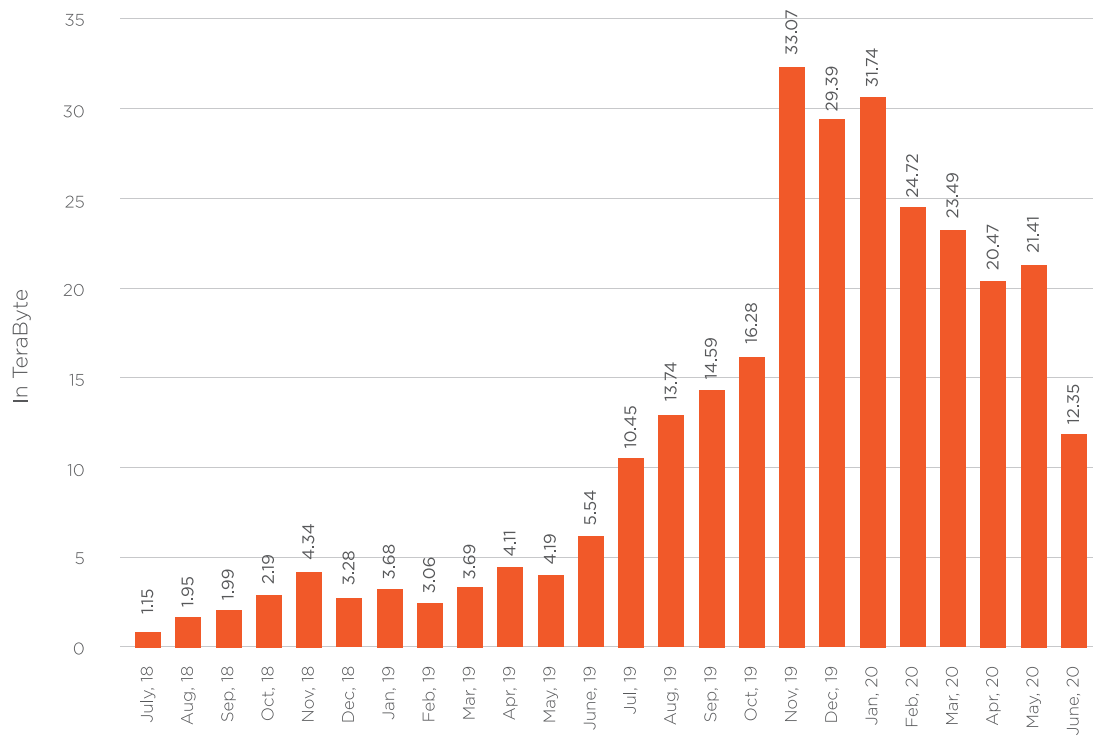
Figure 49: Research Traffic Growth in Last Two Years
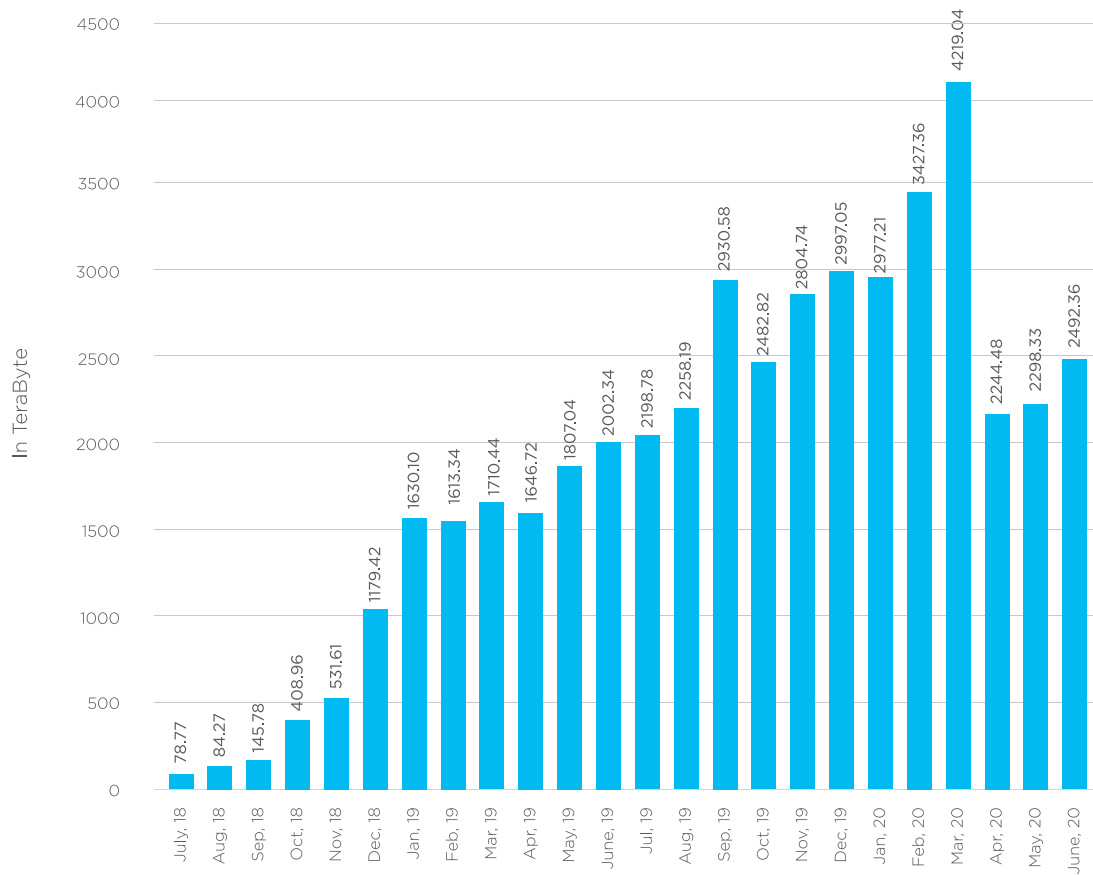
Figure 50: Commodity Traffic Growth in Last Two Years

CLOUD COMPUTING

BdREN provides Cloud computing service to its member institutions. We have 100% availability in the year of 2019-2020. Figure 51 and Figure 52 show respectively the Memory and CPU usage in the last 6 months.
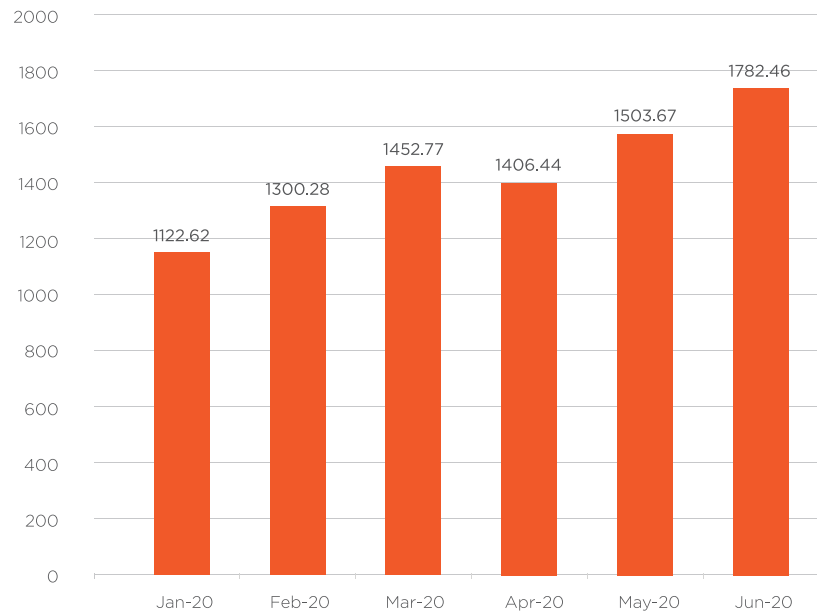
Figure 51: Maximum Memory Usage
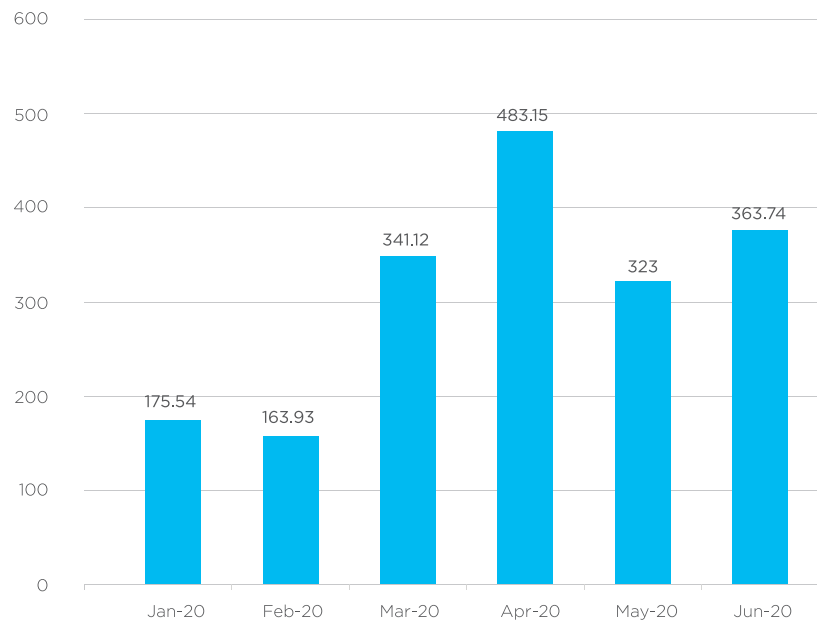
Figure 52: Maximum CPU Usage (GHz)

BdREN

MEMBERS'

LANDSCAPE

BdREN PACKAGE CATEGORY

Table 4: BdREN Package Category

Category-A (600Mbps < "A" ≤ 1000Mbps)
Category-B (400Mbps < "B" ≤ 600Mbps)
Category-C (0 Mbps < "C" ≤ 400Mbps)

PUBLIC UNIVERSITY

Table 5: List of Public Universities as per Package Category

UNIVERSITY NAME	PACKAGE CATEGORY
University of Dhaka, DU	A
University of Rajshahi,RU	A
Bangladesh University of Engineering and Technology,BUET	A
Islamic University, IU	A
Patuakhali Science and Technology University, PSTU	B
University of Chittagong, CU	B
Bangladesh Agricultural University, BAU	B
Shahjalal University of Science & Technology, SUST	B
The Bangladesh University of Professionals, BUP	B
Jashore University of Science and Technology, JUST	B
Khulna University of Engineering & Technology, KUET	B
University of Barishal, BU	B
Rajshahi University of Engineering & Technology, RUET	C
Bangabandhu Sheikh Mujib Medical University, BSMMU	C
Jahangirnagar University, JU	C
Chittagong University of Engineering & Technology, CUET	C

PUBLIC UNIVERSITY

UNIVERSITY NAME	PACKAGE CATEGORY
Jagannath University, JNU	C
Khulna University, KU	C
Bangabandhu Sheikh Mujibur Rahman Agricultural University, BSMRAU	C
Bangabandhu Sheikh Mujibur Rahman Science and Technology, BSMRSTU	C
The Bangladesh Open University, BOU	C
Bangladesh University of Textiles, BUTex	C
Begum Rokeya University of Rangpur,BRUR	C
Chittagong Veterinary and Animal Sciences University, CVASU	C
The Comilla University,COU	C
Dhaka University of Engineering & Technology, DUET	C
Hajee Mohammad Danesh Science & Technology University, HSTU	C
Jatiya Kabi Kazi Nazrul Islam University, JKKNIU	C
Mawlana Bhashani Science &Technology University, MBSTU	C
Noakhali Science and Technology University, NSTU	C
Pabna University of Science and Technology, PUST	C
Sher-e-Bangla Agricultural University, SBAU	C
Sylhet Agricultural University, SAU	C
National University, NU	C

PRIVATE UNIVERSITY

Table 6: List of Private Universities as per Bandwidth Subscription

UNIVERSITY NAME	MEMBER SINCE	BANDWIDTH SUBSCRIPTION-Mbps
BRAC University	2017	67
Independent University, Bangladesh	2017	353
Islamic University of Technology	2017	390
Varendra University	2018	100
Daffodil University	2019	133
Eastern University	2019	67
Manarat International University	2019	100

ASSOCIATE MEMBER

Table 7: List of Associate Members as per Bandwidth Subscription

UNIVERSITY NAME	MEMBER SINCE	BANDWIDTH SUBSCRIPTION-Mbps
Bangladesh Fisheries Research Institute (BFRI)	2018	50
National Institute of Nuclear Medicine & Allied Science (NINMAS)	2018	20
Bangladesh Livestock Research Institute (BLRI)	2019	67
Military Institute of Science and Technology (MIST)	2020	50
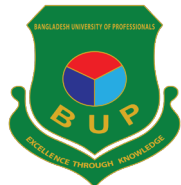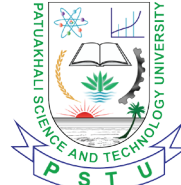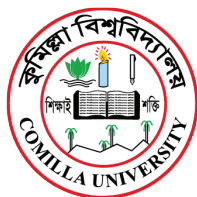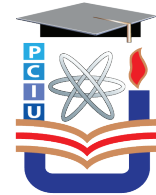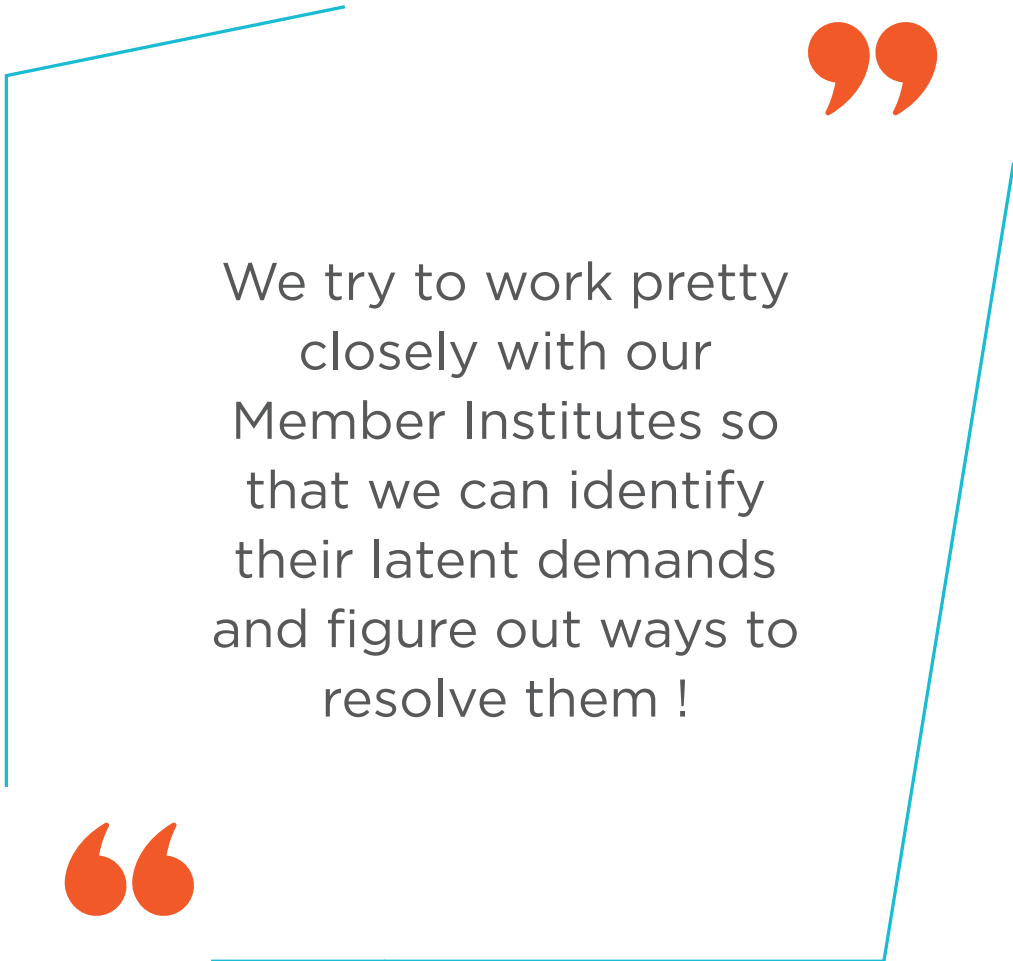
BdREN
LOOKING THROUGH
ITS MEMBERS' EYES

> We try to work pretty closely with our Member Institutes so that we can identify their latent demands and figure out ways to resolve them !

RESPONDENT LANDSCAPE

BdREN conducted an online Survey from 10 October 2020 to 13 December 2020 on "BdREN Service Demand" by preparing a structured questionnaire and then by distributing it online to each individual Member Institution. Out of a Total Member of 100, Total number of respondents were 56 (Table 8). The category-wise distribution of the respondents is shown in Figure 53:

Table 8:List of Survey Respondents

NAME OF INSTITUTES	TYPE OF THE INSTITUTES	TYPE OF MEMBERSHIP
Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU)	Public University	Full Member
Bangabandhu Sheikh Mujibur Rahman Science and Technology (BSMRSTU)	Public University	Full Member
Bangladesh Agricultural University (BAU)	Public University	Full Member
Bangladesh Open University (BOU)	Public University	Full Member
Bangladesh University of Engineering and Technology (BUET)	Public University	Full Member
Bangladesh University of Textiles (BUTex)	Public University	Full Member
Chittagong University of Engineering & Technology (CUET)	Public University	Full Member
Chittagong Veterinary and Animal Sciences University (CVASU)	Public University	Full Member
Comilla University (COU)	Public University	Full Member
Dhaka University of Engineering & Technology (DUET)	Public University	Full Member
Hajee Mohammad Danesh Science and Technology University (HSTU)	Public University	Full Member
Islamic University (IU)	Public University	Full Member
Jagannath University (JNU)	Public University	Full Member
Jashore University of Science and Technology (JUST)	Public University	Full Member
Jatiya Kabi Kazi Nazrul Islam University (JKKNIU)	Public University	Full Member
Khulna University (KU)	Public University	Full Member
Khulna University of Engineering & Technology (KUET)	Public University	Full Member
Mawlana Bhashani Science and Technology University (MBSTU)	Public University	Full Member
National University (NU)	Public University	Full Member
Noakhali Science and Technology University (NSTU)	Public University	Full Member
Pabna University of Science and Technology (PUST)	Public University	Full Member

NAME OF INSTITUTES	TYPE OF THE INSTITUTES	TYPE OF MEMBERSHIP
Patuakhali Science and Technology University (PSTU)	Public University	Full Member
Rajshahi University of Engineering & Technology (RUET)	Public University	Full Member
Rajshahi University (RU)	Public University	Full Member
Shahjalal University of Science & Technology (SUST)	Public University	Full Member
Sher-e-Bangla Agricultural University, (SBAU)	Public University	Full Member
Sylhet Agricultural University (SAU)	Public University	Full Member
The Bangladesh University of Professionals (BUP)	Public University	Full Member
University of Barishal (BU)	Public University	Full Member
University of Dhaka (DU)	Public University	Full Member
Islamic University of Technology (IUT)	International University	Full Member
Bangladesh Army International University of Science and Technology (BAIUST)	Private University	Full Member
Bangladesh University of Health Sciences (BUHS)	Private University	Full Member
BGC Trust University Bangladesh	Private University	Full Member
BGMEA University of Fashion & Technology	Private University	Full Member
BRAC University	Private University	Full Member
East West University	Private University	Full Member
Eastern University	Private University	Full Member
Port City International University	Private University	Full Member
Primeasia University	Private University	Full Member
Shanto-Mariam University of Creative Technology	Private University	Full Member
United International University	Private University	Full Member
Bangladesh Academy for Rural Development (BARD)	Research Institute	Associate Member
Bangladesh Agricultural Research Institute (BARI)	Research Institute	Associate Member
Bangladesh Fisheries Research Institute (BFRI)	Research Institute	Associate Member
Bangladesh Institute of Management (BIM)	Research Institute	Associate Member

NAME OF INSTITUTES	TYPE OF THE INSTITUTES	TYPE OF MEMBERSHIP
Bangladesh Livestock Research Institute (BLRI)	Research Institute	Associate Member
Bangladesh Rice Research Institute (BRRI)	Research Institute	Associate Member
International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B)	Research Institute	Associate Member
National Institute of Textile Engineering and Research (NITER)	Research Institute	Associate Member
Bangladesh Institute of Development Studies (BIDS)	Research Institute	Associate Member
Institute of Chartered Secretaries of Bangladesh (ICSB)	Others	Associate Member
Local government Engineering Department (LGED)	Others	Associate Member
National Institute of Nuclear Medicine & Allied Sciences (NINMAS)	Others	Associate Member
Sylhet MAG Osmani Medical College	Medical College	Associate Member
The Institute of Cost and Management Accountants of Bangladesh (ICMAB)	Others	Associate Member

RESPONDENT PROFILE

Most of the Public Universities have responded in the survey and that sounds good considering the fact that BdREN client base is highly dominated by them. It was found that out of total 56 respondents 30 were from Public University, 11 were from Private University and 9 were from Research Institutes and rest 6 participated from International University, Medical Colleges and Other Institutions (Figure 53).
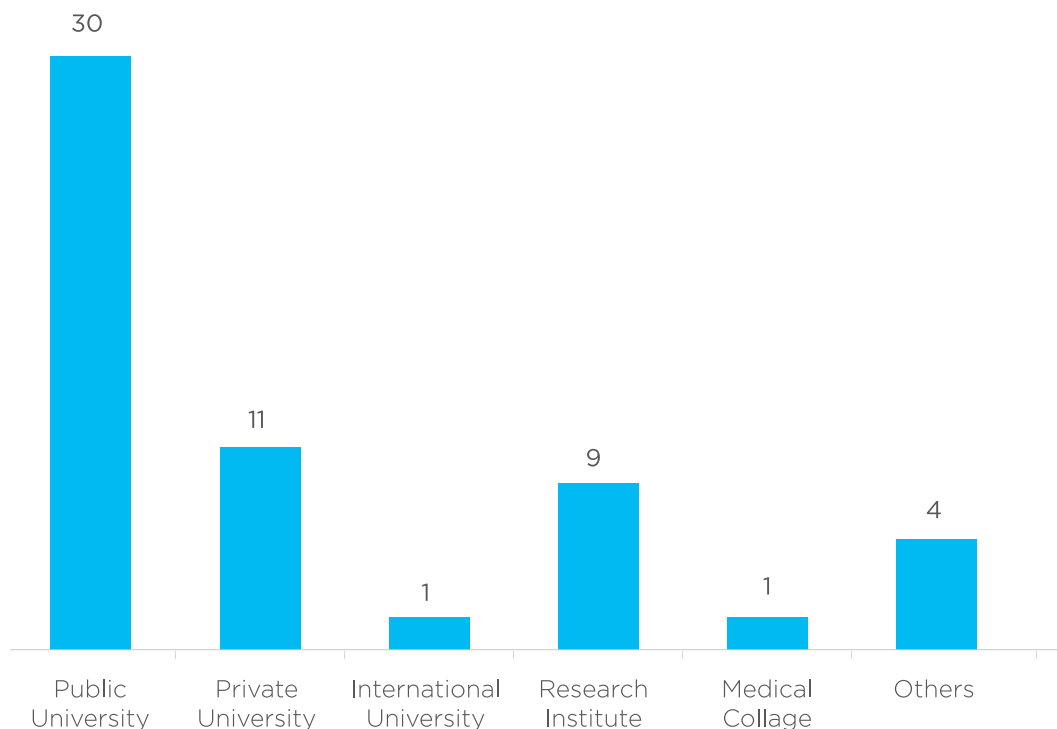
Figure 53: Type of Respondent's Institutes

For probing further, the analysis is performed by dividing the respondents into two separate categories. (1) Public University and (2) Other Institutes consisting of Private University, International University, Research Institute, Medical College and Others. This bifurcation has been done because of the classification in terms of Tariff. Public Universities subscribe their services on the basis of certain packages whereas other Institutes subscribe the services based on certain Tariff Structure applied for individual services.
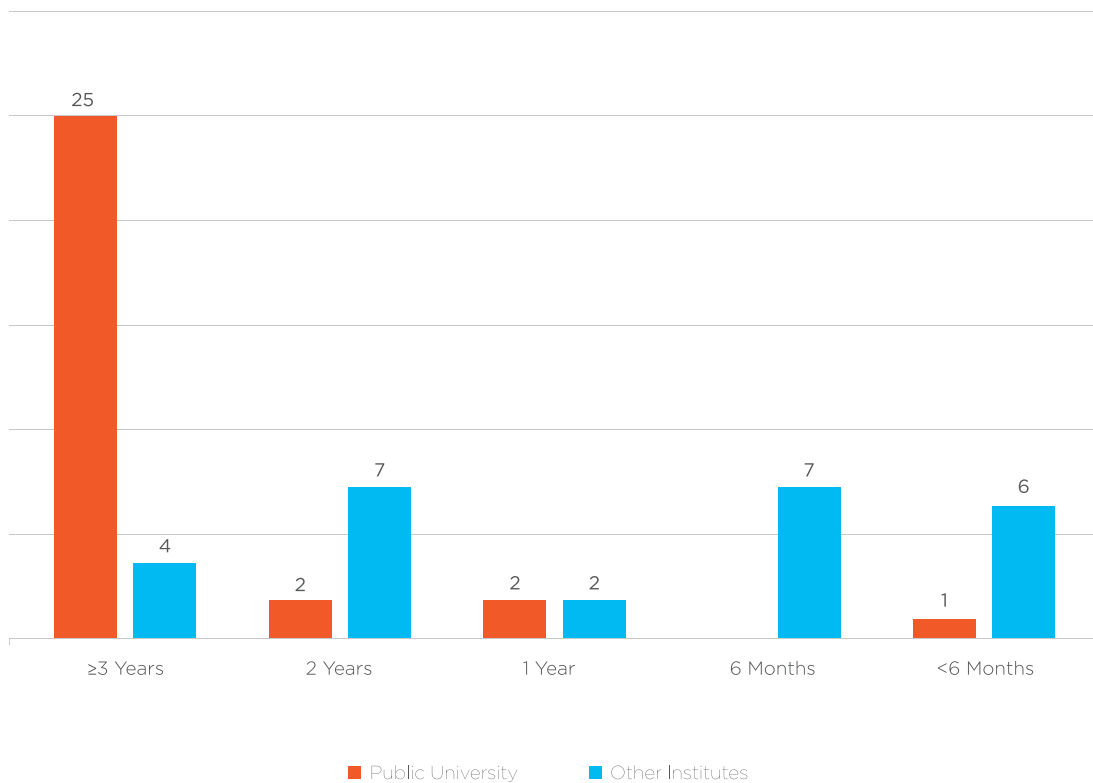
Figure 54: Tenure with BdREN

As demonstrated in Figure 54, 25 out of 30 respondent Public Universities have been using BdREN services for 3 years or more. On the contrary, only 4 Other Institutes have been using BdREN Services for 3 years or more. This expresses BdREN's initial approach in focusing its business. To start with BdREN targeted the Public Universities. However, BdREN's focus is now to extend its connectivity and services to Private Universities, Research and other institutes.

ANALYSIS ON BdREN SERVICE

CATEGORY	NUMBER OF RESPONDENTS
Public University	30
Private University	11
International University	1
Research Institutes	9
Medical College	1
Other Institutes	4
TOTAL	56

RATING BDREN SERVICES

BdREN had been through a long arduous journey in culminating today's stature. Most of the respondents, as Public Universities, have been using BdREN services since the completion of the connectivity under HEQEP in and around 2015. The initial period was more strenuous and equally struggling while BdREN had to promote its services and had to convince each institute about the reliability, stability and quality of the offered services. Once BdREN could establish its claim with regard to the quality, users started to tread warily in using BdREN services.

Response from Public University:

   As evident from Figure 55 it is evident that among the Public Universities only 40% are interested in taking Internet Bandwidth from BdREN. The figure is definitely not promising. It should be further dug down to probe the reasons of their disenchantment. Internet Bandwidth being the main "Cash Cow" Business for BdREN, the desire for having this service should definitely be higher. Services like eduroam, IP Telephony, Virtual machines, Storage and LMS have been found to be the popular services which Public Universities are looking for from BdREN.
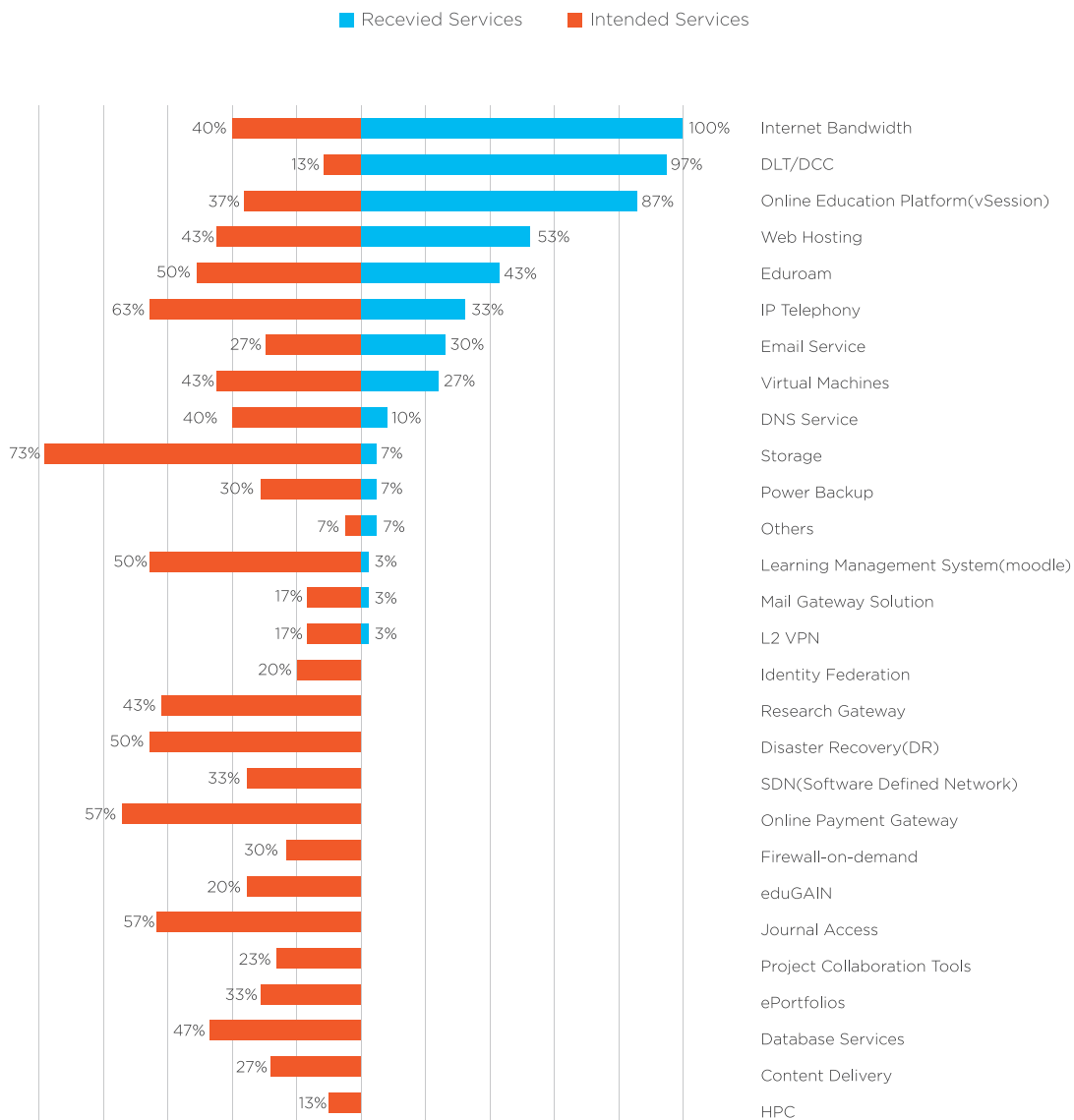
Figure 55: Major Services That Public Universities are Receiving and Their Intended Future Services

Response from Other Institutes:

It is clear from Figure 56 that service usage by other institutes among BdREN's offered services is mostly dominated by Online Education Platform (vSession). Also they are interested in taking Internet Bandwidth, DLT/DCC, Virtual Machines, eduroam and LMS Services.

Recevied Services   **Intended Service**

Service	Intended	Received
Online Education Platform(vSession)	43%	73%
Internet Bandwidth	40%	23%
Others	50%	23%
DLT/DCC	73%	8%
Virtual Machines	63%	4%
Web Hosting	27%	4%
Eduroam	50%	4%
L2 VPN	37%	
Learning Management System(moodle)	50%	
Email Service	43%	
Mail Gateway Solution	40%	
DNS Service	30%	
IP Telephony	7%	
Identity Federation	17%	
Research Gateway	17%	
Disaster Recovery(DR)	13%	
Storage	20%	
Power Backup	43%	
IPv6 address management(IPAM)		
SDN(Software Defined Network)	4%	
Online Payment Gateway	22%	
Firewall-on-demand	17%	
eduGAIN		
Journal Access	43%	
Project Collaboration Tools	9%	
ePortfolios		
Database Services	4%	
Content Delivery	4%	

Figure 56: Major Services that Other Institutions are Receiving and Their Intended Services

It is an undeniable fact that Internet Connectivity is still the main "Cash Cow" of BdREN. It is encouraging that 40% of other institutes have expressed their desire to take Internet Bandwidth from BdREN. BdREN will keep identifying the institutes who are longing for having Internet Bandwidth from BdREN and will pursue each of them to procure the said bandwidth. However, it is to be noted that providing Internet Bandwidth to a particular institute has its challenges in the form of establishing the last mile connectivity. BdREN will explore how to reach those very institutes.

With regard to vSession, it has been found that 73% of the respondents from Other Institutes are presently using this service. It is to be mentioned that vSession has been already found to be a "Flagship" service being offered by BdREN. At the outbreak of COVID-19 BdREN Software Development Team came up with this innovative software which enabled BdREN to cater the huge demand from the education community with its limited number of Zoom Licenses. It has been found that 43% of the respondents are still willing to take this service from BdREN.

Also, for eduroam, LMS and Email Service the demand from the Other Institutes is worth mentioning. All such services can be delivered to the clients out of BdREN's shelf. BdREN is going to contact each individual member who are willing to enjoy those services from BdREN. To be mentioned that LMS service is under development at the moment.

QUALITY OF BdREN INTERNET SERVICE

In response to the question on "How do you rate BdREN Internet Connectivity" four parameters namely 1. Network Availability, 2. Latency, 3. Reliability and 4. Networking Support were made open to the respondents to rate on.
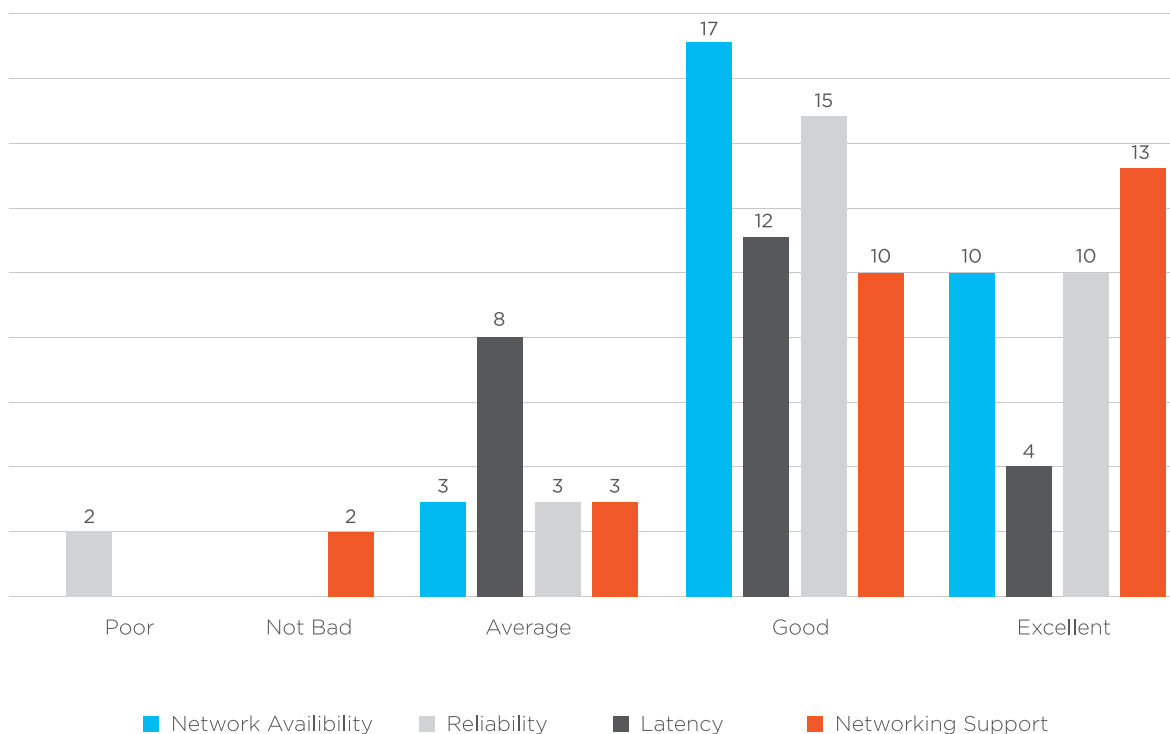
Figure 57: Quality of BdREN Internet Service (Public Univ.)

Response from Public University:

From Figure 57 it can be concluded that BdREN Internet Connectivity service meets users' overall satisfaction against all the parameters. Network Availability and Reliability were found to be BdREN's primary strength where respectively 27 and 25 out of 30 respondents rated the services as either "Excellent" or "Good". 23 respondents rated "Networking Support" as "Good" or "Excellent". The "Latency" rating was not that much promising where 16 respondents rated it as either "Good" or "Excellent". It is to be mentioned that "Latency" issue doesn't depend only on the quality of the Service Providers' network. Having said that, it is to be considered as a warning sign for BdREN. BdREN needs to delve into this problem and needs to establish the fact that the additional "Latency" that is being encountered by the member institutes are not resulting from BdREN connectivity. To substantiate that BdREN is on its way to establish "perfSONAR" Servers in the network of each individual member institute which will provide real time report on the latency, packet loss and jitter of each individual network.

Response from Other Institutes:

From Figure 58 it is found that 7 Institutes under this category have Internet Bandwidth subscription from BdREN, although one of them has only reported on Network Availability. Their rating of BdREN service is quite heartening. None of them has rated any of the parameter as "Bad" or "Poor". All 7 respondents have rated the network availability as either "Good" or "Excellent" whereas 5 of them rated the latency, reliability and networking support as either "Good" or "Excellent".
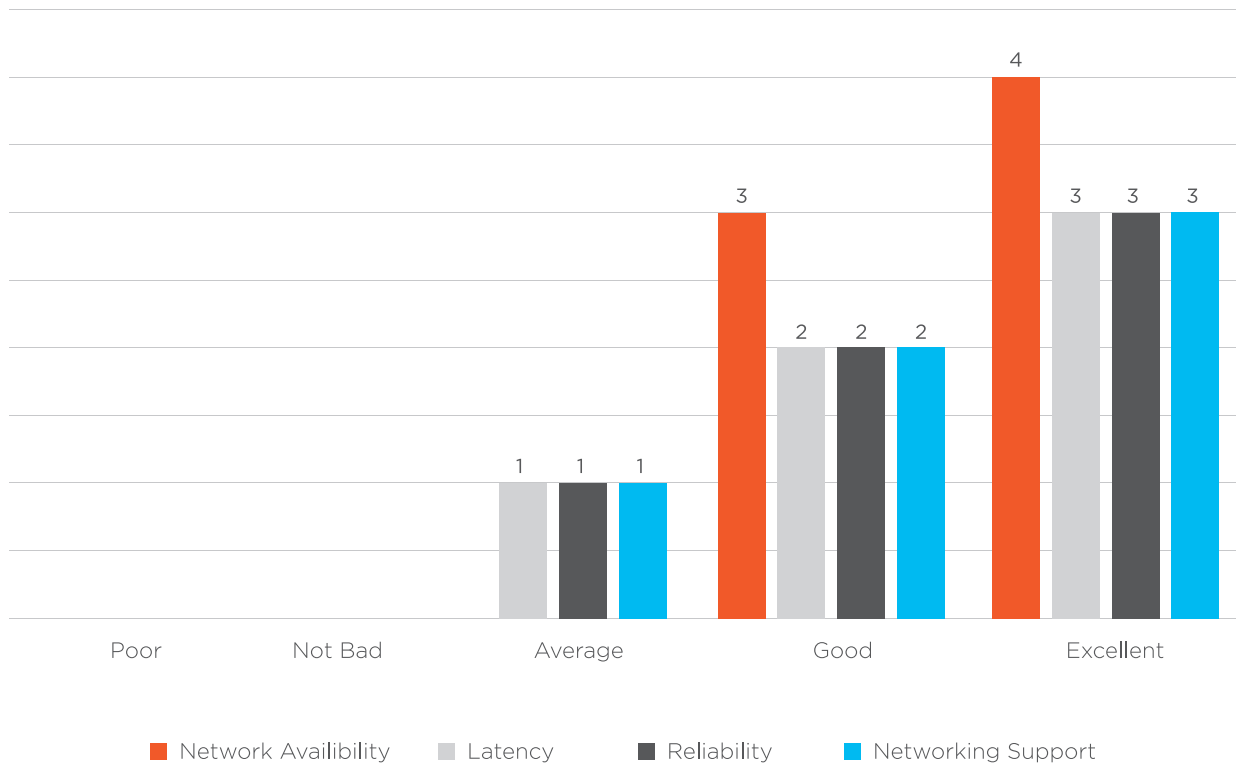
Figure 58: Quality of BdREN Internet Service (Other Institutes)

STRENGTH AND WEAKNESS OF BdREN AS A SERVICE PROVIDER

The overall picture on BdREN's "Strengths" vs "Weaknesses" depicted in Figure 59 and Figure 60 demonstrate BdREN's achievements as it has been found that "Strengths" of BdREN excels the "Weaknesses" by a wide margin.

Response from Public University: Under this category it is revealed (Figure 59) that BdREN's main "Strength" came in the form of Service

Availability (73% vs 4%), 24*7 Support (73% vs 14%), NOC (67% vs 11%), Single Point of Contact (67% vs 0%), Technical Resources (60% vs 18%), Service Reliability (57% vs 11%), and Fault Response Time (50% vs 4%), Fault Restoration Time (30% vs 14%).

■ Strength   ■ Weakness

	Strength	Weakness	
73%		4%	Service Availibility
73%		14%	24*7 Support
67%		11%	Monitoring System- NOC
67%			Single Point of Contact-Helpdesk
60%		18%	Technical Resources
57%		57%	Workshop/Training Programs
57%		11%	Service Reliability
50%		4%	Response time for fault restoration
30%		14%	Fault restoration time
3%		25%	Other*
		11%	High Response time
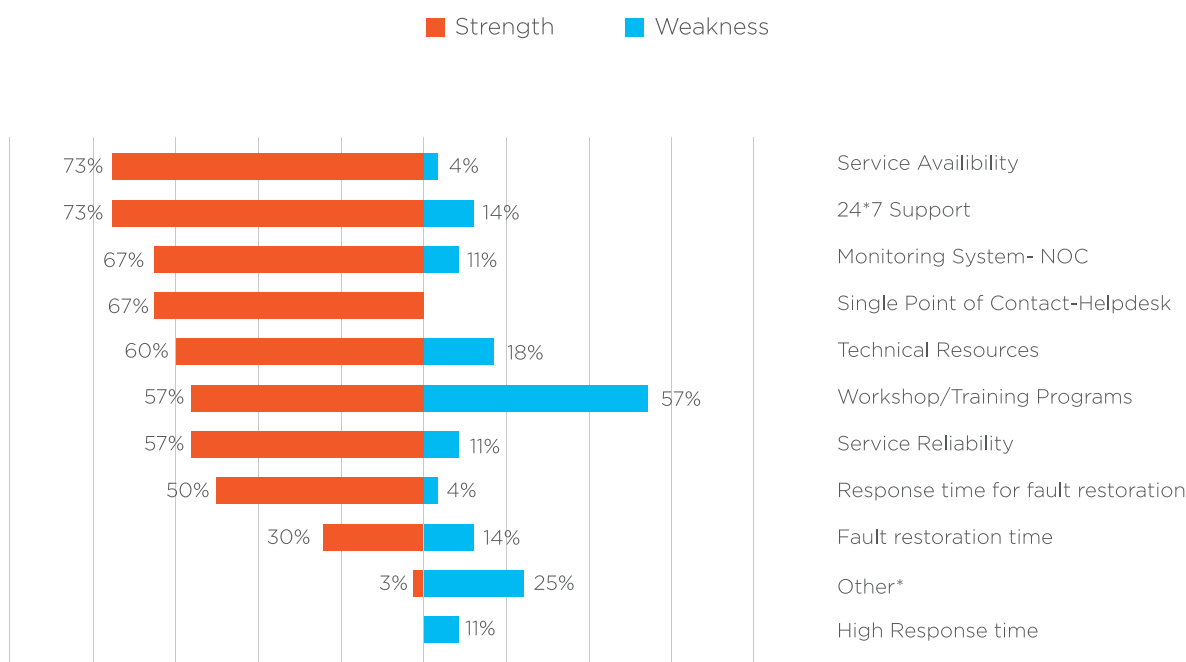
Figure 59: Feedback from Public University

In terms of other Weaknesses which came as separate comments, "SUST" raised about the unavailability of "Backup Link" which is a legitimate demand from them since both their upstream connectivity bank on PGCB OPGW link.

Although the link is very stable, yet it's an issue. BdREN is trying to address this issue subject to affordability of cost in arranging alternate link.

Response from Other Institutes:

Under this category the response (Figure 60) is almost similar as that of Public Universities and equally comforting for BdREN. it is unfolded that BdREN's main "Strength" came in the form of 24*7 Support (65% vs 12%), Service Availability (38% vs 6%), Single Point of Contact (38% vs 0%), Technical Resources (35% vs 0%) and Response Time for Fault Restoration (31% vs 6%).
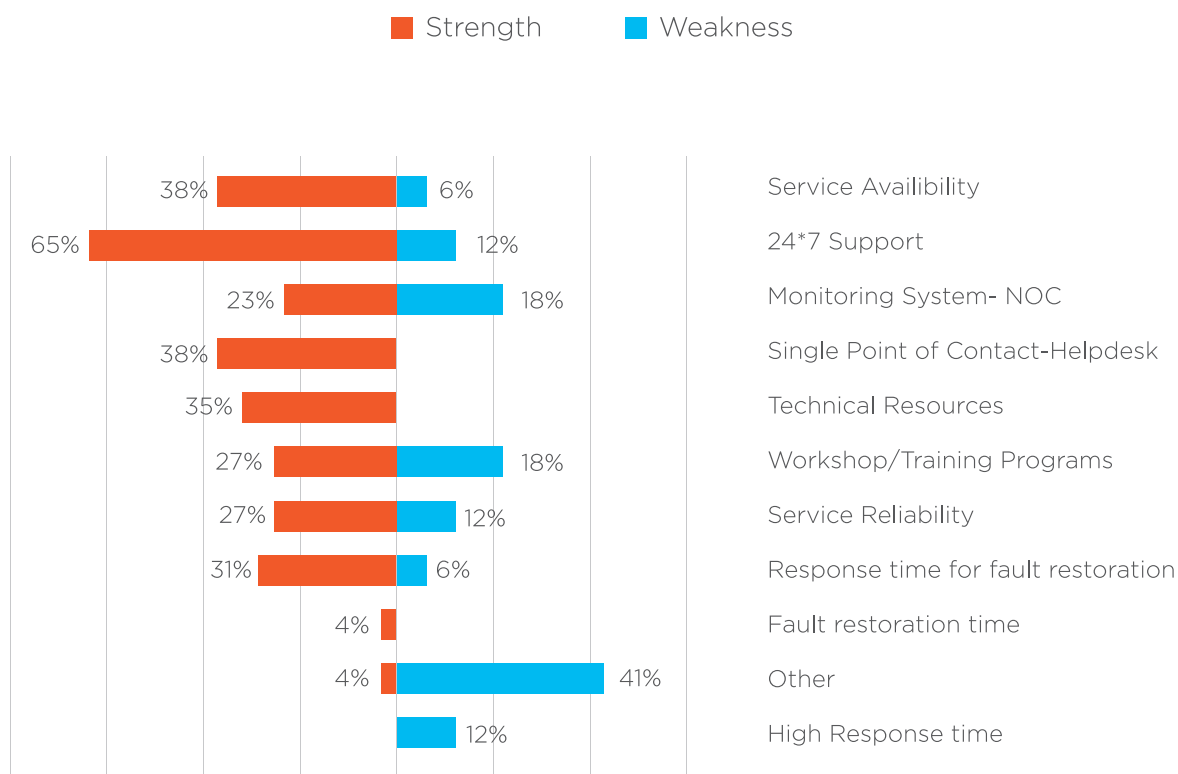
Figure 60: Feedback from Other Institutes

The rating on Workshop/Training (27% vs 18%), Service Reliability (27% vs 12%) and Monitoring System-NOC (23% vs 18%) were not found to be that much satisfactory. More probing needs to be conducted to comment further about the negative rating from the Member Institutions. It is to be mentioned that the other institutes are mostly using BdREN Video Collaboration services which is a flagship service for BdREN. Hence, total satisfaction from the part of the Member Institutions is highly solicited.

Under comments section "failure of generating desired report" issue was raised by "Port City University" using vSession Application as Video Collaboration Support service. BdREN Software Team is in the process of bringing this facility in vSession Application.

BdREN NOC PERFORMANCE

BdREN provides 24x7 single point of contact through Network Operations Center (NOC). A question was framed for collecting feedback about the "satisfaction level" of the users on the provided support from NOC. The feedback that came out of the survey is as follows:

Response from Public University:

The survey results revealed (Figure 61) that out of 29 respondents against this question 24 (82.7%) came up with either "Satisfied" or "Fully Satisfied" with 5 of them commenting as "Neutral". None of the respondents was found to rate their feelings as "Dissatisfied".
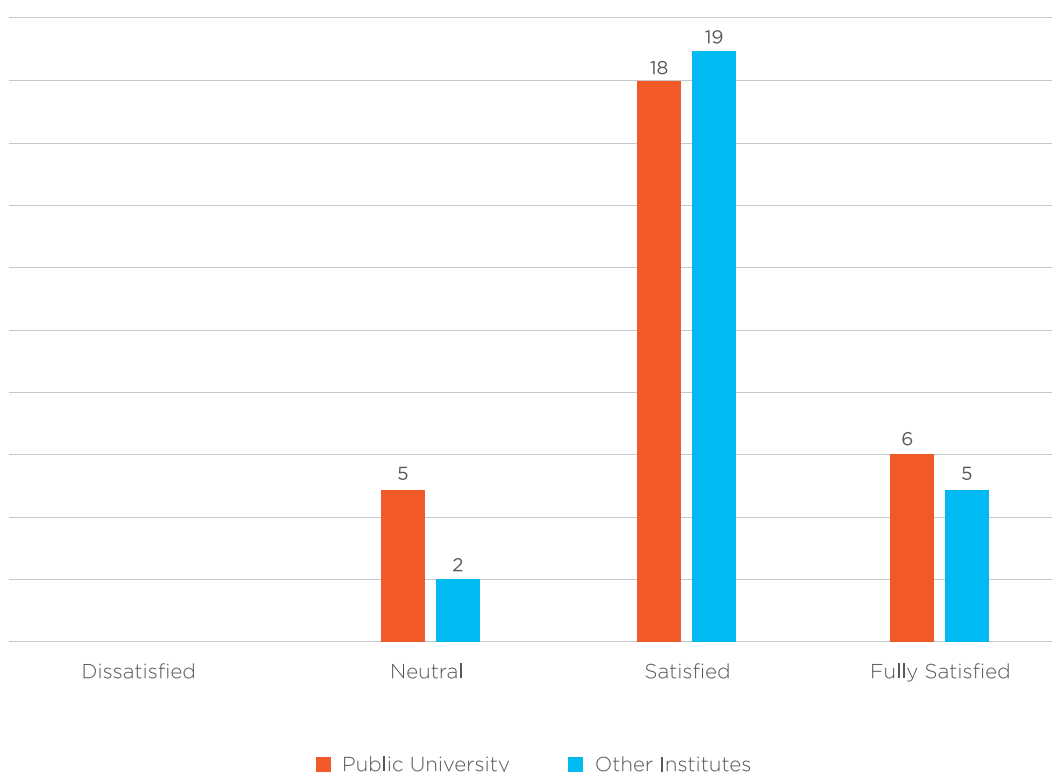
Figure 61: BdREN 24/7 NOC Performance

Response from Other Institute:

Against the category of Other Institutes, (Figure 61) it is revealed that out of 26 respondents 24 (92.3%) came up with either "Satisfied" or "Fully Satisfied" with only 2 commenting as "Neutral". None of the respondents was found to rate their feelings as "Dissatisfied".

With regard to responses against queries on expectation of reporting from BdREN, it was found that availability of "Real Time Traffic Data" came as the top, "Monthly Usage Data" secured second position, and "Real Time Fault Report" held the third position (Figure 62). Also, respondents are interested to get "Monthly Availability" and "Fault Data". Currently BdREN provides Real Time Traffic Data but all users might not be aware of this service. BdREN needs to communicate the availability of this service to all the member institutions. Also, BdREN is taking measures for delivery of other data as well on monthly basis.
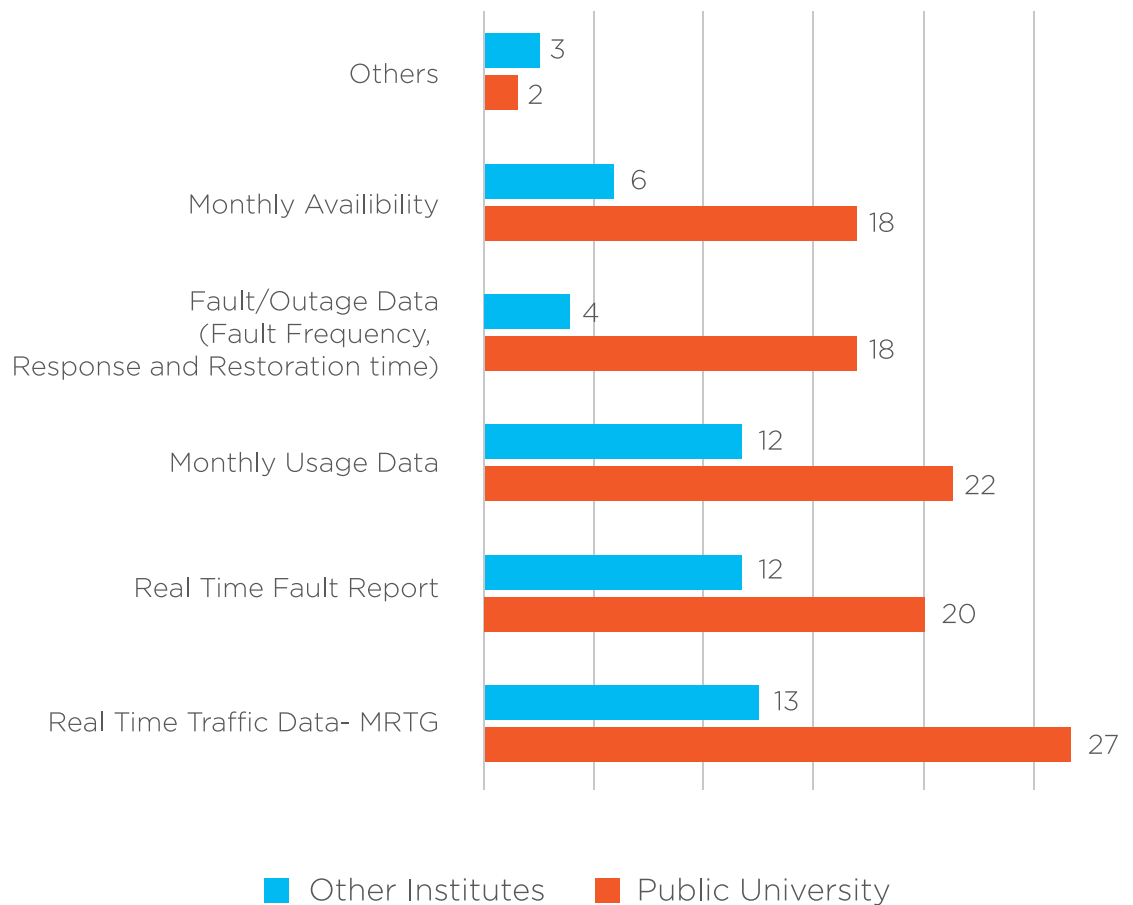
Figure 62: Expected Report from BdREN NOC

The category-wise feedback goes as:

Response from Public Universities:

Out of 30 respondents 27 showed their interest on MRTG, 20 of them on Real Time Fault Report and 22 of them on Monthly Usage Data.

Response from Other Institutes:

Out of 26 respondents 13 showed their interest in MRTG, 12 of them in Real Time Fault Report and 12 of them in Monthly Usage Data. Since most of the Other Institutes are only taking Video Collaboration Services, they were not probably interested in responding to this question because this question is more pertinent to "Internet Bandwidth" service.

In another query on Members' "preferred mode of communication", it came out that "Email" is the most preferred service with "Direct Phone Call" being in the second place (Figure 63).
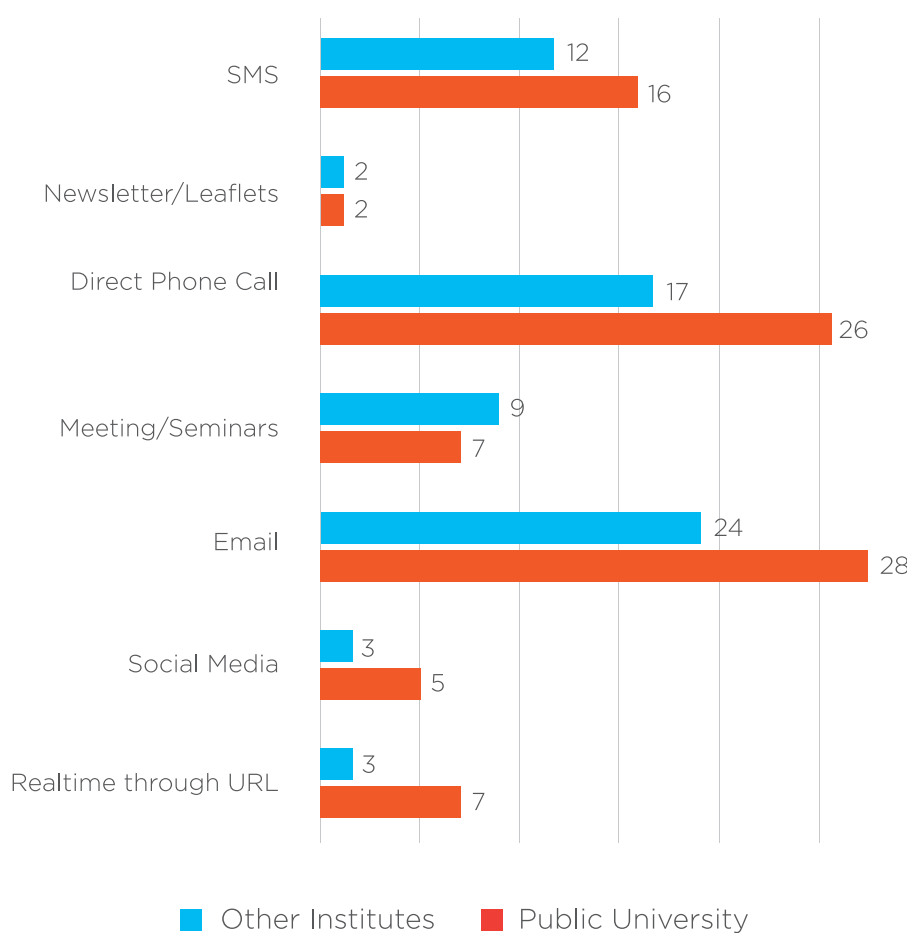
Figure 63: Members' Preferred Mode of Communication

ANALYSIS ON COMPETITIVE EDGE OF BdREN OVER COMMERCIAL PROVIDERS

CATEGORY	NUMBER OF RESPONDENTS
Public University	30
Private University	9
International University	1
Research Institutes	9
Medical College	1
Other Institutes	3
TOTAL	53

BdREN operates as National Research and Education Network (NREN) where it faces fierce competition with traditional Internet Service Providers (ISPs). But BdRENs' Member Institutions should feel that BdREN is more than a traditional ISP. To get a reflection on the perception of the Member Institutions about the popularity of different services, BdREN collected the opinions from its users where the respondents were requested to provide feedback on their current usage of services or future services demand which are not usually available from the traditional ISPs. The category-wise feedback is reflected in Figure 64.

Feedback from Public University:

Out of 30 respondents 20 responded with Internet Bandwidth, 19 with Online Education, 16 with eduroam, 10 with Journal Access and 10 with IP Telephony.

Feedback from Other Institutes:

Out of 23 respondents 15 responded with Internet Bandwidth, 19 with Online Education, 5 with eduroam, 7 with Journal Access and 7 with

Research Gateway. The response for LMS (11) service was found to be encouraging. It means that Private Universities are more interested in pursuing full-blown online education in comparison to Public Universities.

It is to be noted here that BdREN is working on LMS and hopefully in the near future BdREN will be able to come up with its LMS solution. Providing services like "Journal Access" and "Research Gateway" will take some time but it is there in BdREN's strategic plan.

Among other services which the respondents longed for, are like VM, IP Telephony, Web Hosting, DNS Service, Storage, Email Service, L2VPN and Power Backup which are already there with BdREN. A few of them are available "Free-of-Cost" with Membership. However, some of the mentioned services namely VM, IP Telephony, and L2VPN are dependent on the direct connectivity of the institution.
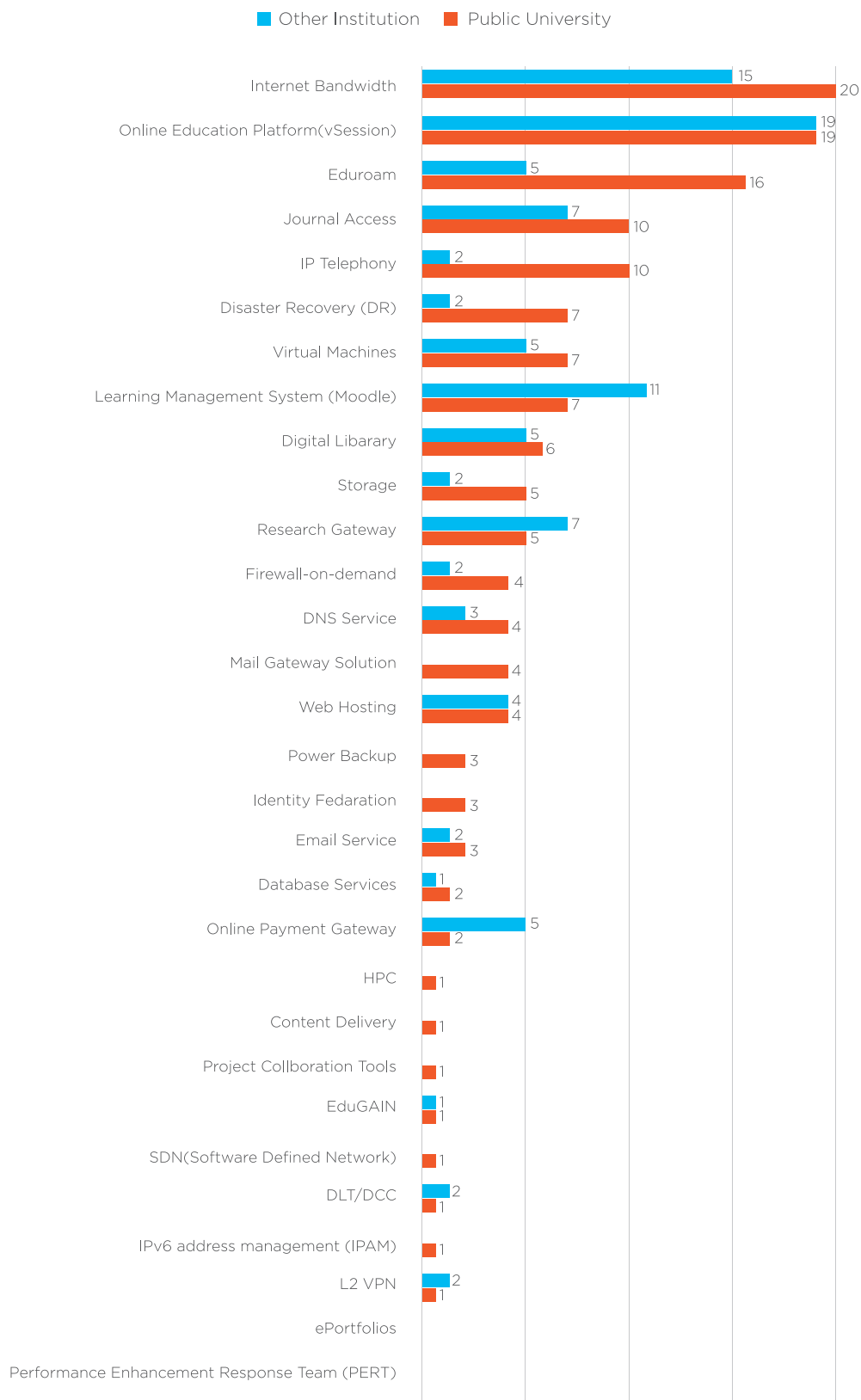
Figure 64: Flagship services which give/may give BdREN competitive advantage over commercial providers

ANALYSIS ON INDIVIDUAL SERVICE QUALITY

CATEGORY	NUMBER OF RESPONDENTS
Public University	30
Private University	9
International University	1
Research Institutes	9
Medical College	1
Other Institutes	4
TOTAL	54

Respondents were also requested to rate each individual service being provided by BdREN with a scale of 1 to 5 with 1 representing "Poor" and 5 being "Excellent. Here the respondents were divided into two categories.

Institutes which have direct Connectivity:

It is to be stated here that some of the services are related with direct connectivity namely Virtual Machines, IP Telephony, eduroam, Disaster Recovery and others. That's why it has been chosen as a separate group.

It was found that (Figure 65) BdREN "Cash Cow" service "Internet Bandwidth" were rated as either "Good" or "Excellent" by 92% of the respondents, similarly 87% responded with either "Good" or "Excellent" for "Online Education". The rating for Virtual machines, Email Service, Storage, Web Hosting, eduroam and DLT/DCC are not disheartening either. BdREN needs to explore why rating of IP Telephony and Power Backup services were rated poor by few institutes.

Legend: Poor · Not Bad · Average · Good · Excellent

Service	Excellent	Good	Average	Not Bad	Poor
Internet Bandwidth	50%	42%	8%		
Online Education Platform (Zoom/vSession)	47%	40%	13%		
Virtula Machine	19%	54%	18%	9%	
Email Service	25%	34%	41%		
IP Telephony	25%	42%	17%	8%	8%
Storage	25%	38%	12%	25%	
Power Backup	25%	25%	17%	8%	25%
Web Hosting	46%	30%	18%	6%	
Eduroam	57%	22%	21%		
Disaster Recovery(DR)	26%	26%	24%	24%	
DLT/DCC	36%	64%			
L2 VPN		50%		50%	
DNS Service	63%	37%			

Figure 65: BdREN Individual Service Quality (Users having direct connectivity)

Institutes which have only Membership:

Only a few services are provided free-of-cost under BdREN Membership. They are Online Education (Zoom Platform), Web Hosting, Email Service and DNS Service. Most of the users under this group are taking Zoom Online services and the rating is favourable. 58% came as "Excellent" and 37% as "Good" (Figure 66). As only one respondent has filled-out the survey form for rating BdREN Web Hosting and Email Service, there is no point of BdREN becoming complacent.

BdREN SERVICES IN TERMS OF QUALITY
(NON INTERNET USER)

Legend: Poor · Not Bad · Average · Good · Excellent

Service	Excellent	Good	Average
Online Education Platform (Zoom/vSession)	58%	37%	5%
Web Hosting		100%	
Email Service		100%	
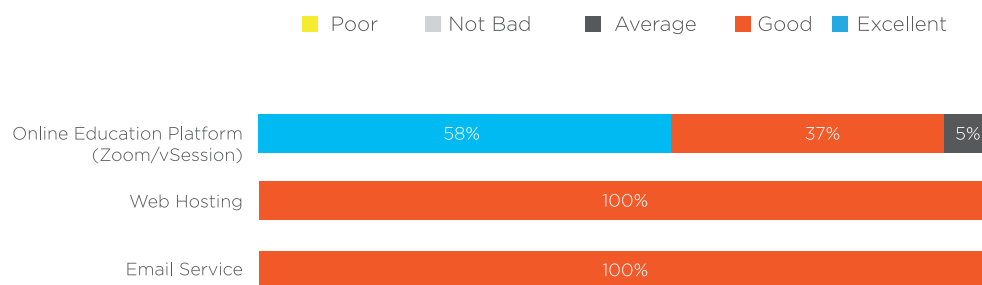
Figure 66:BdREN services in terms of quality (Users having Membership only)

ANALYSIS ON CAMPUS NETWORK INFRASTRUCTURE

CATEGORY	NUMBER OF RESPONDENTS
Public University	30
Private University	11
International University	1
Research Institutes	9
Medical College	1
Other Institutes	4
TOTAL	56

STATUS OF CAMPUS NETWORK

Type of Campus Network

To get an idea about the availability of Structured Campus Network, question was asked "Do you have Structured Campus Network?". From the obtained responses it was found that 83% of the Public Universities and 84% in Other Institutes Category have structured Campus Network (Figure 67).

Number of Existing User

In terms of the Number of Users the following 3(three) respondents out of total 56 were found to have more than 15,000 users under their individual Campus Network (Figure 68):

Dhaka University
Jagannath University and
Rajshahi University

5 of the Universities which had more than 10,000 users in their Campus Network are:
Islamic University
Jatiya Kabi Kazi Nazrul Islam University
Bangladesh University of Engineering and Technology
Bangabandhu Sheikh Mujibur Rahman Science and Technology University and
East West University
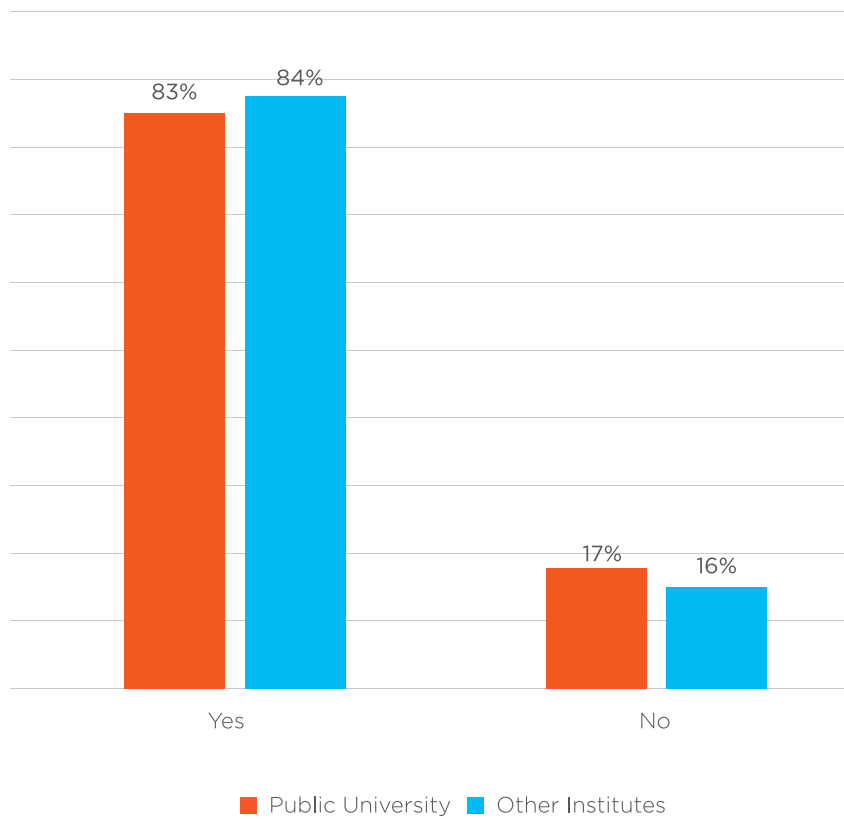
Figure 67:Availability of Structured Campus Network
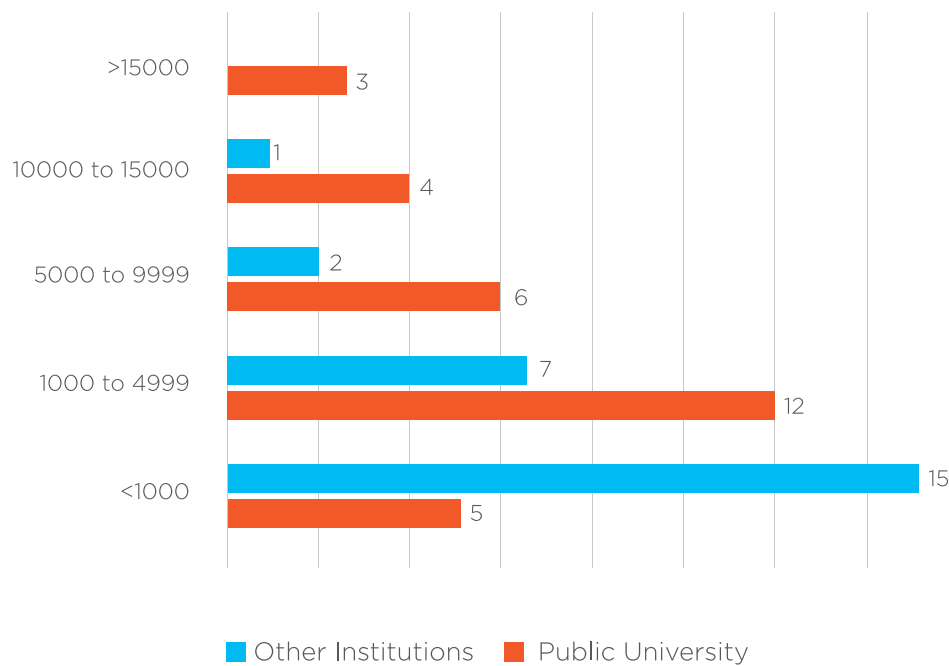
Figure 68: Number of Existing Users

Mode of Connectivity

With reference to Figure 69 demonstrating "Mode of Connectivity" all 30 respondents under "Public University" category have both "Wired" and "Wireless" Connectivity whereas among other institutes 23 out of 26 institutes reported to have both "Wired" and "Wireless" Connectivity. 3 institutes under "Other Institutes" category have only "Wired" mode of connectivity.
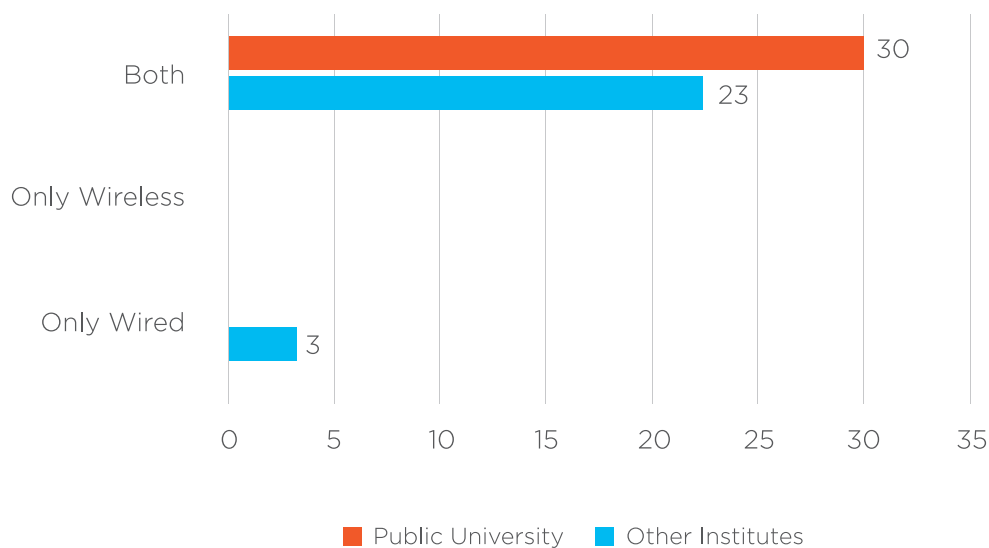
Figure 69: Mode of Connectivity

Campus Network Performance

Under HEQEP, BdREN deployed campus network at 19 Public Universities. BdREN did the design of the network, conducted the procurement of hardware and was involved throughout the process of installation and commissioning of the network. It was very important for BdREN to know the very performance of the installed networks. At the same time, other institutes were also asked to report the status of their Campus Network. Each of these institutes were asked to grade their level of satisfaction on a scale of 1 (Poor) to 5 (Excellent). The brief status is portrayed in Figure 70.

Campus Networks installed by BdREN

Out of the Universities in which the Campus Networks were installed with active involvement of BdREN, it was found that 13 out of 17 respondents where in favour of either "Good" or "Excellent". It means that the installed networks are working fine. It has been found that MBSTU, CVASU, KUET and BU have rated the network as "Average". BdREN is working closely with all these universities to improve the quality of the network.

Self-installed Campus Networks

For self-installed campus networks 11 out of 34 respondents rated their Campus Network as "Average" or "Poor". As performance of BdREN provided Internet Service particularly the latency is very much dependent on the quality of Campus Network, it is a big concern for BdREN.
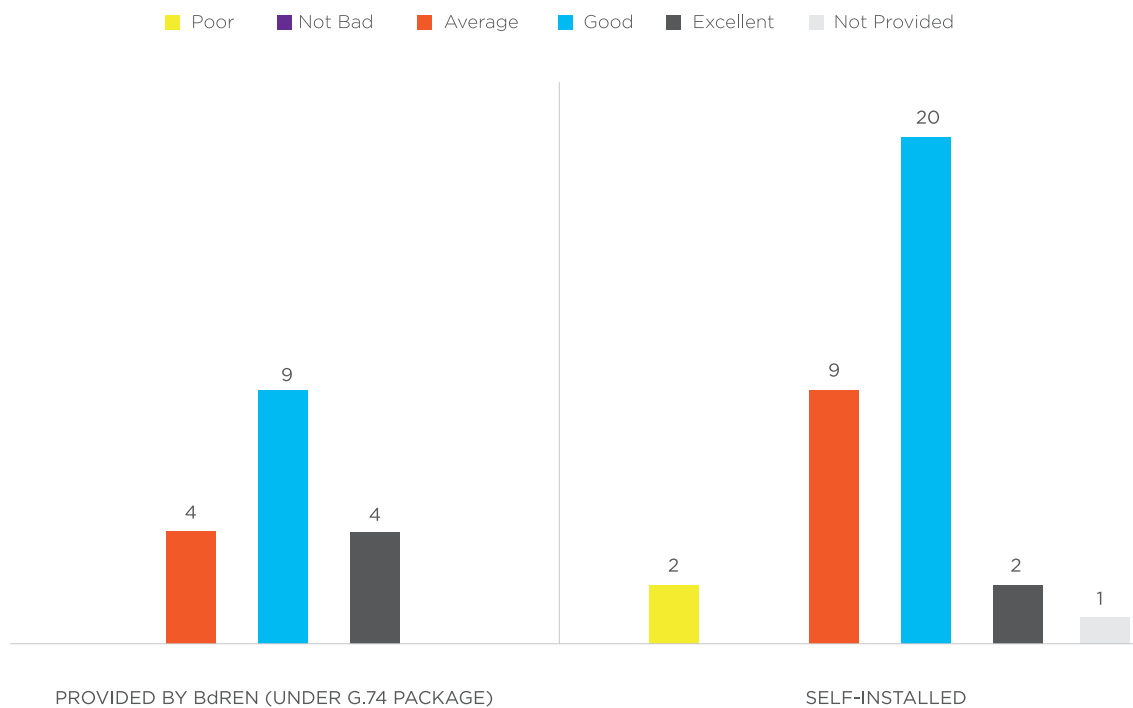
Figure 70: Campus Network Performance

ANALYSIS ON DATA CENTER, VIRTUALIZATION AND APPLICATIONS

CATEGORY	NUMBER OF RESPONDENTS
Public University	30
Private University	11
International University	1
Research Institutes	9
Medical College	1
Other Institutes	4
TOTAL	56

DATA CENTER, VIRTUALIZATIONS AND APPLICATIONS

A few questions were framed to understand about the capacity of the Public Universities and Other Institutions in processing their digital records, assigning computing resources to the faculty members or students for research purposes and also in terms of hosting various applications namely Web Server, Email Server, DNS and other applications. The results that came out of the Survey can be briefed as follows:

Availability of Data Center in Public Universities

Under Public University category, it was found that 18 out of total 30 universities don't have their own Data Center (Figure 71).

Availability of Data Center in Other Institutes

Under the category of "Other Institutions", it was found that 15 out of total 26 don't have their own Data Center (Figure 71).
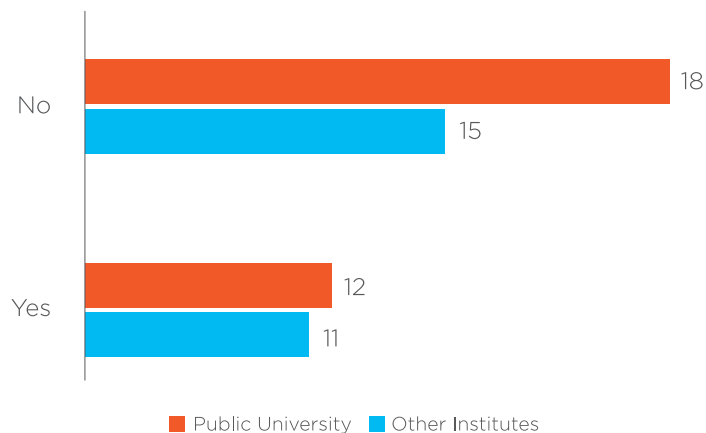
Figure 71: Existence of Data Center

With regard to presence of "Virtualization Platform" in the "Public University" category only 7 Universities out of 12 Universities have the said platform (Figure 72). Under the category of "Other Institutes" only 6 out of 10 institutes provide "Virtualization Platform". It is obvious from the availability of the "Data Center" and the availability of the "Virtualization Platform" that universities are yet to be ready in meeting the demand of allocation of "Virtualized machines" to the researchers. Such being the case, BdREN's virtualized machine service could be a lucrative solution if BdREN can increase the awareness about the availability of the same.
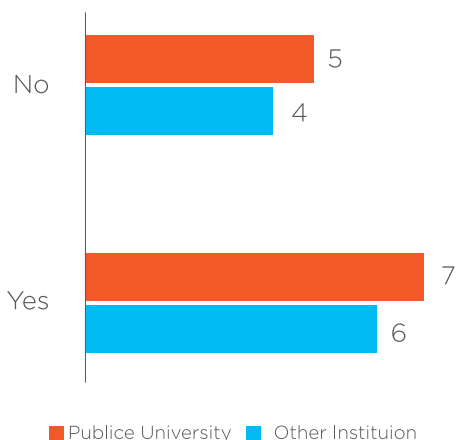
Figure 72: Virtualization Platform in Data Center
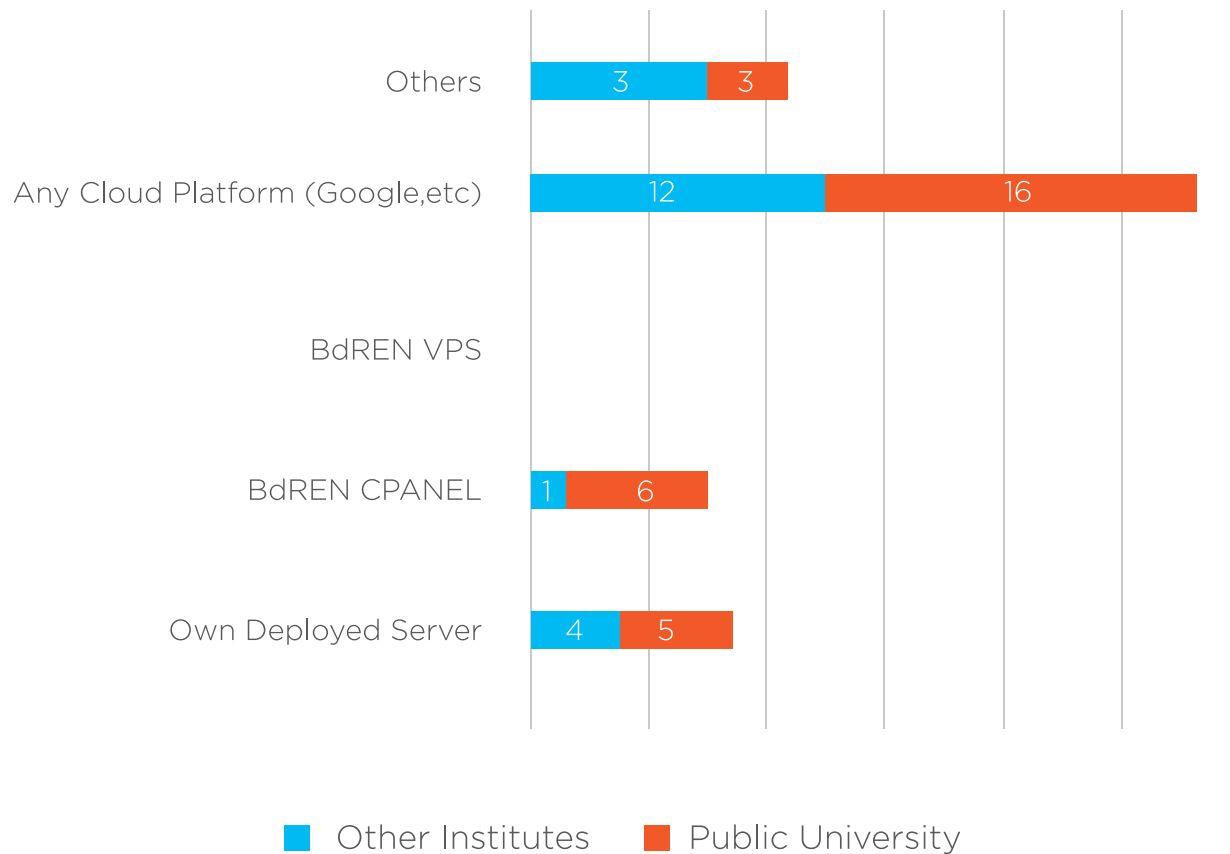
Figure 73: Hosting of Email Service

Email Solution in Public Universities

Among the respondents from Public University, for Email Solution (Figure 73) 16 use Google/Other Cloud Platform, 6 use BdREN cPanel solution, 5 use their own Server and rest 3 have other solutions. Most probably as Google Cloud platform solution under GSuite is available free of cost for education purpose, the universities are more interested to use Google Cloud for Email solution.

Email Solution in Other Institutes

Under Other Institutes category, the statistics are almost similar with 12 of them still having their trust on Google Cloud Platform, 4 on their own platform and 3 on other platform. Only 1 of the other Institutes are in BdREN platform. BdREN might need to streamline its marketing effort to attract more users to take email service solution from BdREN.
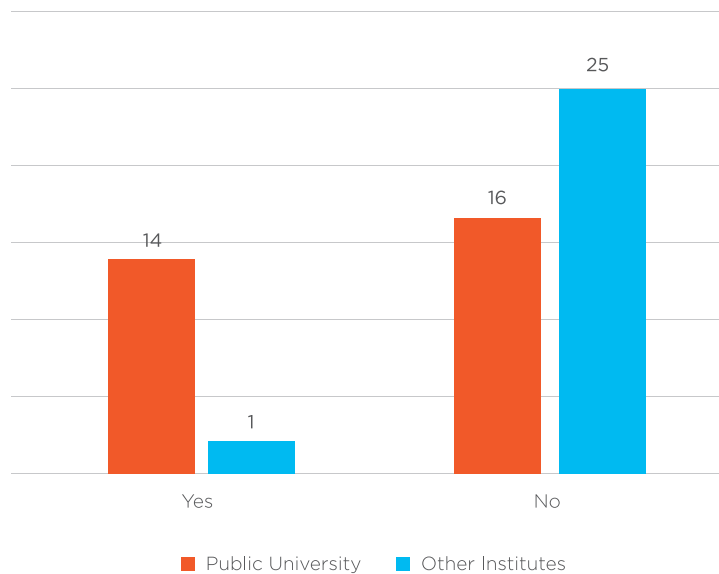
Figure 74: WEB Application at BdREN Data Center

Web Application solution in Public Universities

14 (47%) out of 30 Respondents under Public Universities category use BdREN Data Center to Store Web Applications (Figure 74). Out of those 14, 11 (79%) use Web Service at BdREN Data Center (Figure 75). Other services used are Web Applications, Email, Radius, Web Storage and others.

Web Application solution in Other Institutes

Only 1 out of 26 Respondents under Other Institutes category use BdREN Data Center to Store Web Applications (Figure 74).
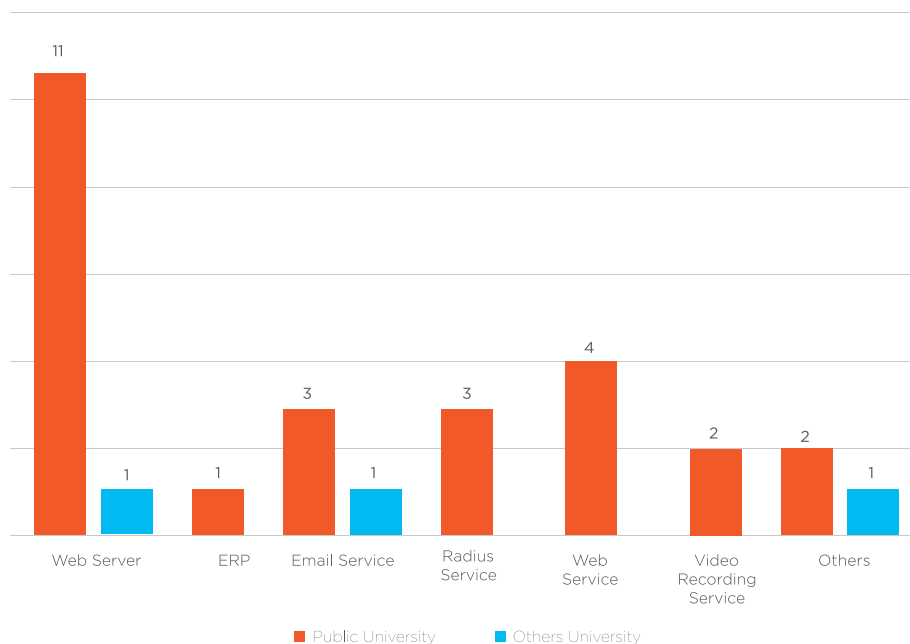
Figure 75: Applications used in BdREN Data Center

It was found that 34 institutes (Figure 76) [18 Public Universities + 16 Other Institutes] use Public Cloud for hosting services whereas only 15 [14 Public Universities + 1 Other Institutes] have chosen BdREN Data Center to host their services (Figure 74). Hosting of Services in BdREN cloud is very poor and this issue needs to be addressed.
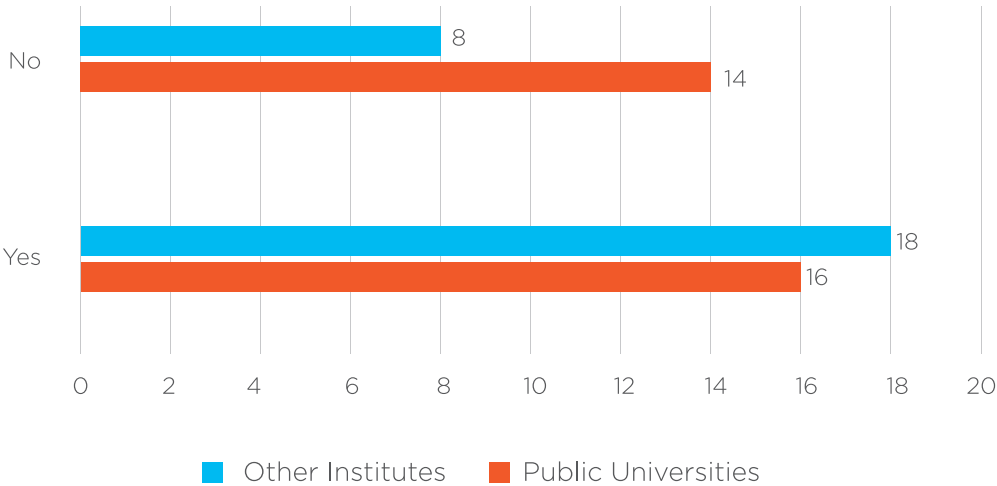
Figure 76: Members' Hosted Applications other than BdREN Cloud

IT INFRASTRUCTURE SECURITY

Considering the importance of security in the Network, the Member Institutes were asked about what security measures they are deploying by themselves at the moment. The collected responses have been reflected in Figure 77 and in Figure 78. It is identified that most of the Member Institutes are yet to implement many of the security features. However, installed security is dominated by Network/Perimeter Security (Public University: 22 and Other Institutes: 21) which means that most of them have installed Firewall at their network. Perimeter Security in 19 Public University Campuses was ensured under G.74 package conducted from HEQEP.
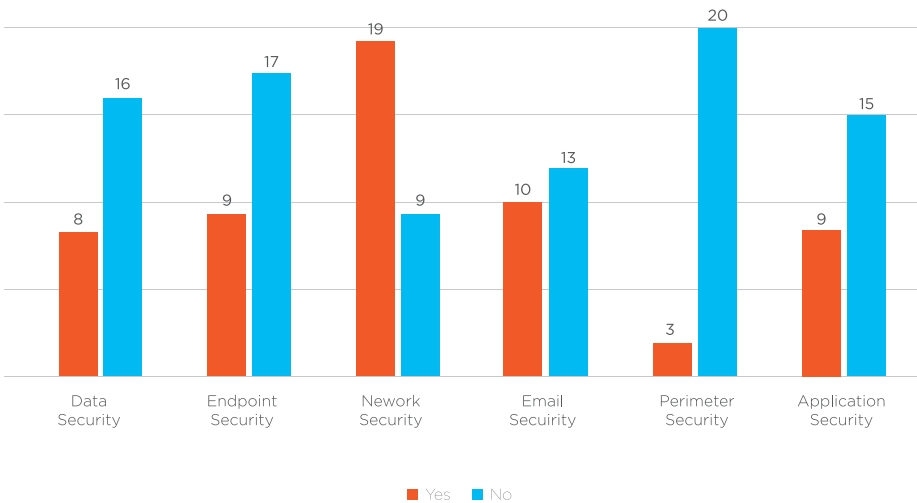
Figure 77: Public University IT Infrastructure Security

Also Email Security is available with many of the Institutes (Public University 10 + Other Institutes 12). Other Institutes are more concerned about Application Security 10 (38%) out of 26 compared to Public Universities 9 (30%) out of 30.
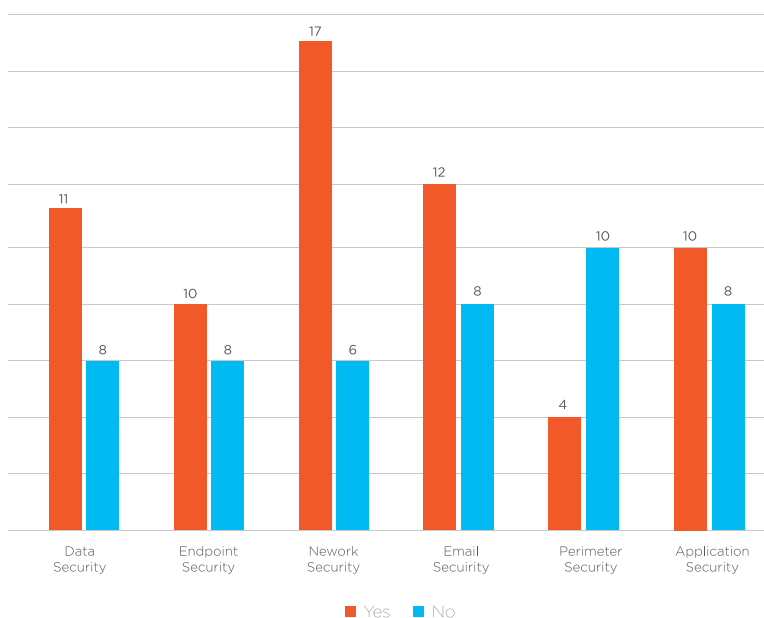
Figure 78: IT Infrastructure Security of Other Institutes

Another comparison was made in Figure 79 about the approach toward security undertaken by Public vs Private and International Universities. It is clear from the Figure 79 that Private and International Universities are more concerned with security than Public Universities.
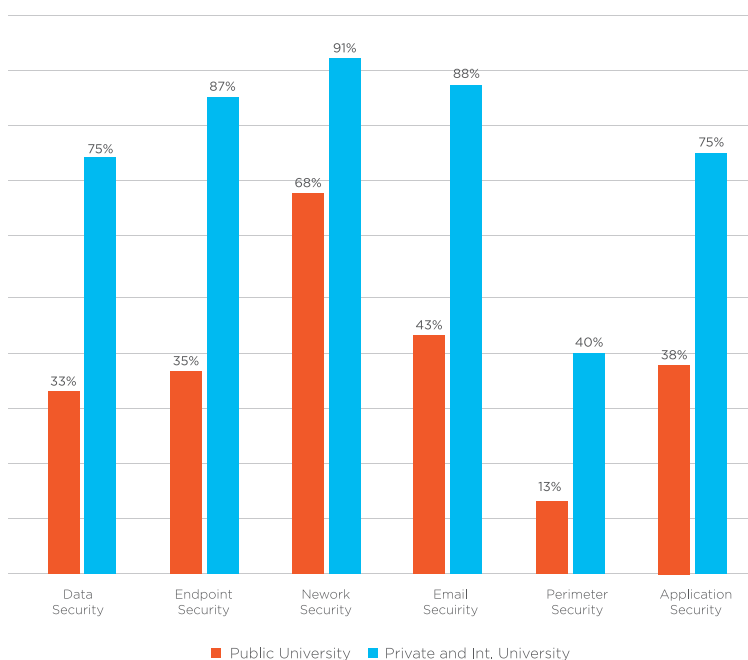
Figure 79: Comparison of Security Services undertaken by "Public" vs "Private and International" University

It is also evident from Figure 80 and Figure 81 that both Public Universities and Other Institutes are very much eager to take Security Services from BdREN. However, BdREN needs to figure out how such security services can be extended to the universities.
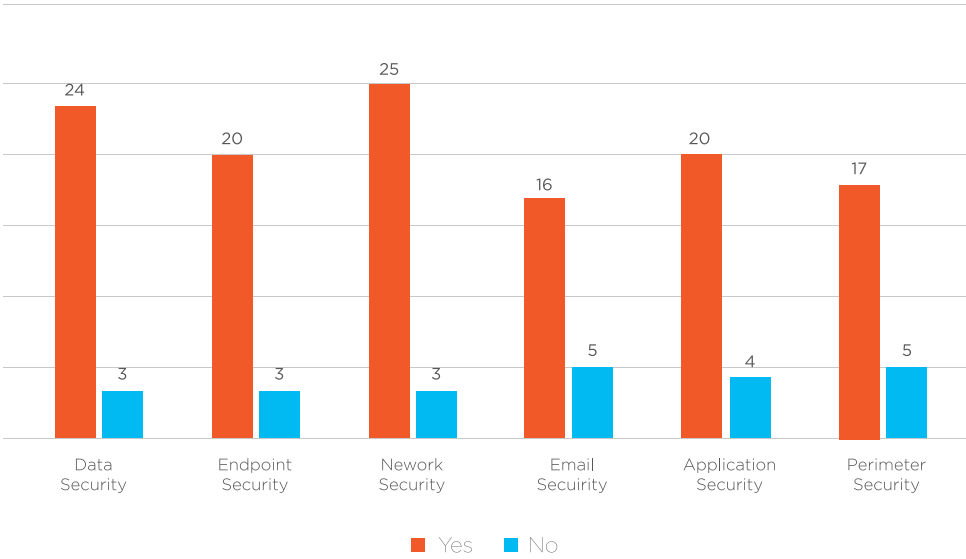
Figure 80: Security Services warranted from BdREN (Response by Public Universities)
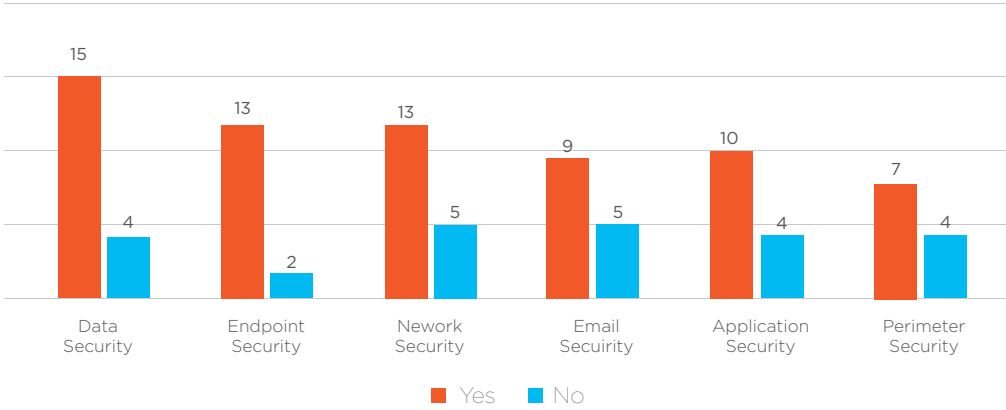
Figure 81: Security Services warranted from BdREN (Response by Other Institutes)

COMPARISON OF BDREN HOSTING VS OTHER VENDORS

CATEGORY	NUMBER OF RESPONDENTS
Public University	16
Private University	10
International University	1
Research Institutes	3
Medical College	1
Other Institutes	3
TOTAL	34

An initiative was undertaken to evaluate the quality of BdREN services in comparison to the services being offered by other service providers. To this end a question was asked "Which services are you using from Public Cloud?" The responses have been portrayed in Figure 82.

Response from Public University

Out of the 16 respondents who are hosting their services in Public Cloud Internet Bandwidth (10), Email Service (9), Online Payment Gateway (6), Web Hosting (4), Storage (4) and Journal Access (5) found to be the most popular hosting services. Public Universities host comparatively less applications in the Public Cloud than Other Institutes (Private University, Medical Colleges or Research Institutes). It is also found that 10 of the universities are still taking Internet Bandwidth from the second vendor. It means that BdREN is yet to earn the confidence of the universities as a single Internet Service Provider. BdREN needs to actively think about that aspect.
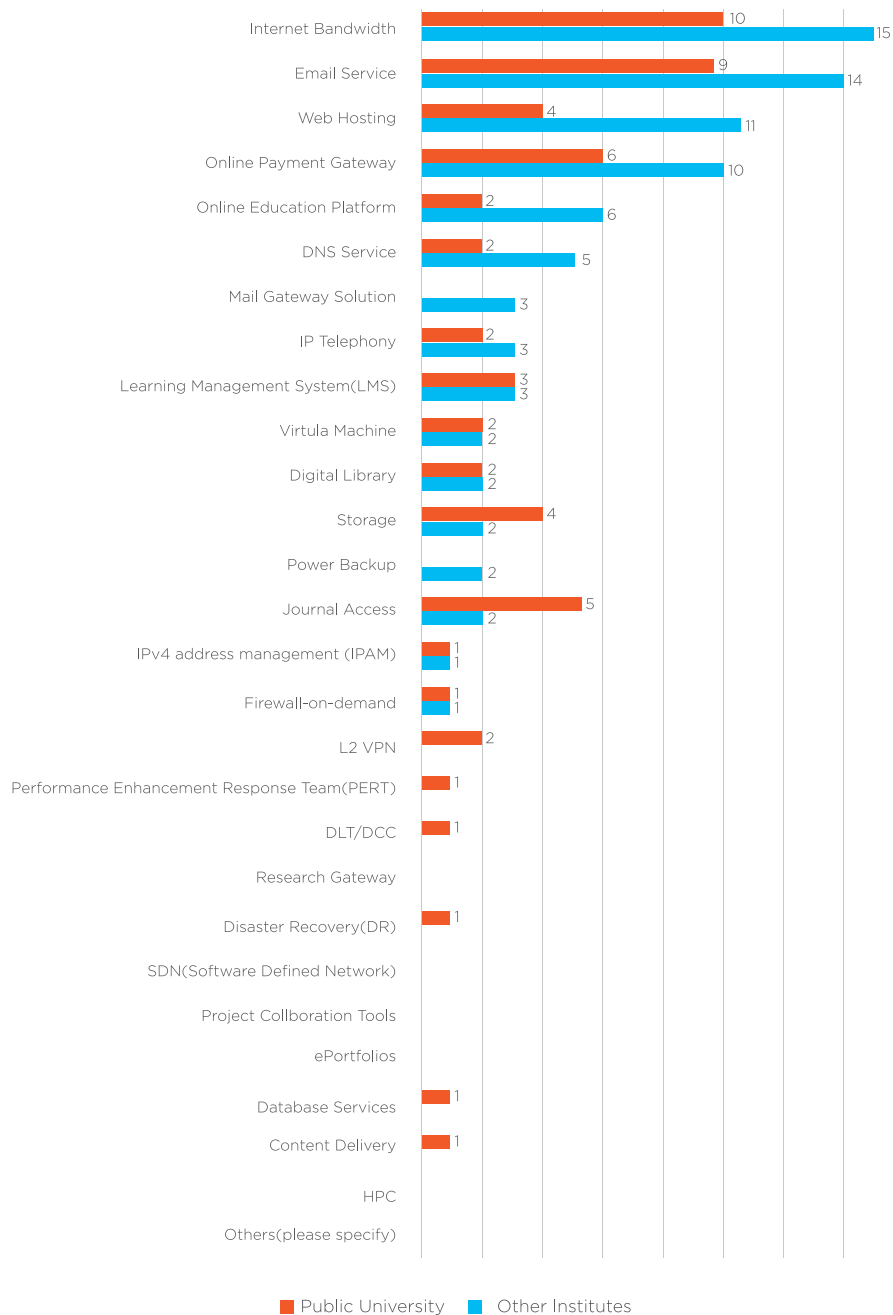
Figure 82: Services used from Public cloud or Other Vendors

It is also evident from Figure 82 that out of the 18 respondents under this category who are hosting their services in Internet Public Cloud Internet Bandwidth (15), Email Service (14), Web Hosting (11), Online Payment Gateway (10), Online Educational Platform (6) and DNS Service (5) found to be the most popular hosting services.

QUALITY OF SERVICES OF BdREN AND OTHER VENDORS

CATEGORY	NUMBER OF RESPONDENTS
Public University	14
Private University	7
International University	1
Research Institutes	3
Medical College	1
Other Institutes	2
TOTAL	28

It is highly encouraging for BdREN to know that the respondents considered BdREN Services better than that of other vendors. In answer to a question "How do you compare the quality of the services taken both from BdREN and Other Vendors?" the responses received from Public Universities and Other Institutes are reflected in Figure 83.

Response from Public University

Out of total 14 respondents, 4 universities responded that BdREN services are far better, 5 universities responded that BdREN services are better and 3 of them responded that services offered by BdREN and that of other vendors are same. Out of 2 universties which reported in favor of other vendors, 1 reported that other vendor is far better. In this regard BdREN should try to target each specific university who went in favor of other vendor and try to address their issues, if any. Also, it needs to be identified why majority of the universities refrained themselves from rating BdREN compared to other vendors. Did they feel embarrassed to rate BdREN in the negative? If it is so, then this is a warning sign for BdREN.
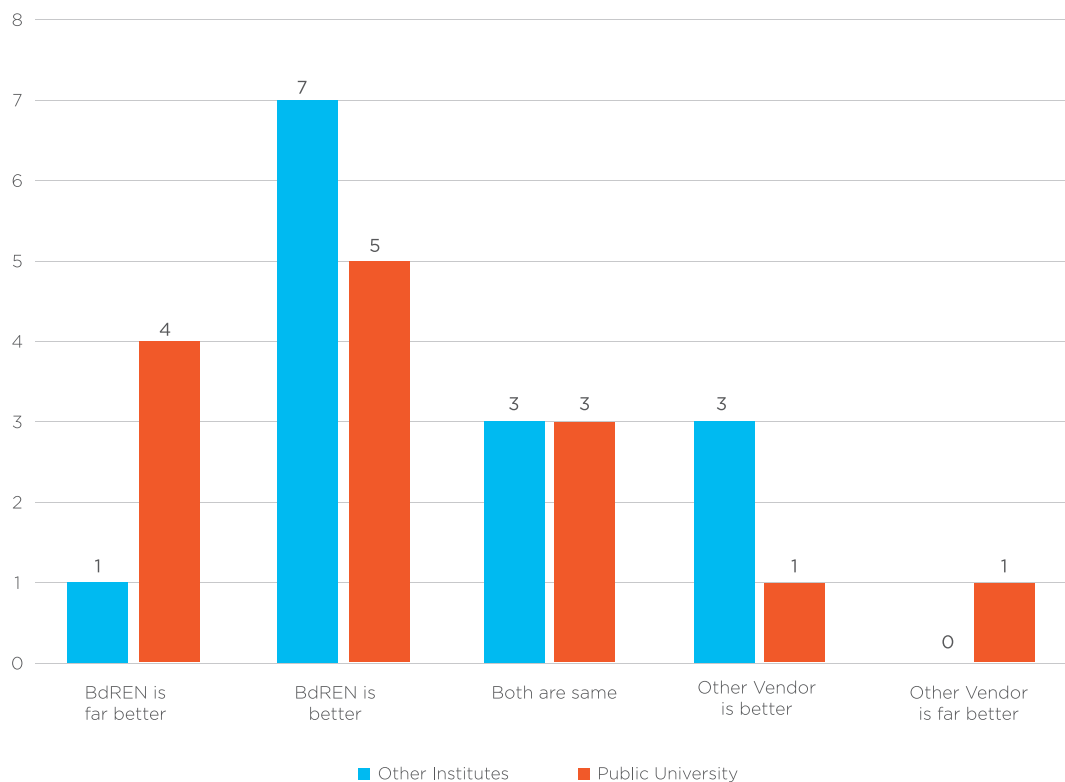
Figure 83: BdREN vs Other Vendors

Response from Other Institutes

Out of total 14 respondents under this category, 1 institute responded that BdREN services are far better, 7 institutes responded that BdREN services are better and 3 of them responded that services offered by BdREN and that of other vendors are same. 3 institutes were in favor of Other Vendors. The evaluation of both Public Universities and Other Institutes are more or less same which is skewed in favor of BdREN.

ANALYSIS ON BDREN CONTRIBUTION TO R&E COMMUNITY

CATEGORY	NUMBER OF RESPONDENTS
Public University	29
Private University	11
International University	1
Research Institutes	9
Medical College	1
Other Institutes	4
TOTAL	55

In another question it was asked that **"Do you agree that BdREN has a significant impact on Academician and Research community?"**. The responses from the Public Universities and Other Institutes are placed in Figure 84. The brief is as follows:

Response from Public University

Out of 29 respondents 9 universities voted for "Strongly Agree" and 19 universities opted for "Agree" with only 1 university going for the option "Strongly Disagree".

Response from Other Institutes

Out of 26 respondents 5 Institutes voted for "Strongly Agree", 18 Institutes opted for "Agree" with only 1 Institute going for the option "Disagree" and 1 remained "Undecided".
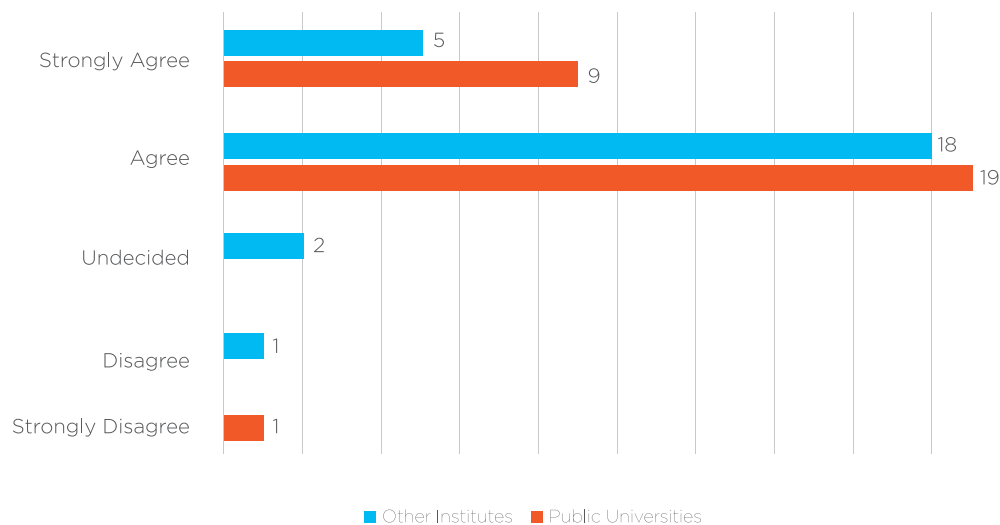
Figure 84: Impact of BdREN on Academic and Research Community
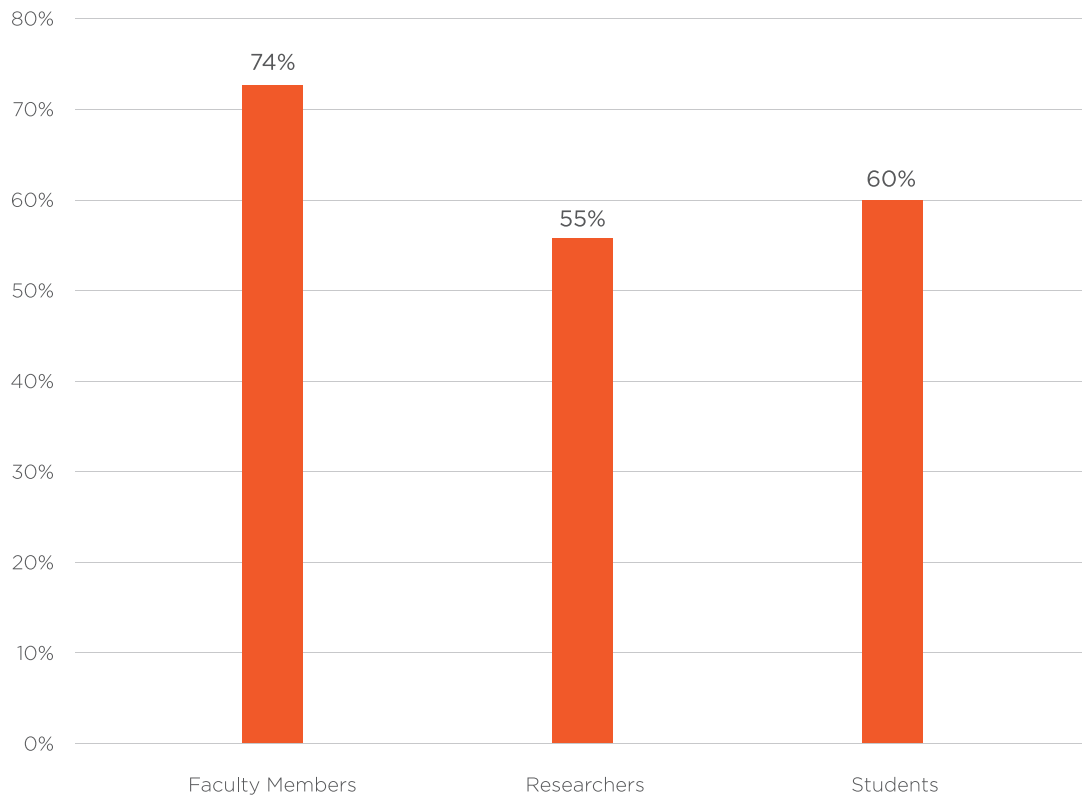
Figure 85: Beneficiaries of BdREN Services

In response to a question on "Approximate percentage (%) of beneficiaries covered by BdREN in Research and Education Community compared to the whole industry" the responses are mapped in Figure 85.

From the comments passed by the respondants it is found that 74% of faculty members, 55% of the Researchers and 60% of the Students [Higher Education] could be accommodated under the umbrella of BdREN Services.

BdREN
R&D ACTIVITIES

A. CONNECTIVITY WITH "TLR" AND ENABLEMENT OF "F-TICKS"

Being a national research and education network operator, BdREN has been offering educational roaming (eduroam) services in a number of Institutes across the country since October 2017. BdREN has been continuously developing this service adding new Institutes under the belt of eduroam services and promoting its benefits and opportunities among the REN community. Using eduroam service, Bangladeshi students, researchers, faculty members and staff from participating Institutes could be able to obtain free, secure WiFi roaming access when visiting other national and International participating Institutes by simply opening their laptop or turning on their smart phone.

01
Upstream PoP-1 Netherland

Hostname: etlr1.eduroam.org
IPv4 Address: 192.87.106.34
IPv6: 2001:610:1:80bf:192:87:106:34
Protocol/Port: Radius 1812/UDP 2083/TLS

02
Upstream PoP-2 Denmark

Hostname: etlr2.eduroam.org
IPv4 Address: 130.225.242.109
IPv6: 2001:878::e000:82:e1:f2:6d
Protocol/Port: Radius 1812/UDP 2083/TLS

TLRs

03
Upstream PoP-3 Hong Kong

Hostname: apeduroam1.polyu.edu.hk
IPv4 Address: 158.132.12.192
Protocol/Port: Radius 1812/UDP 2083/TLS

04
Upstream PoP-4 Australia

Hostname:eduroam-apan.anycast.aarnet.net.au
IPv4 Address: 202.158.207.12
Protocol/Port: Radius 1812/UDP 2083/TLS

Figure 86: Four (4) TLRs in .bd federation providing redundancy for users

Federation Level RADIUS (FLR), alternately known as National RADIUS servers (NRSs) are used to connect Identity Providers (IdPs) and Service Providers (SPs) across the nation, and also provides an uplink with Top-Level Radius Servers (TLRs) in order to connect IdPs and SPs located across the world. Currently, BdREN provides roaming opportunities to 20 campuses (having both IdP and SP), containing 1912 Access Points (APs) within Bangladesh. BdREN is planning to expand its eduroam service to other Institutes and even to the public hotspots namely Airports and Railway Stations. Our deployed FLR/NRS servers are connected with 4 Top Level

RADIUS servers, 2 of them are (TLRs) located at AARNet (Australia) and HARNET (Hong Kong) and rest 2 are eTLRs located at SurfNet (Netherlands) and DEIC (Denmark). Although for BdREN the legitimate connectivity should be to TLRs however because of non-response from the TLRs, BdREN established its connectivity with eTLRs during the initial phase. At the beginning of 2020 BdREN could finally establish its connectivity with both the TLRs. Now gradually the connectivity with eTLRs will be severed. In deploying eduroam, BdREN follows the best practices given by GEANT.

As a National Roaming Operator (NRO), we send all Federated Tickers (FTicks) for national and international roaming to the central eduroam Operations Team operated by GEANT which is the pan-European Regional Research and Education Network (RREN) connecting all the NRENs across Europe. Figure 87 shows accumulated National and International users' login statistics for BdREN in FY 2019-2020.
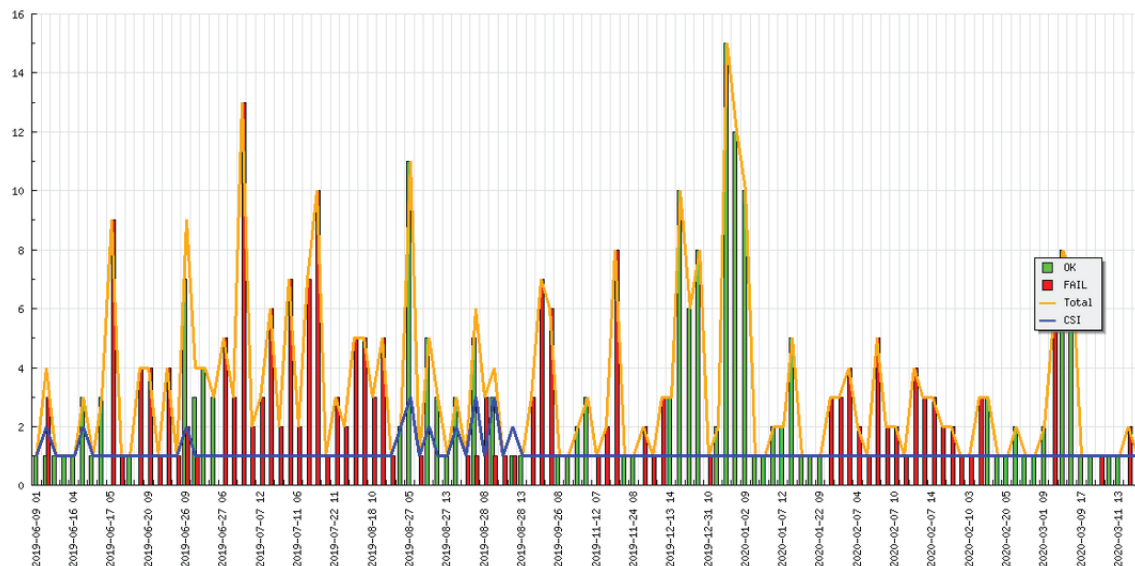
Figure 87: eduroam login statistics for BdREN home and foreign users during FY 2019

Use of this service is another indicator of the quantity of services provided and their value to both our members and to the visitors who visit Bangladesh from global research and education community. We arrange exclusive workshops for the engineers of education and research institutes to train them on how to configure their own Institutional Radius Server (IRS) for their campuses. We are planning to deploy eduroam configuration assistant tool (CAT), which is

under development. Eduroam, the secure global roaming wireless network for the research and education sector, is now available at more than 12,000 locations in over 100 countries worldwide. BdREN will continue working with its member Institutes to extend their access to eduroam realm.

B. VOLTAGE & TEMP MONITORING

Background

BdREN has many Routers and DWDM devices across the country. We can fetch a plethora of information using programming language and configuring the devices to respond to that programming language. The information may contain voltage level, temperature level, interface information, span loss and similar other parameters of the devices. We can use this information to take decisions in many critical situations. For example, if the voltage level of a certain node goes below certain threshold level, we can suspect that electrical power might not be available in that device. One way to implement that is to monitor all the devices manually. This is a time-consuming and might be susceptible to errors. Voltage and Temperature of these devices may cross the danger limit at any time causing accidents. For example, at any point of time certain parameters related to a device may cross the threshold limit with the person responsible for monitoring that device being oblivious of the fact as he/she might not be checking the parameters at that particular point of time. This may lead to potential loss of valuable resources and may also cause interruption of service. To solve the problem of constantly monitoring device parameters manually, we had come up with a software solution namely "Device Parameter Monitoring" Application.
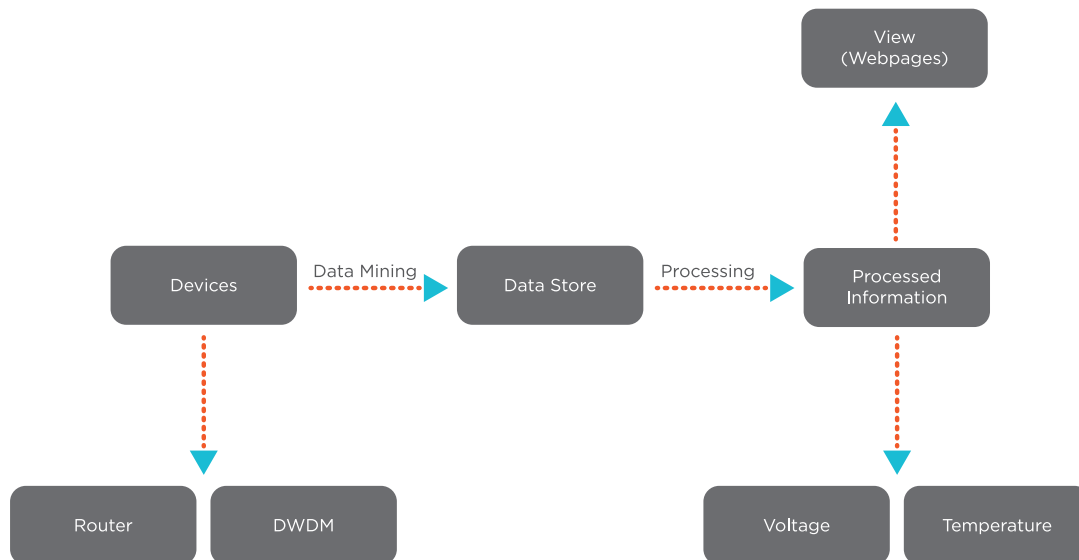
Figure 88: Flow chart of BdREN Voltage and Temperature Monitoring Software

C. vSESSION

Since the very outbreak of the pandemic when all educational institutes were declared closed by the government, BdREN started supporting online education for the faculty members of universities and higher education institutes by offering "Zoom Application Licenses" free-of-cost to the community. As demand from the community surged dramatically, in mitigating that burgeoning demand, BdREN started facing account crunching in the form of "Zoom Licensing". It immediately reacted to develop a web-based software application which could enhance the efficiency of individual Zoom Account many times.

To provide maximum zoom video conference support with limited resources, BdREN team created "vSession" Application. By this software, all users were able to create schedules and take their classes at the scheduled times with almost all the features of "Zoom Application" available under their repository.
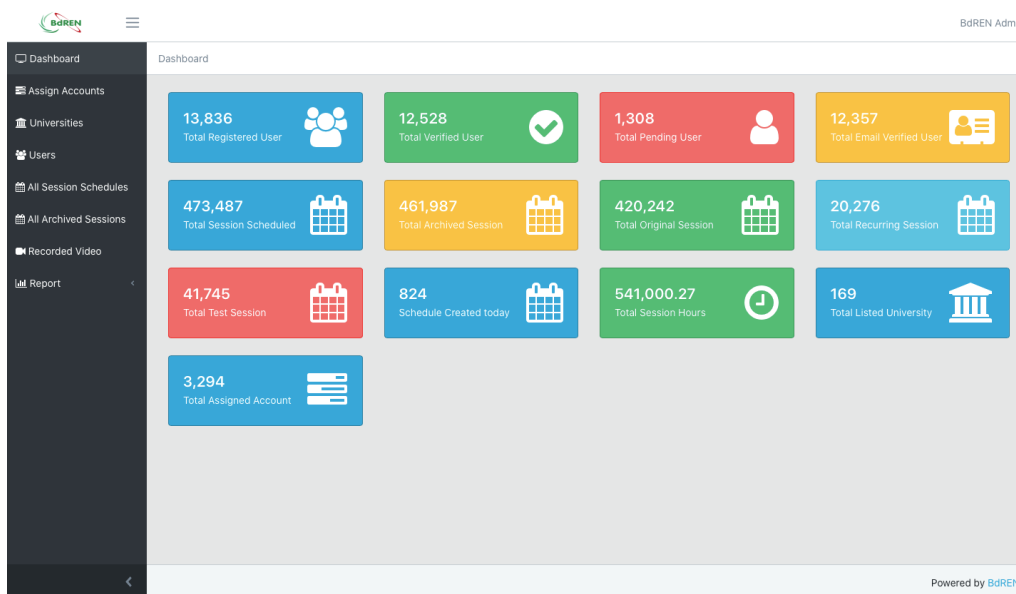
Figure 89: vSession admin dashboard

The software gained in overwhelming popularity and within the first four-month BdREN vSession hosted 2.7 lac+ classes and provided the service among 11k+ faculty members with only 3k+ zoom account. 150+ organizations/universities had been served by this software.

D. ZOOM REPORTING APPLICATION

   In order to support the faculty members and university administration with the facility to generate reports about the classes being taken by the faculty members of the university, BdREN developed a web-based application which could generate customized report as needed by the community. Also, it helped BdREN and the administration to get a real-time glimpse of what are the proceeds of online education in higher education community. Here is a snapshot of the output of the software (Figure 90)
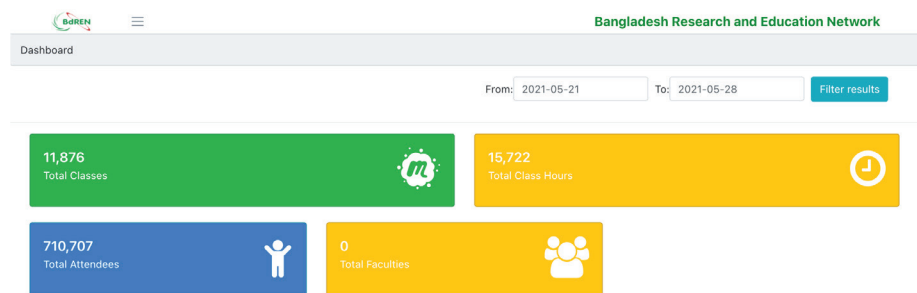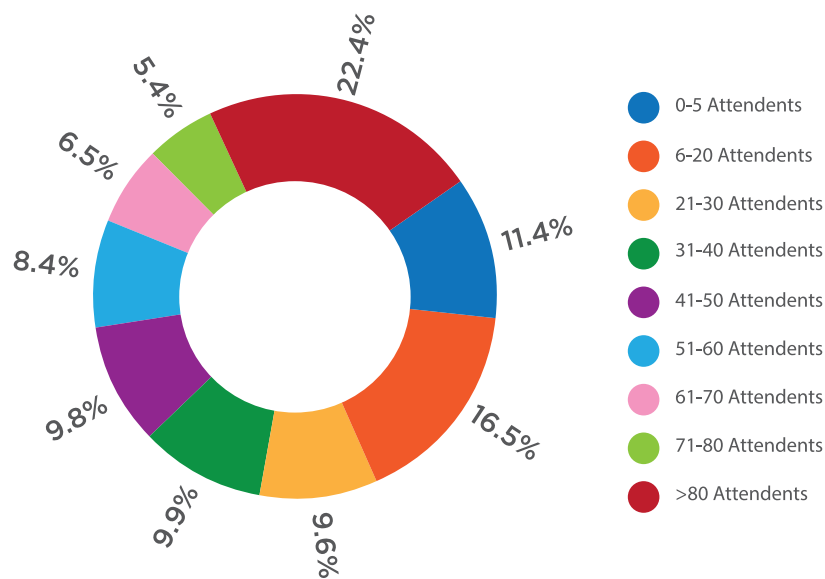
Figure 90: vSession Report

E. vPRESENCE

BdREN Officials need to travel every now and then to different parts of the country for network operations and maintenance purpose. To record flawless real-time data about each such tour describing the travelled destination, duration and the very purpose, BdREN developed an application "vPresence" which comes with the idea of a virtual presence system. vPresence is a Mobile application that facilitates reporting virtual site attendance by the employees themselves. From that reporting, the supervisor can generate a monthly report to verify the "Tour Bill" submitted by each employee.
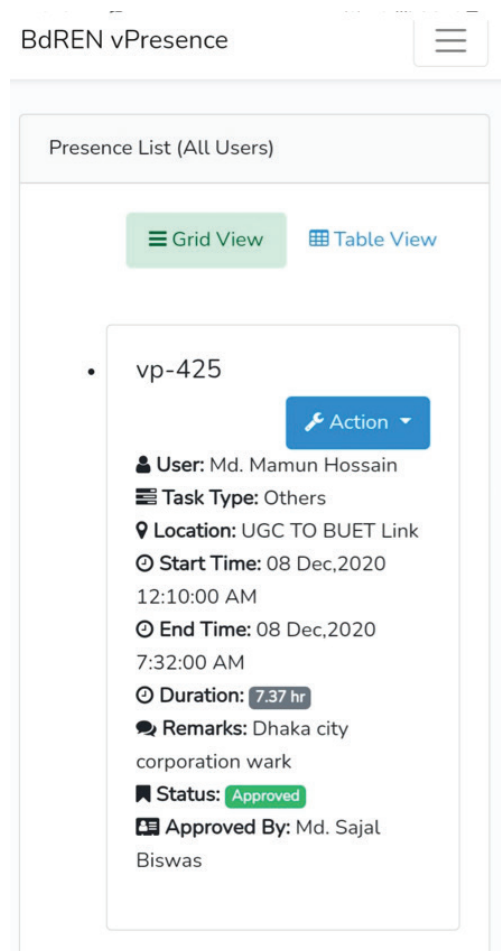
Figure 91: vPresence User Dashboard

F. TESTING ALIEN WAVELENGTH IN BdREN

Alien Wavelength is a colored optical signal that is originated from equipment not under the direct control of the transmission network operator.

BdREN has been using Cisco DWDM products in its Transmission portfolio. It was a long-time curiosity whether the Cisco DWDM products support "Alien wavelength" as claimed by the vendor. In that venture, BdREN communicated with Tejas Networks, the reputed DWDM manufacturer in India and created a test setup to pass wavelength generated from Tejas DWDM product through Cisco and get it terminated again in Tejas DWDM at the destination. The experiment was conducted between UGC in Dhaka and PSTU in Patuakhali. The test was successfully conducted by both BdREN and Tejas Engineers jointly contributing their expertise. The success will allow BdREN to carry 100G Alien Lambda to pass through Cisco DWDM Network which will enable BdREN to support its system for carrying 100G Lambda without any additional cost. The brief of the test architecture is given below:
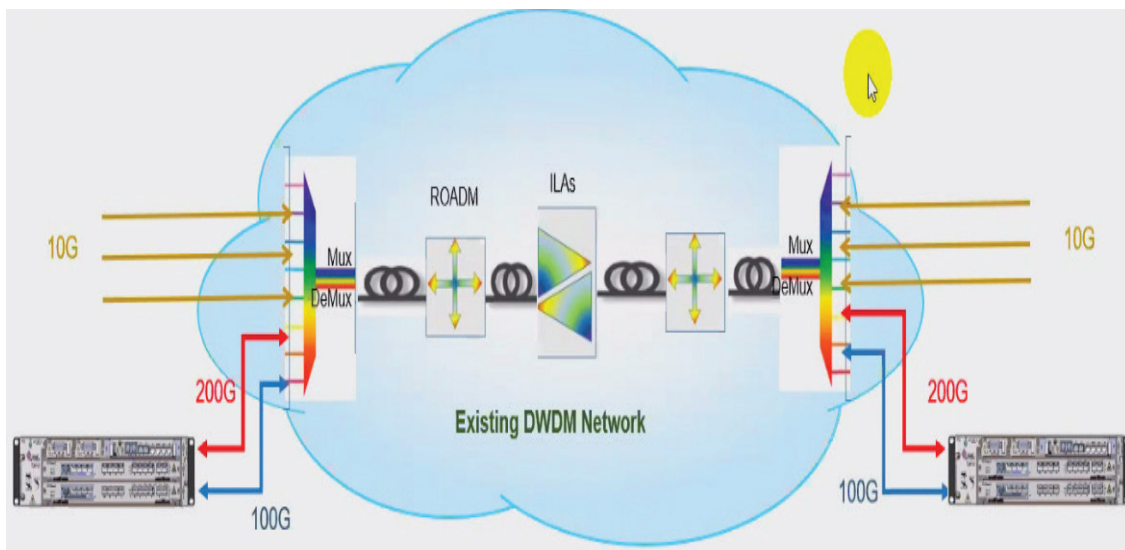
Figure 92: Alien Wavelength Test Architecture
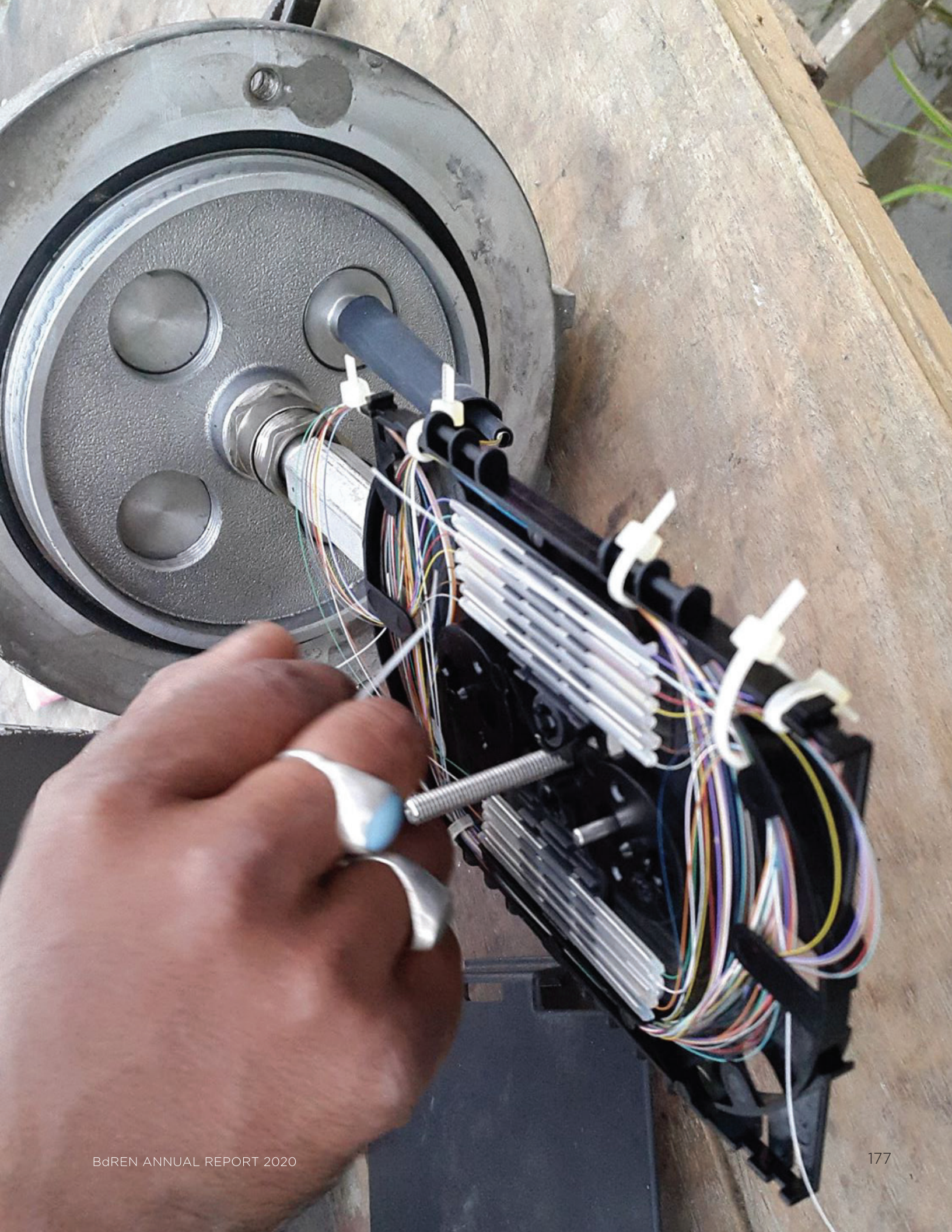
BdREN
FINANCIAL REPORT

OUR FINANCE

"

BdREN's overall revenue for 2019-2020 amounted to BDT 200.02 million compared with a total expenditure of BDT 304.36 million generating a net deficit of BDT 104.34 million. The value of the total Assets was BDT 2,482.92 million, total Trust Fund was BDT 2,434.58 million and External liabilities was BDT 48.34 million as at 30 June, 2020. However, BdREN's cash generation is positive, it's a strong indicator that the BdREN is in a good position to expand its business. Also, another indicator of BdREN's Financial Strength is its higher equity ratio of 0.98.

"
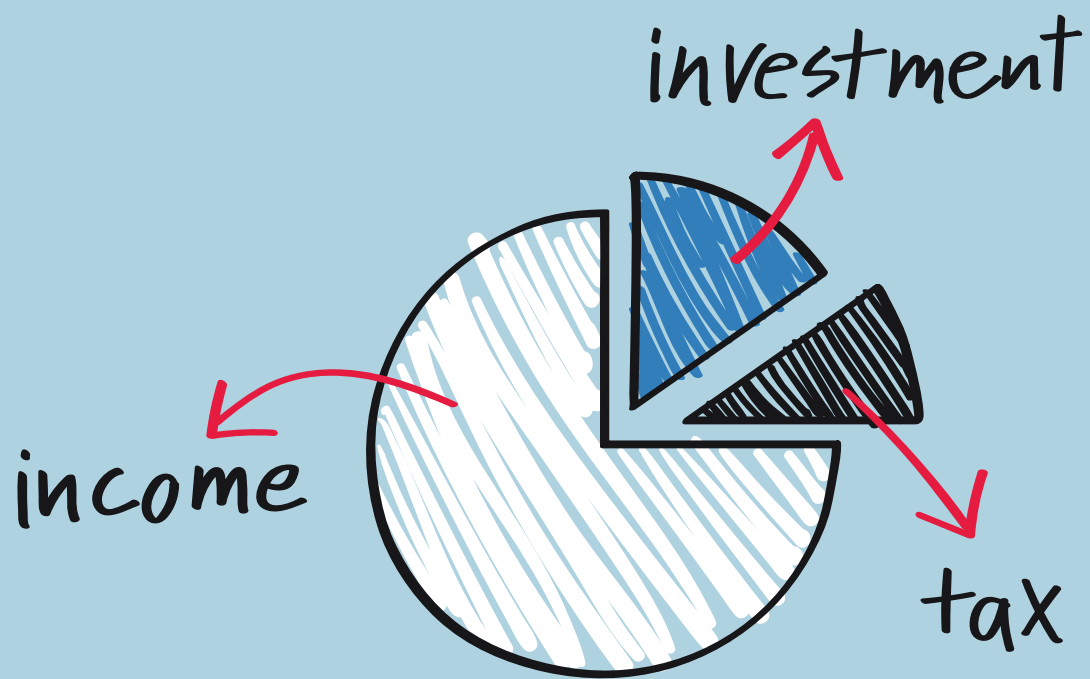
Financial Plan

REVENUE

Our overall revenue for FY 2019-2020 of BDT 200.02 million represented an increase of BDT 43.72 million (27.97%) compared with FY 2018-2019. The major heads of revenue were Bandwidth Service Revenue (BDT 107.56 million), Annual Membership Fees (BDT 1.45 million) and Non-Operating Income (BDT 91.01 million).

Total Revenue
BDT 200.02 million

91.01m (45.50%)
Non-Operating Income

BREAKDOWN
OF REVENUES
2019-2020

107.56m (53.77%)
Bandwidth Charge Fees

1.45m (0.73%)
Income from
Membership Fees
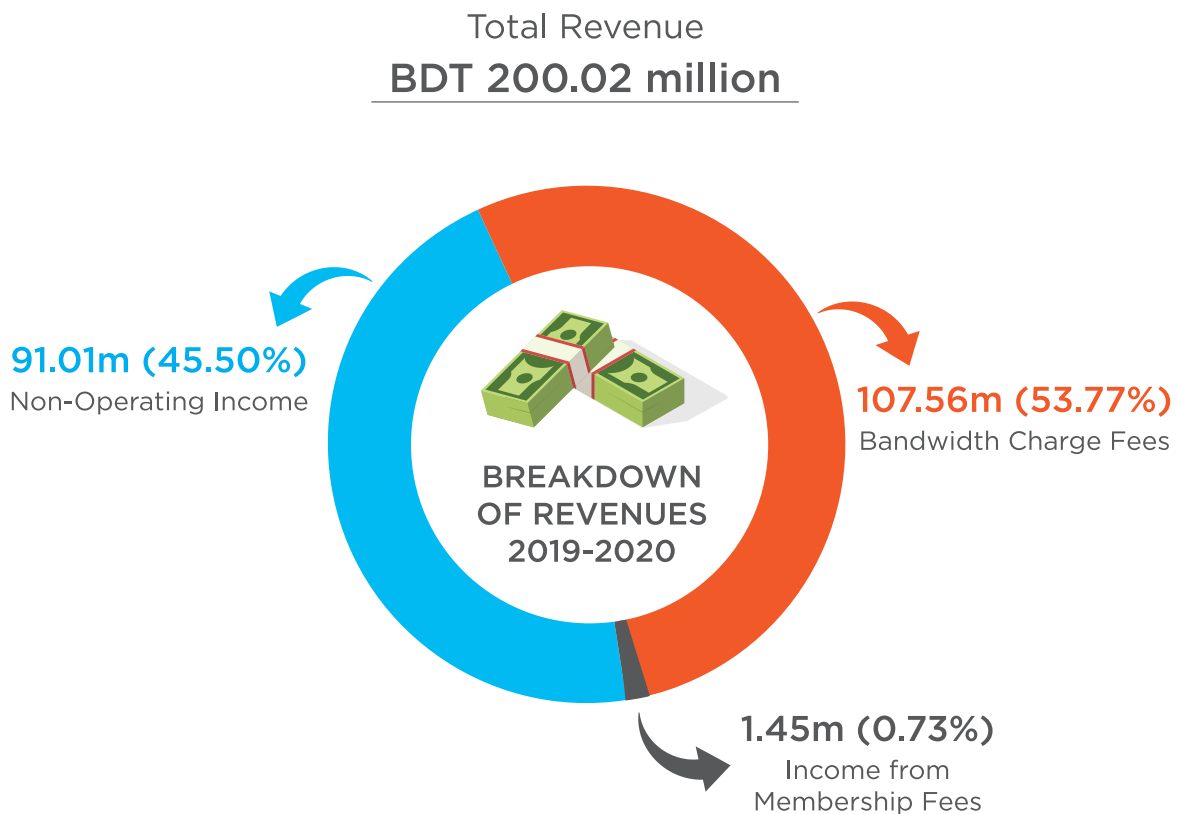
Figure 93: Revenue in FY 2019-2020

EXPENDITURE

The total expenditure of BdREN for FY 2019-2020 was BDT 304.36 million, an increase of BDT 167.89 million (123.02%) compared to FY 2018-2019. The major cost heads were Network Operational Expense (BDT 34.23 million), Network Maintenance Expense (BDT 52.31 million), General & Administrative Expense (BDT 30.32 million) and Depreciation and Amortization Expense (BDT 187.06 million) and Non-Operating Expense (BDT 0.44 million).

Total Expenditure
BDT 304.36 million

34.23m (11.24%)
Network Operational Expense

52.31m (17.19%)
Network Maintenance Expense

0.44m (0.15%)
Non-Operating Expense

BREAKDOWN OF EXPENDITURE 2019-2020

187.06m (61.46%)
Depreciation and Amortization Expense

30.32m (9.96%)
General and Administrative Expense
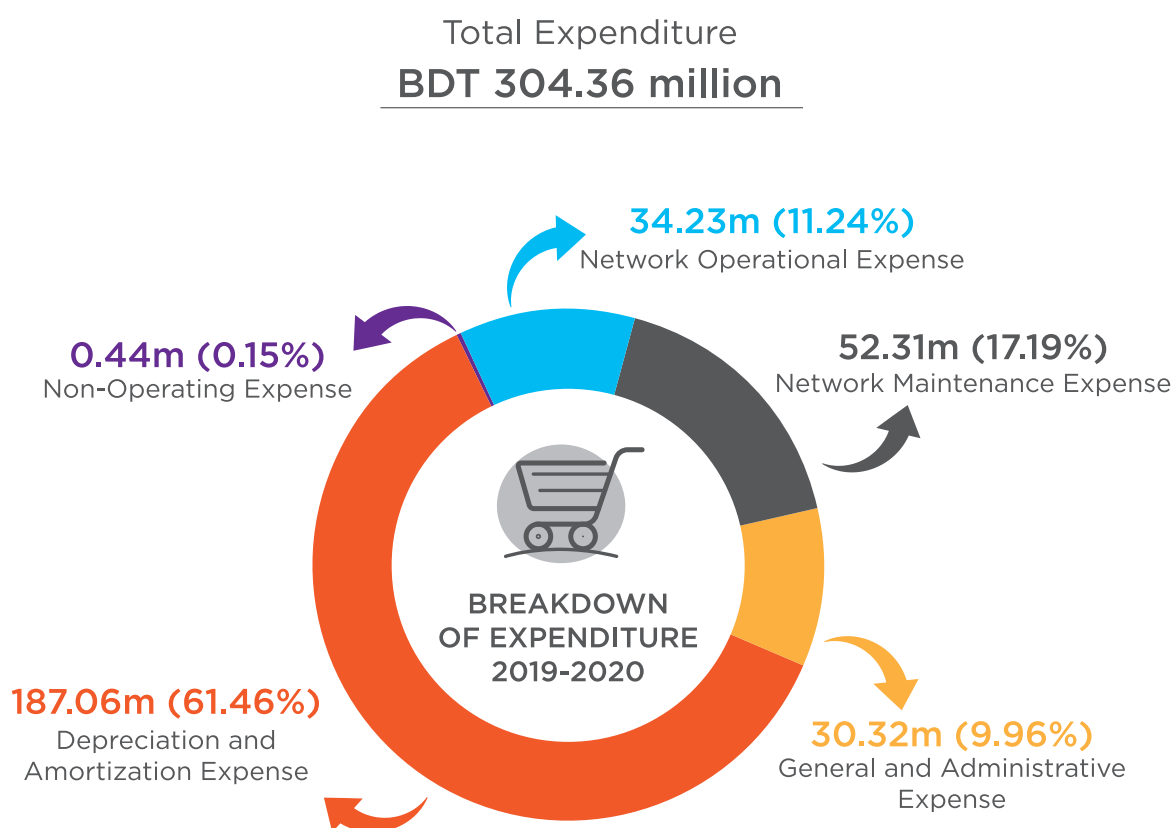
Figure 94: Expenditure in FY 2019-2020

STATEMENT OF COMPREHENSIVE INCOME

Total Income during this financial year was found to be BDT 200.02 million and Total Expense was BDT 304.36 million (Figure 95). Total Income increased by 27.97% whereas Total Expenses increased by 123.02% mostly due to high depreciation and amortization expenses. This also resulted in Operating Loss. In ratio format:

Net Income Ratio = (-) 52.66%

Operating Expense Ratio = 2.79 times.
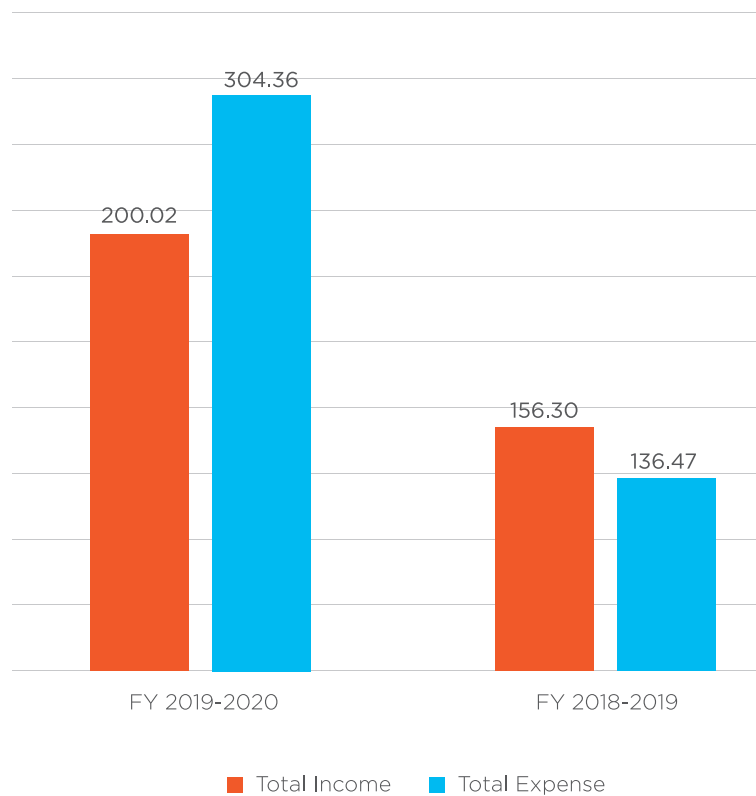
Figure 95: Total Income vs Total Expenses in BDT (m)

OPERATING AND NON-OPERATING INCOME

Total Income includes BDT 109.01m Operating Income and BDT 91.01m Non-Operating Income (Figure 96).

Operating Income
54%

Non-Operating Income
46%
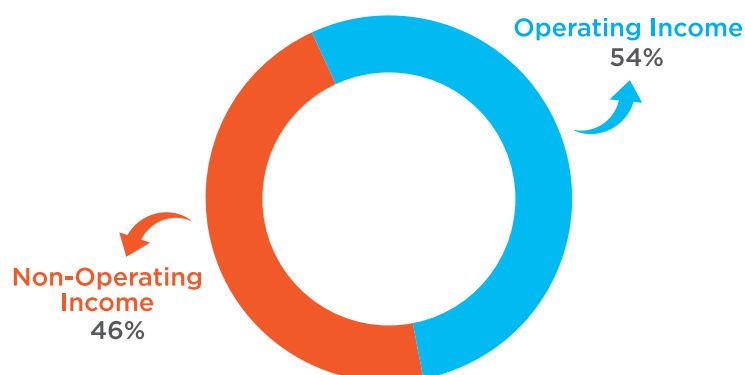
Figure 96: Contribution of Income in FY 2019-2020

STATEMENT OF FINANCIAL POSITION

In Ratio analysis it was found that the Quick Ratio was 1.11, Current Ratio was 2.85, Working Capital Ratio was 1.85, Debt to Equity Ratio was 0.02, and Equity Ratio 0.98. The high Equity Ratio which is close to 1.00 is typically favourable for BdREN. It also indicates that the BdREN is more sustainable and less risky. Distribution of Assets and Liabilities for BdREN as at 30 June 2020 is shown in Figure 97.

Balance Sheet Strength

Assets
50%

Trust Fund
49%
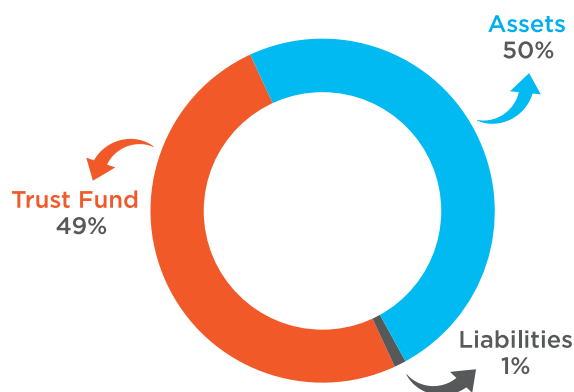
Liabilities
1%

Figure 97: Distribution of Assets and Liabilities

STATEMENT OF CASH FLOW

BdREN Trust follows standard and best practices for cash and fund management. It manages its cash separately for operating activities, investment activities and financing activities. Its cash generation is positive (Figure 98) which indicates that BdREN is in a good position to survive and expand its business.
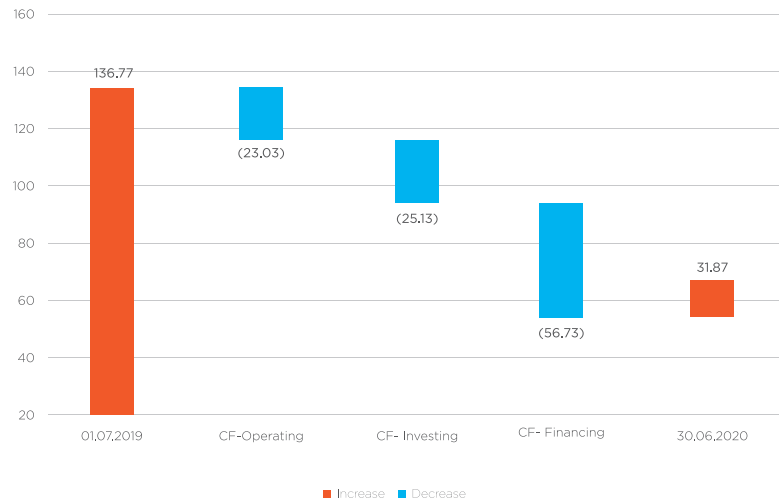
Figure 98:Cash Inflow-Outflow and Balance

CHANGES IN EQUITY

BdREN's Financial achievement in FY 2019-2020 is demonstrated with an increase in its Accumulated Surplus of BDT 64.81 million and the percentage being 59.55% (Figure 99).
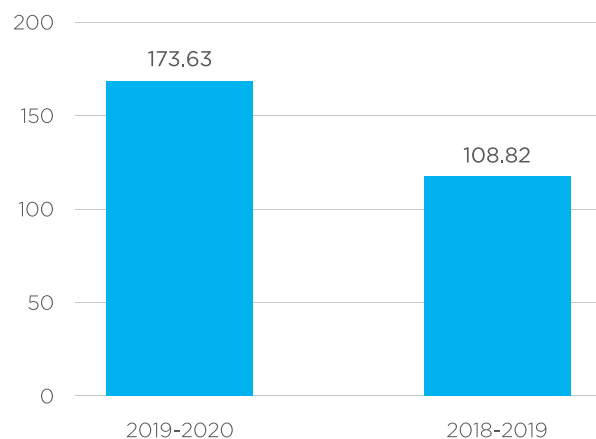
Figure 99: Rise in Accumulated Surplus in FY 2019-2020

BdREN Trust
Statement of Financial Position
As at 30 June 2020

	Notes	Amount in Taka FY 2019-2020	Amount in Taka FY 2018-2019
ASSETS			
Non-Current Assets	3	**1,350,997,979**	**1,512,919,385**
Property, Plant & Equipment(Tangible)		1,112,271,945	1,262,842,091
Furniture and Fixtures		101,201,861	112,431,512
Intangible Assets		22,324,174	12,845,782
Long-Term-Advance		115,200,000	124,800,000
Current Assets	4	**1,131,926,450**	**1,112,111,581**
Cash and Cash Equivalents		31,871,913	136,771,579
Investment in FDR/DPS		1,050,000,000	925,000,000
Inventories		17,097	8,212
IT Accessories		-	27,264
Advance, Deposite & Pre-payments		371,963	13,552,750
Accounts Receivables		32,997,901	29,364,749
Advance Income Tax (AIT)		16,667,575	7,387,026
			-
Total Assets		**2,482,924,429**	**2,625,030,966**
LIABILITIES & TRUST FUND			
Current Liabilities	5	**28,723,490**	**8,735,684**
Accounts Payable		20,560,381	3,244,830
Expenses Payable		792,776	1,291,828
Audit Fee Payable		57,500	-
VAT Payable		68,933	50,002
Withholding Tax Payable		16,118	55,899
Unearned Revenue		3,767	-
Provision for Income Tax		3,974,773	2,974,641
Asi@Connect Project Fund		939,141	619,641
fDLuDCf Project Fund		2,310,101	498,842
Non-Current Liabilities		**19,619,878**	**76,187,088**
Accounts Payable -dataedge Ltd.	7	19,619,878	76,187,088
Trust Fund	9	**2,434,581,060**	**2,540,108,194**
Capital Fund		896,700,000	896,700,000
		-	
Operational Fund		62,211,825	62,211,825
Donation and Grants		84,089,446	84,252,987
Revaluation Reserve		1,217,951,127	1,388,119,385
Accumulated Surplus		173,628,662	108,823,997
Total Equity & Liabilities		**2,482,924,429**	**2,625,030,966**

The annexed notes form an integral part of these financial statements

GM (HR, Admin & Finance) Chief Executive Officer Vice-Chairperson Chairperson

Signed in terms of our annexed report of even date.

Place: Dhaka
Date: 21 October 2020

Mahfel Huq & Co.
Chartered Accountants

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BdREN Trust
Statement of Profit or Loss and other Comprehensive Income
For the year ended 30 June 2020

	Notes	Amount in Taka FY 2019-2020	Amount in Taka FY 2018-2019
Operating Income:	10	109,012,772	91,219,412
Annual Membership fee		1,450,000	2,660,000
Service Revenue		107,562,772	88,559,412
Less: Operating Expenses:	11	303,916,147	136,215,566
Network Operational Expense		34,228,530	18,073,986
Network Maintenance Expense		52,312,333	6,679,000
General & Administrative Expense		30,319,021	14,694,884
Depreciation and Amortization Expense		187,056,263	96,767,696
Profit/(Loss) from Operations		(194,903,375)	(44,996,154)
Add: Non-Operating Income	12	91,013,555	65,083,754
Income from Bank Interest		90,902,038	64,626,809
Discount receipts on payment		16	375
Others receipts		111,501	456,570
		(103,889,820)	20,087,600
Less: Non-Operating Expense	13	446,377	256,657
Financial Expense		436,500	250,000
Bank Charges		9,877	6,657
Profit/(Loss) before Tax		(104,336,197)	19,830,943
Less: Income Tax Expense		1,000,132	2,974,641
Profit/(Loss) after Tax		(105,336,329)	16,856,301

The annexed notes form an integral part of these financial statements

GM (HR, Admin & Finance) Chief Executive Officer Vice-Chairperson Chairperson

Signed in terms of our annexed report of even date.

Place: Dhaka
Date: 21 October 2020

Mahfel Huq & Co.
Chartered Accountants

BdREN Trust
Statement of Changes in Trust Fund
For the year ended 30 June 2020

Amount in Taka

Particulars	Capital Fund	Operational Fund	Donations & Grants	Revaluation Reserve	Accumulated Surplus	Total
Balance as at 01 July 2019	896,700,000	62,211,825	84,252,987	1,388,119,385	108,823,997	2,540,108,194
Add: Addition During the year	-	-		-	(27,264)	(27,264)
Less:Adjustment During the year			(163,541)			(163,541)
Add: Net profit for the year	-	-	-	-	(105,336,329)	(105,336,329)
Add: Accumulated Depreciation				(170,168,258)	170,168,258	-
Balance as at 30 June 2020	**896,700,000**	**62,211,825**	**84,089,446**	**1,217,951,127**	**173,628,662**	**2,434,581,060**
Balance as at 30 June 2019	**896,700,000**	**62,211,825**	**84,252,987**	**1,388,119,385**	**108,823,997**	**2,540,108,194**

The annexed notes form an integral part of these financial statements

GM (HR, Admin & Finance)   Chief Executive Officer   Vice-Chairperson   Chairperson
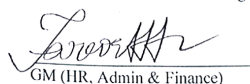
Signed in terms of our annexed report of even date.

BdREN Trust
Statement of Cash Flows
For the year ended 30 June 2020

	Amount in Taka	Amount in Taka
	FY 2019-2020	FY 2018-2019
Cash flow from operating activities		
Net Income	(105,336,329)	16,856,301
Depreciation	177,456,263	96,767,696
Increased Inventories	(8,885)	(8,212)
Decreased Long-term Advance	9,600,000	-
Decreased Advance, Deposite & Pre-payments	13,180,787	17,287,325
Increased Accounts Receivables	(3,633,152)	(29,364,749)
Increased FDR	(125,000,000)	(135,000,000)
Advance Income Tax Paid	(9,280,549)	(7,387,026)
IT Accessories		(27,264)
Increase Accounts Payable	17,315,551	3,244,830
Increase in Audit Fee Payable	57,500	
Decrease Expense Payable	(499,052)	1,291,828
Increase in unearned Revenue	3,767	
Increase VAT Payable	18,931	50,002
Decrease Asi@Connect Project Fund	319,500	(1,056,369)
Increased fDLuDCf Project Fund	1,811,259	498,842
Increase Provision for Income Tax	1,000,132	2,974,641
Decrease Withholoding Tax Payable	(39,781)	55,899
Net cash flow from/(used in) operating activities (A)	**(23,034,058)**	**(33,816,256)**
Cash flow from Investing activities		
Purchase of Non-Current Assets	(25,134,857)	
Net cash flow from/(used in) investing activities (B)	**(25,134,857)**	**-**
Cash flow from financing activities		
Edowment Fund Receipt (Capital Fund)	-	115,000,000
Refund of Donation and Grants	(163,541)	
Payment of Long Term Debt	(56,567,210)	-
Net cash flow from/(used in) financing activities (C)	**(56,730,751)**	**115,000,000**
Net Cash flow from All Activities [A+B+C]	**(104,899,666)**	**81,183,744**
Cash and cash equivalents at the ending of the Previous year	**136,771,579**	**55,587,835**
Analysis of cash and cash equivalents at the ending of the year	**31,871,913**	**136,771,579**

The annexed notes form an integral part of these financial statements

GM (HR, Admin & Finance)	Chief Executive Officer	Vice-Chairperson	Chairperson

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Contributions We Humbly Acknowledge

Sponsoring Trustees:

World Bank Officials:

Yoko Nagashima
Sr. Education Specialist, Co-Task Team Leader

Mokhlesur Rahman
Sr. Operations Officer, Co-Task Team Leader

Shiro Nakata
Education Consultant

Asahabur Rahman
Education Policy and Planning Consultant

Representative, International Partner of BdREN under HEQEP:

Dr. Javed I. Khan
Professor. Kent State University

Ex-BdREN Consultants:

A.K.M. Habibur Rahman
Former CEO, BdREN

Prof. Dr. M. M. A. Hashem
Former TST Consultant, Technical, BdREN

Mohammad Yousuf Niaz
Former TST Consultant, Management, BdREN

Sayedur Rahman
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Prof. Dr. Md. Mamun-Or-Rashid
Former TST Consultant, Technical, BdREN

Prof. Dr. Kazi Muheymin-Us-Sakib
Former TST Consultant, Technical, BdREN

Mohammad Atiqur Rahman
Former Director, Network Operations, BdREN

Md Rezaur Rahman Akand
Former CIO, BdREN

Acronyms & Definitions

BU .... University of Barishal
BUBT .... Bangladesh University of Business and Technology
BUET .... Bangladesh University of Engineering and Technology
BUP .... Bangladesh University of Professionals
BUSCO .... Benchmarking Universal Single Copy Orthologs
BUTEX .... Bangladesh University of Textiles
CAE... Collaboration Asia Europe
CamREN .... Cambodia Research and Education Network
CAT .... Configuration Assistant Tool
CCTV .... Closed-Circuit Television
CE .... Customer Edge
CERNET .... China Education and Research Network
CMC .... Chittagong Medical College, Chittagong
CNT .... Carbon Nanotube
CoU .... Cumilla University
CPU .... Central Processing Unit
CSTNET.. China Science and Technology Network
CTO... Chief Technical Officer
CU.. University of Chittagong
CUCM... Cisco Unified Communications Manager
CUET .... Chittagong University of Engineering and Technology
CVASU.. Chattogram Veterinary and Animal Sciences University
DCC... Distance Collaboration Center
DDC... Dhaka Dental College, Dhaka
DeiC .... Danish e-Infrastructure Cooperation
DESCO.. Dhaka Electric Supply Company Limited
DFT .... Density Functional Theory
DID/DOD .... Direct Inward Dialing/Direct Outward Dialing
DigiNar .... Digital Seminar
DIU.. Daffodil International University
DLC .... Distance Learning Courses
DLT.. Distance Learning Theater
DMC.. Dhaka Medical College
DNS... Domain Name System
DRC... Disaster Recovery Center
DrukREN... Druk Research & Education Network
DU... University of Dhaka
DUET .... Dhaka University of Engineering and Technology
DWDM .... Dense Wavelength Division Multiplexing
EBITDA... Earnings Before Interest, Taxes, Depreciation, and Amortization
eduGAIN.. EDUcation Global Authentication INfrastructure
eduroam .... education roaming
EEE.. Electrical & Electronics Engineering
eFile .... Electronic File
EP.. Explosive Percolation
ErdemNET .... Mongolian Research and Education Network

eTLR .... European Top-Level Radius
EU .... Eastern University
EU .... European Union
EWU.. East West University
F-ticks .... Federated Ticker System
fDLuDCf... facilitating Distance Learning using Digital Conferencing facility
FDR .... Fixed Deposit Receipt
FEM... Finite Element Modeling
FET... Field-Effect Transistor
FIC .... Fix-Inducing Changes
FinFET .... Fin Field-Effect Transistor
FLR... Federation Level RADIUS Server
Gbps .... Gigabits Per Second
GC.. Guanine-Cytosine
GEANT.. GÉANT is the pan-European data network for the research and
education community
GHz .... Gigahertz
GGC... Google Cache Server
GPU... Graphics Processing Unit
HARNET .... Hong Kong Academic and Research NETwork
HEI.. Higher Education Institute
HEQEP.. Higher Education Quality Enhancement Project
HPC... High Performance Computing
HPE .... Hewlett Packard Enterprise
HSTU .... Hajee Mohammad Danesh Science & Technology University
IaaS... Infrastructure as a Service
IAM.. Identity and Access Management
ICDDR'b .... International Centre for Diarrhoeal Disease Research, Bangladesh
ICMAB... The Institute of Cost and Management Accountants of Bangladesh
ICSB .... The Institute of Chartered Secretaries of Bangladesh
IdP... Identity Provider
IDREN .... Indonesia Research and Education network
iFIRE .... Increasing Federated Identity, Roaming and E-infrastructure
IGP .... Interior Gateway Protocol
IIG... International Internet Gateway
IMCH... International Medical College and Hospital
mmREN.. Myanmar Research and Education Network
IPTSP.. IP Telephony Service Provider
IPv4... Internet Protocol version 4
IPv6... Internet Protocol version 6
IRS .... Institutional Radius Server
IRU.. Indefeasible Right of Use
IS-IS.. Intermediate System to Intermediate System
ISP... Internet Service Provider
IU .... Islamic University
IUB... Independent University, Bangladesh

IUBAT .... International University of Business Agriculture and Technology
IUT .... Islamic University of Technology
IXP .... Internet eXchange Point
JKKNIU .... Jatiya Kabi Kazi Nazrul Islam University
JnU .... Jagannath University
JU... Jahangirnagar University
JUST .... Jessore University of Science & Technology
KREONET.. Korea Research Environment Open Network
KU .... Khulna University
KUET .... Khulna University of Engineering &Technology
KVA .... Kilo-Volt-Amperes
KVM... Kernel-based Virtual Machine
KW... Kilo Watt
L2VPN .... Layer 2 Virtual Private Network
LEARN... Lanka Education and Research Network
LERNet.. Laos Education and Research Network
LMS .... Learning Management System
MAFFIN... Ministy of Agriculture, Forestry and Fisheries Reseach Network
MB... Mega Byte
Mbps... Megabits per second
MBSTU.. Mawlana Bhashani Science and Technology University
MCU .... Multipoint Control Unit
MDA .... Mediation-Driven Attachment
MIU .... Manarat International University
ML.. Machine Learning
MMC.. Mymensingh Medical College, Mymensingh
MMR.. MultiMedia Router
MoE .... Ministry of Education
MOSFET.. Metal–Oxide–Semiconductor Field-Effect Transistor
MoU... Memorandum of Understanding
MPLS .... Multiprotocol Label Switching
MRTG... Multi Router Traffic Grapher
MWG.. Medical Working Group
MyREN... Malaysian Research and Education Network
NICT... National Institute of Information and Communications Technology
NII... National Institue of Informatics
NINMAS... National Institute of Nuclear Medicine & Allied Science
NKN... National Knowledge Network
NMS .... Network Management/Monitoring System
NOC.. Network Operation Center
NORDUnet.. Regional Research and Education Networks (RRENs) of the five Nordic countries
NREN... National Research and Education Network
NREN... Nepal Research and Education Network
NRO .... National Roaming Operator
NSTU .... Noakhali Science and Technology University

NSU .... North South University
NU.. National University
On-Prem .... On Premise
OPGW... Optical Ground Wire
OS.. Operating System
PAC .... Precision Air Conditioning
PaaS... Platform as a Service
PCM.. Phase Change Memory
PCRAM... Phase Change Random Access Memory
PE... Provider Edge
PERN .... Pakistan Education and Research Network
PGCB.. Power Grid Company of Bangladesh
PLMN.. Public Land Mobile Network
PoP... Point of Presence
PREGINET.. Philippine Research, Education, and Government Information
Network
PSTN... Public Switched Telephone Network
PSTU... Patuakhali Science and Technology University
PUST... Pabna University of Science and Technology
QTL... Quantitative Trait Loci
R&D... Research and Development
R&E .... Research and Education
RAM .... Random Access Memory
REANNZ .... Research and Education Advanced Network New Zealand
RMC .... Rajshahi Medical College
RPKI .... Resource Public Key Infrastructure
RpMC... Rangpur Medical College
RREN... Regional Research and Education Network
RU .... University of Rajshahi
RUET .... Rajshahi University of Engineering & Technology
SAU .... Sylhet Agricultural University
SBAU... Sher-e-Bangla Agricultural University
SBMC... Sher-e-Bangla Medical College
SDN... Software Defined Networking
SingAREN .... Singapore Advanced Research and Education Network
SLA.. Service Level Agreement
SMS .... Short Message Service
SNP .... Single Nucleotide Polymorphism
SOMC.. Sylhet MAG Osmani Medical College
SP.. Service Provider
SSHMC... Shaheed Suhrawardy Medical College
SSKMC... Sheikh Sayera Khatun Medical College
SSMC... Sir Salimullah Medical College
SSO .... Single Sign On
SurfNet.. National Research and Education Network (NREN) of the
Netherlands

SUST .... Shahjalal University of Science and Technology
TB .... Terabyte
TCAD .... Technology Computer-Aided Design
TDM .... Time-Division Multiplexing
TEIN*CC .... Trans-Eurasia Information Network-star Corporation Center
ThaiREN .... Thailand Resaerch and Education Network
TIGERfed .... Trust, Identity and Group management for Education and
Research Federation
TLR .... Top Level Radius
TST .... Technical Support Team
TTT .... Train The Trainer
UGC .... University Grants Commission of Bangladesh
UPS .... Uninterruptible Power Supply
VAT .... Value Added Tax
VC .... Vice Chancellor
VinaREN .... Vietnam Research and Education Network
VM .... Virtual Machine
VPN .... Virtual Private Network
VRF .... Virtual Routing and Forwarding
vSession .... Virtual Session
VU .... Varendra University
WAN .... Wide Area Network
WebRTC .... Web Real-Time Communication
Wi-Fi .... Wireless Fidelity

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