Worldwide Emergence of Research and Education Networks and a Proposal for Bangladesh

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"The beginning is the most important part of the work"
-Plato

1   Introduction

A high performance national network connecting universities- popularly known as **Research and Education Network** (REN) is increasingly viewed as the vital and core components for higher education institutions worldwide. Internet used to be an auxiliary service for universities in the 1990's. In 2000's it became an essential limb, and in 2005 it is becoming the 'central artery' in the running of modern universities and research organizations. Almost all the countries in the world have moved forward and adopted REN as the centerpiece of their information and communication technology (ICT) plan for higher education. Now about 92 countries around the world have REN-- 25+ more are building [8,16]. The concept is marching further forward. Countries worldwide are now forming mega REN alliances of continental proportion with a vision of creating a world community of universities- a grand kiosk of higher education and scholarship. Bangladesh seems to be one of the few remaining exceptions. Even among its neighbors- the universities of India, Sri-Lanka, Pakistan and Myanmar are running their RENs since quite a few years and Bangladesh seems to rank with Bhutan, Nepal and Maldives.

A REN itself does not solve all the problems but it enables the entire research and education establishment of all disciplines of a country to come to an even point in technological readiness from where it can take full advantage of ICT and exchange learning and problem solving resources and knowledge and participate in national problem solving [4,5,16]. A REN is also the showcase of ICT capability of a country- a place for to demonstrate capabilities of the research universities. Engineers, national experts and researchers of a country who cannot manage the ICT problem of their own institutions, it is questionable if they can solve it for the country.

RENs such as Internet2 are also used as a laboratory for developing future technology. Right at this moment there are applications being experimented on many RENs which sounded like science fiction just a few years back such as virtual laboratory, telepresence, remote instrumentation. These innovations will radically change the educational use landscape of the Internet. The entire student group and higher education community from countries without any REN risk being left out.

RENs are particularly empowering for the universities of the developing world. The self-managed non-profit REN models have been proved to be very effective in providing very fast as well as advanced digital communication services at substantially lower cost required by the higher education and research communities worldwide. In Bangladesh several attempts have been taken before with partial success. However, there is a new momentum now. In November 2005, an international consortium has finished the installation of half a billion dollars South East Asia-Middle East-Western Europe (SEA-ME-WE4) undersea cable. The country is finally ready to see the benefit of digital communication. With proper planning Bangladesh can build a state-of-the-art service centric REN system at par with some of the best ones.

REN can provide the latest and fastest communication services and comprehensive access to state-of-the-art applications and resources available digitally within and outside of the country required for highest quality learning and research to all the student, faculty, staff and researchers. This is one strategic investment opportunity for the higher education sector which can not only arrest the current alarmingly downward trend- but also dramatically change the higher education scenario of Bangladesh. Bangladesh faces a formidable task of expanding 3-4 times its higher education capacity in short few years to meet the impending wave of students coming out from the primary education sector which has seen its growth over last decade. It would be impossible to face this challenge without a solid ICT infrastructure in place now. A plan for a REN in Bangladesh should

> **"Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world."**
> **Albert Einstein**

be enacted by a committee of interested faculty, new generation research students, and technical person in these institutions under the leadership of UGC. Hereafter this initiative is referred as **Bangladesh Research an Education Network** (BREN).

Table-1 Worldwide REN [8]		
Region	**Installed**	**In Progress**
Africa	5	17
Asia	35	3
Australia	1	1
Europe	34	
North America	6	
South and Central America	11	7
Total	**92**	**28**

Table-2 REN & HEI in South Asia [6,8]			
Country	**HEI**	**REN**	**DLC**
India	320 (university only)	ERNET	YES
Pakistan	110	PERN	YES
Bangladesh	104		
Myanmar	50	E-EDUCATION WAN	
Sri Lanka	27	LEARN	YES
Afganistan	18		
Nepal	5		
Bhutan	1		
Maldives	0		

This concept paper presents an outline of a probable network. It is not intended to present detail design but rather outlays the major design issues. It draws upon an in-site situation survey on the state of higher education networks conducted in late 2005.

Section 2 first provides a brief overview of modern REN and international perspectives and trends. In Section 3 and 4 it presents a stock check on the networking and ICT situation of Bangladesh and particularly her universities and states the implication of BREN for Bangladesh. Then in section 5 outlines (1) an action plan for the initiative and (1) management and organization model (2) the network model and (3) various services those should be considered for a state-of-the-art BREN. Section 6 then provides specific discussion on some key design issues.

It seems one of the key service is going to be the digital library access. A sister concept report on the **Digital Library Consortium** (DLC) effort is also presented that can be considered as the capstone service project for BREN [8].

> "The secret of getting ahead is getting started. The secret of getting started is breaking your complex overwhelming tasks into small manageable tasks, and then starting on the first one."
> **Mark Twain**

2   Overview of a Modern REN

2.1   Organization and Assets

A REN is a high performance network created and run for the and by the research institutions, public and private universities, and the institutions dominantly engaged in higher education and research activities within a country. A REN generally administers a high performance national backbone network interconnecting all member campuses to provide state-of-the-art high performance/broadband access. A REN like an ISP maintains own routers, switches, various network management devices. It rents links from telecom operators or establishes its own links to create this network. Advanced western RENs (such Internet2's LambdaRail) have also started acquiring their own dark fibers [1]. The business model of commercial ISPs and does not satisfy the advanced need of higher education and research. REN also connects data centers, supercomputing centers, advanced graphics and visualization centers, etc. An advanced network multiplies the user base of specialized resources manifold thus makes highly sophisticated resources more affordable.

2.2   Services

The core importance of REN is that this infrastructure- once in place now enables universities to take full benefit of ICT- a whole new range of services and applications can be instituted. With maturation, RENs are now rapidly expanding beyond the network and are establishing enterprise applications and services that benefit its members with enormous cost saving from a federated approach. Major services can range from universal enterprise email to digital library, multimedia communication, courseware and content management, scholarly publishing, computerized university, to Grid supercomputing. REN enables new models of learning. It also improves traditional learning. It also provides the scientists and engineers an unhindered test-bed to develop new network technology, services and application with experimentation, which is not possible in traditional ISP internet.

2.3   Partnership and Funding

World wide RENs have been organized as a non-profit consortium. In most of the countries both private and public universities have joined together in their RENs except few such as in Pakistan where private universities are yet to join. Few such as Vietnam also include secondary education institutions. Most countries have also included their research organizations. In almost all cases the primary initiative and funding for REN has been initiated by governments such as through their national science foundation, (USA, China), education and technology ministry (Myanmar, Vietnam), or university grants commission (Pakistan, India, Sri Lanka) [2]. In the developing world, the initial capital has often been handsomely leveraged by international donors (India). REN through its non-profit nature generally ensures Internet access and digital services at lesser cost at better quality for its member organizations. In most countries it has been proven instantly cost saving and mostly self-supporting.

3   Benefits of REN for Bangladesh

A REN will provide a unique opportunity to the institutions oh higher education in Bangladesh to close the gap with peer institutions in rest of the world. Indeed, without any legacy problem, Bangladesh can adopt the best set of services and rapidly bring its institutions at par with their peers at the developed world.

Research and higher education communities are grossly disconnected from rest of the world. Their colleagues worldwide are using electronic communication- which ranges from all pervasive email to global electronic conferencing. Alarmingly, in Bangladesh- even in BUET- 90% students (undergraduate students and staff) don't have institutional email! This gap has to be mended to keep the science and technological pursuit live.

Libraries are in a very poor and neglected shape. Books are old. Whatever poor print journal subscriptions are there also falling rapidly. Digital library consortium can work miracle to revitalize libraries- not only in terms of traditional print- but also by offering new format digital media.

Resources (laboratory, specialized equipment, supercomputer etc.) to conduct higher education and research are becoming out of reach for public universities. An advanced network can multiply the user base of current and future specialized resources manifold. Thus, it can make highly sophisticated resources more affordable.

There is already massive pool of valuable world class resources available freely to the non-profit world of REN. An example would be the New England Journal of Medicine which is free to third world. A REN is the gateway to this rich and vast pool of free resources.

The research organizations and universities themselves possess valuable resources and user bases which are complimentary. There is opportunity to use local resources to solve local problem by bringing them closer to local researchers. Some of these are also research treasure to the world community. An example is the folk song collection of Bangla Academy.

Without the electronic presence the work and contribution of country's researchers will remain obscure. Developing countries may loose squarely rights on its intellectual resources. REN can arrest this loss.

The case of Bangladesh has few specific advantages. The institutions are in a small geographical locality with exceptionally dense user concentration. Thus infrastructure cost per capita will be much smaller compared to other countries. There is quite positive collaboration atmosphere between private and public universities. Most organizations are new. These organizations are in the similar state in terms of access to ICT and their nature of need is almost identical. This is the best time to launch a federated approach to modernize their ICT infrastructure.

4   Background Assessment

4.1   National Policy Environment in Bangladesh

Though, ICT has been identified as an important component of various national development objectives, however, various policy documents demonstrate unawareness about the worldwide trends of REN [9, 10, 11]. There also seems to be gap in the articulation of specific coherent

strategy. Still there are statements that can help the cause of REN. One particular interesting statement in National Telecommunication Policy [9] states (section 5.1): *"The requirement to carry out R&D will be a part of the conditions under which licenses are issued and at least 1% of the annual expenditure should be allocated for the purpose"*. This massive untapped fund can be justifiably used to support the ICT need of higher education sector. The public universities and research institutions are currently the main R&D facilities of the country. Even a fraction of this expenditure can satisfy backbone and access needs of the REN.

4.2   Education Network Initiatives

There were two past efforts to form multi-institutional education/research network. Back in 1997 UGC initiated the Bangladesh Education and Research Network (BERNET). In 1998 BANSLINK initiative tried to connect research libraries. Unfortunately, both failed. A 2005 survey reveals only 38 of the 52 private and 9 out of the 21 public universities- roughly half of the universities, have internet connectivity [12]. For three years UGC has a plan in table to provide internet access to the 21 public universities via ISPs.

4.3   Potential Members: Higher Education Institutions (HEI)

A total of about 104 institutions represent the conventional higher education institution (HEI) in Bangladesh. These include 54 private universities, 19 public universities, and 31 specialized collages. There are also about 1500 colleges organized under the umbrella of National University (NU), an Open University (OU), and a parallel religious high-ed education system. Table-3 provides a snapshot of these institutions. Eighty percent of the 104 institutions are fairly young-born after 1990. These 104 institutions and the main and regional campuses of OU and NU should also be in the initial phase of BREN.

Table-3 Various Types of HEIs in Bangladesh [7,17]		
Types	**Institutions**	**Students**
Public Universities [1]	19	112,327
Private & International Universities [1]	54	46,080
Public Medical & Dental Colleges [2]	14	
Private Medical & Dental Colleges	17	
Total Conventional R&D Universities	**104**	**158407**
National University Public & Private Colleges [1]	1596	416,646
Other Collages Affiliated with Public Universities [1]	1548	
Kamil Maddrassas [2]	147	92,000
Open University (National, Regional & Local Centers) [2]	1013	437,489
Planned Public Universities [1]	9	
Total	**4417**	**1104542**

4.4   Potential Members: Advanced Research Institutions (ARI)

Besides the universities, Bangladesh also has 55-60 institutions engaged in various research activities. There are about 10-15 research grade libraries, museums, and academies which can be potentially major contributor of digital information invaluable for the higher education and research community in Bangladesh. Bangla Academy has one of the largest folklore archive which it has collected over few decades. Another institute has digitalized geographical and topographic

map of the Bangladesh which is potentially useful in advanced research- ranging from disease control to crop planning. Table-4 provides a snapshot of these institutions. These institutions should be invited to join BREN.

Table-4 Advanced Research Institutions (ARI)	
Type of R&D Institutions	**Number**
Research Institute/Center-Agriculture	15
Research Institute/Center-Biology	7
Research Institute/Center-Energy	5
Research Institute/Center-Engineering	14
Research Institute/Center-Medical	15
Research Institute/Center-Weather	2
Research Academy	3
ARI Admintrative Centers	10
Collections-Major Library (Non-University)	7
Collections-Museum	8
Other Institutes & Centers	6
Total	**92**

4.5   Network/ Fiber Assets of Bangladesh

Currently, there are three public companies which have fiber optic networks. **Bangladesh National Railway-** a nationally owned company is the first to install fiber in Bangladesh. It has approximately 1,800-km STM-4 (622 Mbps) optical fiber along that touches over 300 of the 454 rail stations reaching most corners of the country. Only 25-40% of this capacity is currently being used via a long term lease agreement with a teleco called Grameen Phone [13]. A fraction of this unused capacity- if allocated to education sector can dramatically change the education networking scenario of Bangladesh. **Bangladesh Telephone and Telegraph Board** (BTTB), the government owned telecom has 1365 km of Optical Fiber. BTTB is also set to work as a national ISP running 9 Internet PoPs. BTTP offers Internet connection to all 64 districts of the country and 164 Upazillas. It offers leased DSL services called DDN in 13 district towns, with 22 PoPs on standard copper. In Dhaka, BTTB is building an all fiber ring [14]. A third nationwide 1200 km fiber system touching all the existing power stations and grid sub-stations is now being installed by the **Power Grid Company of Bangladesh** (PGCB). PGCB expects only to utilize 5-10% of this capacity for its internal use (energy management, data-transmission, supervisory control and monitoring systems). The rest (more than 90%) will be available for reselling [15]. A part of its excess unused capacity of this public asset can also be used by the education sector.

Table-5 Projected Usage of Cable Bandwidth [3]		
Applications	**Existing Use 2005**	**Projected Use 2010**
Internet Bandwidth	50 Mbps	500 Mbps
Voice Circuits	150 Mbps	1 Gbps
Multi Media		200 Mbps
Other New Application		100 Mbps
Call Center Type		100 Mbps
Total		**2 Gbps**
BREN (25% of unused capacity)		622 Mbps

4.6 International Connection

At the moment the entire data communication with outside world is based on long delay satellites operated by ASIASAT and INTELSAT. All peering for data networking is done at Hong Kong or Singapore by 34 VSAT operators. BTTB has 4 more ground stations. It is believed that total outgoing Internet capacity is only 50 Mbps (Khandkar & Niaz, 2004)! However, the situation changes with the debut of the country's first International submarine cable SEA-ME-WE4. It has landed in November of 2005. Its Cox's Bazar-Chittagong link that connects it to Dhaka (Moghbazar Exchange) is still under construction. SEA-ME-WE4 has 16 international landings (Table-8). BTTB owns its 10 Gbps capacity (7.04%). Table-5 provides a BTTB projection of its future usage. It seems that until 2010 only 20% of its capacity will be used. BREN can easily request 155 Mbps- 622 Mbps from this cable system [3].

5 A Road Map for BREN

5.1 Part-1: Initiative and Action Plan

In Bangladesh UGC is the most appropriate body to convene the REN initiative. Already UGC is incurring unnecessary duplicate cost[1] in personnel, library and internet connectivity. Naturally UGC will be the largest benefactor. Besides, almost all the private universities surveyed are interested to join such as initiative under UGC even on cash cost sharing basis. UGC may seek partnership from the Ministry of Science and Technology and Education, as well as national industries.

A **high performance national research and education network** (REN) should be included as a key strategic element for the Higher Education and ICT plans. A study of all comparable as well as neighboring countries will show this is indeed the case.

UGC should take the lead and convene and organize a **non-profit consortium for BREN** by inviting all the universities and research institutions of Bangladesh. A proposal should be prepared and submitted to government and International organizations for capital funding.

UGC and the higher education community should work together to ensure a national commitment to higher education and may ask for the following:

1-5% of public licensed telecommunication capacity available for non-profit educational use (including higher, primary, and maddrassa education). National Telecommunication Policy already calls for 1% R&D investment. But it is yet to be enacted.

Additionally, when there is any long term unused capacity (such as for a period of 3 years), about 25% of it should be made available for use by the non-profit education sector on time limited (such as for 2 years) basis.

Non-profit education network should get tax-free and priority access to required communication assets (such as radio frequency, fiber networks, roof-top-tower in government owned buildings) required to build it.

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1 For example BUET has a VSAT which can be easily shared by Dhaka University of Dhaka Medical College, or DUs connection can be shared by BUET. But, both are remaining single homed and facing outages.

Additionally, government may establish an education superfund to tap the 1% R&D commitment from all national license income.

Next three sub-sections sections presents probable (a) management structure, (b) network model, and (c) service models for a modern BREN in line with international trend.

5.2   Part-2: Governance and Organization

BREN should be organized in such a way that it remains vibrant and be able to avoid the fate of earlier local initiatives. This is probably achievable if it follows the open, inviting, and community participation based organizational model adopted by RENs in many other countries. Below are some recommendations

REN should be organized as a <u>non-profit consortium</u> of institutions engaged in research and higher education in any discipline of knowledge in Bangladesh.

The initial **membership** can be comprised of all public and private universities, willing research organizations, and UGC and perhaps can be called the "founding hundred". Its governance should be decided by a board of trustee appointed by the Chief Executive Officers of the institutions.

The body should be able to add additional classes of non-voting membership such as **affiliate membership** and **industrial** and **international partnership**.

Its technical direction should come from open, inviting, and community based **technical committees** crated by the members and comprised of interested individuals, faculty, practitioners, and scholars from the participating organizations and outside.

Its main operation may be run by establishing one **Network Operation Center** (NOC) and a set of **National Service Centers** (NSC). The NOC will be in charge of running the core network asset. The NSCs should provision enterprise services over REN such as Digital Library, Content Hosting, Electronic Mail, Directory and Information services etc, as decided by the need of time and evolution of technology.

When there is a choice- the policy of the REN should be to remain maximally inclusive, favor universal access and encourage sharing and cooperation between members. For example, any communication asset provided to the member institution by the consortium (such as VSAT) should be given in a way that it encourages sharing and access facilitation to other members- rather than monopoly use by one.

5.3   Part-3: Network Infrastructure

UGC should convene a BREN Networking Task Force involving the ICT staff, networking and IT faculty, and researchers of the member institutions. Every member university may consider contributing several professional network engineer and faulty not less than one. The body should meet regularly and frequently.

The body should design and execute the creation of BREN with its national backbone, access network and international linkage with state-of-the-art high performance broadband access to all member campus buildings, dormitories, research installations and offices.

It may use 1-5% of fixed capacity and/or time limited 25% of unused/unscheduled capacity of the publicly owner or government funded, licensed telecommunication fibers/resources, and allocated education frequency bands as suggested in the management and funding section.

It should also setup required DNS, firewall, authentication, caching, monitoring, routing, and any other infrastructure to ensure seamless operation of the network and its services.

It should take initiative to peer with regional and international RENs and networks worldwide (such as APAN, Internet2, GEANT) via establishing international connections using national fibers, satellites, etc and signing appropriate traffic exchange contracts.

BREN should ensure ultimate end-user access by setting up user facilities such as cyber cafes, high speed wi-fi campus wireless, mobile units so that students, faculty, and researchers can have access to advanced Internet from anywhere in Bangladesh, etc.

BREN should establish collaboration class-room/video conference wing in institutions in all corners of the country, so that all institutions can access (either on premise or in a fellow member institution within few km) them and conveniently participate in remote conferencing as needed.

It will also facilitate Data Centers, Supercomputing Centers, Advanced Graphics and Visualization Centers, Environmental Computing Centers (flood modeling, weather prediction, crop cycle modeling etc.), National Computing Grid, etc. and ensure high performance connectivity of these specialized resources via the network, and leverage their access.

BREN should pursue some advanced network technology and capability goals. The backbone and access network should be IPV6 capable so that campuses can grow IPV6 networks to assuage the severe IP address shortage of Bangladesh. There can be similar system wide support for integrated voice, video and data, multicast and VOIP capability.

5.4   Part-4: ICT Services & Applications

A network is an infrastructure not visible to the end-user. To make this infrastructure useful to its user communities a REN initiative must be augmented with enterprise applications and services. RENs in the developing countries are to be more aggressive in establishing these services since individual institutions there don't have them. Ultimately, the services bring the benefit home to the end-user. The REN service is a fast growing area. It is important to be visionary. Setup enterprise systems that can serve thousands from one place- thus can provide economy as well as best service quality. Below are few recommendations, but it should continually look for expanding and improving its service capabilities with time.

Digital Library Consortium (DLC): Create a digital library consortium with twofold goal. It should ensure ubiquitous access to all remote digital library contents. It should negotiate best possible rates from providers. Its second goal will be to host and serve local content. It should facilitate electronic journal hosting, cataloguing, archiving, and dissemination services for all forms of educational contents originated, created and owned by its member communities.

Higher Education Information Service (HEIS): The service should electronically collect and distribute (make available online) comprehensive, authenticated and up-to-date information about the member organizations. It should help resource sharing, ensure exemplary transparency in higher education, and facilitate informed choice- and thus improve quality.

User Communication Services (UCS): Provide all major forms of digital communication services used in educational and research collaboration including email, groups, content hosting, conference management, voice/video conferencing. Make them available to all members and research groups and communities. Think about providing visionary services such as perpetual email forwarding, and a small but perpetual web space for all, video conferencing rooms all over the country. Advanced applications such as virtual conferencing, 3D tele-presence, distributed musical and theatrical production, will also be available soon.

University and Organizational Services (UOS): Provide enterprise services to member institutions such as course management, certificate servers, business data exchange, paperless process management, data warehousing, business-printing, etc.

Science Resource Services (SRS): Many universities are developing virtual laboratories, remote instrumentations, grid computers etc. There are ongoing projects to provide synthetic environment to learn and experiment with concepts in chemistry, physics, biology and math, virtual tools for practicing human surgery. Several institutions have developed Internet enabled labs which allow remote experimentation with highly specialized real scientific instruments such as electron microscope, forest animal lab, astronomical telescopes, coordinated sensor operation in multiple locations, remote operation of undersea autonomous vehicle, etc. Countries world wide are also building computing Grids base on REN to provide low cost supercomputing access to their scientists by pooling together underused ordinary computers CPU cycles.

New Mode Learning: There are also new age systems for new format education where combination of online, and offline technology is used to deliver education.

6   Few Design Considerations

A REN like most large and complex networks will have two major components (a) backbone network and (b) access network. The backbone is the highway system. Individual institutions connect to this backbone by a series of access links. A REN also will have International access that would connect it to other RENs and networks such as the Internet.

BREN- like other RENs should obtain the point-to-point links from the telecom operators or from radio link providers directly. The REN engineers should maintain the routers and switching equipments to control and maintain the packet routing satisfying the requirements of the member organizations –without having to go through the ISPs. Below we provide discussion on few design aspects of BREN.

6.1   Required Design Capacity/ Bandwidth

Currently, the institutions with internet access have 64-512 Kbps links. In most- particularly in public universities only faculty not the undergraduate students or staff[2] has access. BREN must take a policy of universal access- full service Internet for all in HEI. The students are after all the main customer of the higher education. Thus the each institution will require at least 2-10 Mbps. Technically it means national backbone and the international link should be 155-622 Mbps. The new advanced voice/video/science data applications and the expected rapid capacity growth in

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[2] If 90% of the students are without any institutional email service, the claim of having any form of Internet service in a university is a stretch.

higher education are expected to saturate this **155 Mbps-155 Mbps-10 Mbps** architecture within a rough span of 2-4 years. There should be a five year target to reach 622 Mbps- 1Gbps-10/100Mbps architecture.

6.2   Backbone

The 100–155 Mbps backbone network can be built using the grossly unused capacity of the three government owned fiber assets. While, several network topologies can be adopted, a design with one national ring (NR) and one metropolitan grid (MG) at Dhaka with 12-16 PoPs arranged in a mesh can provide almost blanket coverage to each to the listed educational and research institutions of the country. A Network Operation Center (NOC) can be operated at Agargaon (such as in UGC compound).

6.3   Access Network

The realistic choices for access links in Bangladesh are leased DSL (BTTB's DDN package) and VSAT or customer installed radio links (in free band of 2.4 Hz, 5.8 GHz), copper or fiber, free space optics, and WLL (IEEE-802.16). VSAT can reach otherwise difficult places but is the most expensive to operate. Fiber is expensive to install but the cheapest afterward. Wireless links can be deployed very fast and cheap in free bands. One can use radio link such as VINE or MCDSS which operates at 2.4 GHz free-band, offering bandwidth up to 11 Mbps for a distance up to 60-75 km. Larger capacity is available for shorter distances. A possible action plan for access networking might be to obtain 100 radio equipment sets to connect the first 100 sites in one or two capacity/distance category. Radio deployment is generally fast and easy. In this way, first 100 institutions can be brought under a network perhaps just in few months. Larger institutions ought to be eventually linked via fiber. Their radios can be re-deployed to other/newer institutions. Institutions will see overnight saving as they will receive 5-4 times more bandwidth at higher quality than what they are currently receiving from commercial ISPs.

6.4   Campus Area Network (CAN)

Most universities should be able to build a 10/100/GigE campus networks on their own. UGC may want to fund public universities. BREN should provide CAN guidelines and specifications. Services provided by the BREN ought to reach all. There should be strong universal access goals and commitments. Campus networks must connect all the academic and administrative buildings, student dormitories and faculty housing not only the formers. BREN should set goals such as: (i) all campuses must have 10/100/GigE network and WLAN access (ii) Cyber Café for each 5000 students, (iii) connectivity to the libraries, (iv) at least 25% campus wi-fi coverage, etc. BREN should arrange training for university engineers and keep one network support and design team to help smaller institutions design their CANs.

6.5   International Connection

The submarine cable is the most cost effective and logical choice for the primary international linking. BTTB estimates that only 20% of the capacity of SE-ME-WE4 cable will be used until 2010. BREN, as a non-profit consortium of higher education institutions can ask for government approval to obtain about 622 Mbps- 5% from the unused capacity of this nationally owned cable system free or at cost. This 622 Mbps fiber link will reach Magh Bazar from major exchange points at Singapore and France.

6.6 Peering with other RENs

BREN can peer with a major ISPs through Singapore or France. REN should form peering with other RENs on the basis of exchange of non-profit REN traffic. Table-1 column-2 shows the operational RENs in the landing countries. Bangladesh can follow a several confederations simultaneously a) a **Western Federated REN** Connectivity with in JAPAN, US and EU (via peering with Singapore, France, Italy). b) **South Asian Federated REN** Connectivity with India, Pakistan, and Sri-Lanka, and (c) **Pan-Asian Federated REN** connectivity with Malaysia, Singapore, and Thailand and rest of Asia via APAN, and a (d) **Pan–Islamic Federated REN** connectivity with Malaysia, Pakistan, India, UAE, Egypt, Saudi Arabia, Algeria & Tunisia etc. Each of the regional RENs has unique social and cultural resources into which the academic community of Bangladesh can gain as well as contribute.

Table-6 Possible Peering RENs [3]			
Landing	**Country**	**REN**	**Regional REN**
1	Singapore	SINGAREN	APAN
2	Malaysia	MYREN	
3	Thailand	ThaiSARN	APAN, TAIN2
4	Bangladesh		
5	India (Bharati)	ERNET	
6	Sri Lanka	LEARN	
7	India (VSNL)	ERNET	
8	UAE		
9	Pakistan	PERN	
10	Saudi Arabia		
11	Egypt	EUN	EDMEDCONNECT
12	Italy	GARR	
13	Tunisia		
14	Algeria		EUMEDCONNECT
15	France (FTelcom)	RENATER	GEANT
16	France (MCIF)	RENATER	

7 Acknowledgements

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