



SERENE

South-South Exchange of Research and Education Network Experience
- Models of how to build and manage a National Research & Education Network (NREN)

Final report
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Spread the Word

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Background and summary

Given the global and collaborative nature of contemporary research and the digitization of knowledge resources, access to Internet and to research networks has become a pre-requisite for the provision of quality Higher Education in a country. Yet in some South Asian countries access to Internet is poor and still very expensive, leading to academic isolation, exclusion from global research and low quality of teaching. Connectivity is improving with the growing availability of submarine cables, and in-country deployment of fiber networks. The European Commission (EC) and the US National Science Foundation (NSF) are offering to link South Asian countries' National Research and Education Networks (NRENs) to GÉANT and Internet2. Afghanistan, Bangladesh, Bhutan and Nepal, which are lagging in this regard, requested advice from the World Bank on how they should go about building a network in their respective countries, learning from others in the region on models that are relevant to their situation.

Through meetings sponsored by the EC within the TEIN program (Trans Eurasia Information Network) and through participation in virtual dialogues in the Global Development Learning Network (GDLN), the ministries of education in the four countries had become aware of the experience of Pakistan, Vietnam, Thailand, and Sri Lanka in the establishment and management of their respective NRENs. Each of these countries offered different experiences and strategies in addressing the issue of connectivity for their universities and research centers, in both governance/management areas and technical aspects. Specifically, it was believed that they could share their experiences on: 1) How to devise an ownership, governance, and management structure for the NREN. 2) How to establish a sustainable financing scheme of government/user contributions. 3) How to negotiate for bandwidth purchase and how to apply known creative low-cost solutions for acquiring capacity. 4) How to design a manageable network infrastructure and its interface with campus networks. 5) How to create and maintain user groups and client support services.

The SERENE program, coined as an acronym for South-South Exchange of Research and Education Network Experience, was a series of activities that applied what is called the "blended learning" approach, using a combined variety of tools such as web based discussions, live multisite videoconferences, and in person study visits and workshops, as a program of the Global Development Learning Network (GDLN - www.gdln.org)

Those invited to participate in the program were senior policy makers and network professionals in Ministries of Education, Science and Technology, and Communications, in Higher Education Authorities, Universities, and Telecommunications Companies of the respective countries.

The objectives of the program were to assist the participants in producing country policy plans for building research networks in their own countries and to encourage the establishment of a regional association of South Asian NRENs.

The eventual outcomes of the program were, on the one hand, a conviction by the participating policy makers that an NREN was essential for the development of their higher education systems, and on the other, a series of policy notes to their respective governments on how to go about establishing and managing such a network. The SERENE website hosted and maintained by Lanka Education and Research Network (LEARN) in Sri Lanka remains as a permanent resource for continuing the dialogue and for other countries to learn from.

Activities in the project

The project was named SERENE, the acronym for South-South Exchange of Research and Education Network Experience. The activities were designed as a blended learning program of the Global Development Learning Network (GDLN) and consisted of the following inter-related activities:

- 1) **A virtual Community of Practice** - a web based discussion forum on the range of topics in NREN management. This forum has a repository of documents and reference materials on the topics and is hosted on an ongoing basis by the LEARN network of Sri Lanka. See: <http://serene.learn.ac.lk>
- 2) **Monthly videoconferences** on the themes, with expertise drawn from the NRENs of VinaREN (Vietnam), LEARN (Sri Lanka), PERN (Pakistan), HEAnet (Ireland), GEANT (EU), and Internet2 (US). Experts from the global REN community participated from Australia, Ireland, UK, and the US. Six multipoint videoconferences were held between October '09 and January '10 in preparation for the country visits and workshops and a final videoconference was held in July '10 in order for the beneficiary countries to report on their suggestions for their own country NRENs. Their suggestions were presented as their local solutions based on what was learned during the previous videoconferences and study visits. The presentations and video files of the videoconferences are accessible on the SERENE website.
- 3). **Visits** of key high level ministry and university personnel from Afghanistan, Nepal, Bhutan and Bangladesh to the NRENs and their member institutions of Pakistan, Vietnam, Thailand and Sri Lanka.
- 4). **Policy Workshop** on “ Research and Education Networks; Governance, Management and Operation” at the end of the study visits in Colombo, Sri Lanka, January 2010. The main result from these visits and policy workshop was a general commitment by the ministry participants to pursue the establishment of an NREN for their respective countries. See participant list in Annex.
- 5). **Technical Knowledge Exchange Meetings/Workshops** on “The Experience of the Higher Education Commission (HEC) of Pakistan in establishing and operating the Pakistan Education and Research Network (PERN)” in Islamabad, Pakistan, July 2010. This meeting was aimed at the technical managers who would be involved in any future NREN in each beneficiary country, with the objective of applying what they learned from the experience of PERN to their own situations. See participant list in annex.



The GDLN blended learning approach: An integrated mix of Web, Videoconferencing and Face-to-Face

Program content

1. SERENE web discussion forum and Community of Practice (CoP)

The SERENE website and discussion forum was set up and maintained by Nimal Ratnayake and hosted on the LEARN server. Please see <http://serene.learn.ac.lk> for the details. The site will continue to be hosted by LEARN after the project finishes on July 29th 2010 and maintained and updated as a Community of Practice (CoP) for emerging NRENs globally.

2. Videoconference series, topics and speakers:

VC 1. Introduction and what is an NREN? Michael Foley, with George McLaughlin and Nimal Ratnayake.

Michael started the session by introducing the whole SERENE program to participants in Afghanistan, Nepal, Bangladesh, Bhutan, Sri Lanka, Ireland, Pakistan, Cambridge UK, Internet2 in Michigan, USA, Canberra, Australia, Kent State University, USA and Indiana University USA. Then, with inputs from George and Nimal, Michael gave an overview of the nature of NRENs, what they are used for, their benefits and how they are owned and managed in different countries. Slides and video of presentation available at: <http://serene.learn.ac.lk/events/vc1>

VC 2. The Case of VinaREN; Dr. Ta Ba Hung, Director NACESTI and VinaREN, Hanoi.

Dr. Hung gave an overview of VinaREN and its governance structure, how it got started, how they went about making it valuable, its financial operations and sustainability, and its relationship with ISPs/Telcos. He finished with lessons to be learned from the experience of VinaREN and took questions from the participants. Video and pdf available at: <http://serene.learn.ac.lk/events/vc2>

VC 3. Costing an NREN: Prof Javed Khan, Kent State University, Dr. Jim Williams, Indiana University.

Javed gave an account of how he had calculated the costing for an NREN in Bangladesh, taking into account the number and location of universities in the country, their student and faculty populations, the state of campus networks, the availability and cost of fiber optic networks within the country, the openness of the fiber provider/s to doing deals for long-term lease or purchase of fiber, and some idea of ownership and governance structure of the entity that would be the NREN and the range of services it would provide. Slides from the presentation available at: <http://serene.learn.ac.lk/events/vc3>

VC 4. The Case of PERN: Dr. Anwar Amjad, Director PERN, HEC Islamabad

Anwar introduced the Higher Education Commission of Pakistan and its mission and described the beginnings of its NREN, the Pakistan Education and Research Network (PERN), and how it grew into a high speed network with the roll-out of PERN2. He described the range of services offered to its 70 university members, and its international links to the US Asia and Europe. He finished with an explanation of PERN's financial planning and billing strategy. Slide presentation available at: <http://serene.learn.ac.lk/events/vc4>

VC 5. Using International Bandwidth Efficiently: Prof. Javed Khan , Kent State University and Mr. George McLaughlin, Vice-chairman, Asia Pacific Advanced Network (APAN).

For many emerging economies, international bandwidth is expensive. There are a number of approaches that can be used to minimize the same data being requested multiple times across international links, and consequently make more efficient use of the expensive international bandwidth. These techniques rely on updated information from international sources being transferred during times when there is low-use of international links and storing the information obtained in local repositories. The data can then be accessed from the local repository efficiently and at full performance by users connected to the NREN.

Where an NREN allows access to the commodity Internet, it is also important to ensure it is connected to an open-access in-country exchange point. This ensures that traffic between the NREN users and other in-country users or data sources occurs without the data transiting international links to an overseas exchange point. Slides available at: <http://serene.learn.ac.lk/events/vc5>

VC 6. The Case of HEAnet (Ireland): Mr. Mike Norris, Chief Technical Officer, HEAnet, Dublin.

This presentation was in response to demand from some SERENE participants that they hear from an EU NREN. Mike Norris and Daniel Lete of HEAnet, Ireland, described the history and gradual growth of HEAnet, the rationale for its policies, services and strategy, and some lessons learned along the way (some about what does not work). HEA is the acronym for Higher Education Authority, the funding and governance body of Ireland's higher education system. Javed Khan of Kent State University also gave a short report of his visit to Dublin and HEAnet in December and the lessons he considers that it can give for NRENs in South Asia. Slides available here: <http://serene.learn.ac.lk/events/vc6>

VC 7. Final closing session July 20, 2010. Reports from the beneficiary countries on their reports to government. These inputs are in the section on program outputs where the participants answered fifteen key questions about plans for their NREN.

Additional inputs to the videoconferences came from:

- David West, Projects manager at DANTE, and coordinator of the EC funded TEIN program,
- Jim Williams, Director of Indiana University's Global NOC, Chairman of Internet2's South Asia Special Interest Group (SIG), and implementer of National Science Foundation (NSF) grant for connecting PERN (Pakistan) to Internet2.
- Jocelyn Gerich, Program Coordinator, International Relations at Internet2, Michigan.

Videoconference participating sites:

- World Bank Washington DC, USA
- Kabul University, Kabul, Afghanistan
- Nepal NREN, Kathmandu, Nepal
- World Bank Office Dhaka, Bangladesh
- Royal University of Bhutan (RUB) Thimpu, Bhutan,
- Sri Lanka Distance Learning Center, Colombo, Sri Lanka
- BRAC University Distance Learning Center, Dhaka, Bangladesh

- Kabul Distance Learning Center, Ministry of Communications, Kabul, Afghanistan
- LEARN Network Operations Center University of Peradeniya, Sri Lanka
- Ministry of Higher Education, Colombo, Sri Lanka
- NASATI, Hanoi, Vietnam
- Australia National University, (ANU), Canberra, Australia
- DANTE, Cambridge, England
- HEAnet, Dublin, Ireland
- Internet2 Ann Arbor, Michigan, USA
- Kent State University, USA
- Global NOC, Indiana University, Indianapolis, USA

Bridging arrangements for the videoconferences

The first six videoconferences were bridged through the World Bank MCU in Washington DC, and connected to the participating sites through the commodity Internet at 256Kbps. The final session was bridged through the LEARN MCU in Colombo operated from the LEARN Network Operations Center in Kandy, Sri Lanka, and where possible the sites were connected through the TEIN3 links at between 1.5 and 4 Mbps using High Definition (HD) codec's and cameras. This was a first for the LEARN NOC and a first for GDLN in South Asia, and it demonstrated to the participants the benefits of using NRENs and regional REN links for improving the quality of interactivity of international discussions.



Seven multisite videoconferences were held during the SERENE program

3. Knowledge exchange visits

Vietnam Jan 24 – 26

- **Central Hydrometeorological Forecasting Centre**, Hanoi: Discussions with experts on weather forecasting services that use VinaREN and TEIN3.
- **National Hospital of Pediatrics (NHP)** Hanoi: Videoconference on Pediatric Cardiology with Hue Central Hospital and Melbourne Royal Children Hospital.
- Reception by **Vice-Minister of Science and Technology**.
- **NASATI** (National Agency for Science and Technology Information): Presentation on VinaREN by Director General.
- **Vietnam National University** : Videoconference on e-learning and applications in the universities with remote participation from Ho Chi Minh City National University, Can Tho University, Hue University and Thai Nguyen University.

Visit to VinaREN in Hanoi, Vietnam



Thailand Jan 26 - 28

- **Chulalonghorn Hospital** Bangkok: Telemedicine application demonstration and discussion with users from the Faculty of Medicine.
- **Asian Institute of Technology**, Pathumthani: **intERLab**, **TEIN3 HRD**, **CanalAVIST** and applications at AIT, and presentation and discussion with remote sensing and GIS users.
- **Science Park visit**, Pathumthani.
- **UniNET/ThaiREN**, Bangkok: presentations by Secretary General of CHE, Director UNINET and Deputy Director. Presentation of Uninet REN and Network Operation. Visit to UniNET NOC.
- **ThaiSarn**, Bangkok: visit to Network Operations Center (NOC).

Study Visit to Thailand



Sri Lanka Jan 28 – Feb 3

- **Cinnamon Grand Hotel**, Colombo: Presentation on **LEARN** by CEO.
- **Sri Lanka Telecom (SLT)** Internet Data Centre, Colombo.
- **University of Peradeniya**, Peradeniya: visit campus and demonstration of LEARN NOC.



Visit to University of Peradeniya and LEARN NOC and videoconference facilities

4. Policy Workshop, Colombo, Sri Lanka, February 1-2, 2010

Hosted by Sri Lanka Distance Learning Center

The workshop objective was to provide an opportunity for the study visit participants to review what they had learned from the country visits and to begin to formulate policy guidance notes on how to build and manage an NREN in their own countries. Participants were formed into country teams and were guided through the process by the resource persons, George McLaughlin, Nimal Ratnayake and Michael Foley.

The outcomes for this workshop are amalgamated into the policy note summaries of the whole program.



Afghanistan, Bhutan and Nepal Country teams prepare their policy notes at the Sri Lanka Policy Workshop



South Asia Policy makers get to know each other and share experiences in Sri Lanka

L to R: Prof. Tajul Islam, Member UGC Bangladesh; H.E. Osman Babury, Deputy Min. of Higher Ed. Afghanistan; Dr. Ram Hari Aryl, Sec of Science and Technology, Government of Nepal; Prof Jiffry, Vice-Chair UGC Sri Lanka; Prof. Hamidullah Amin, Chancellor Kabul University; Prof Nazrul Islam, Chair UGC Bangladesh; Mr. Michael Foley, World Bank; Mr Syed Ataur Rahman, Sec of Education, Government of Bangladesh.

5. Technical Knowledge Exchange meeting and workshop, Pakistan, July 5-7, 2010.

Higher Education Commission (HEC), Islamabad

The workshop was aimed specifically at the technical personnel who had participated in the earlier videoconferences, study visits and workshop with the objective of learning from the experience of HEC Pakistan in establishing and operating the Pakistan Research and Education Network (PERN), now in its second phase as PERN2. The topics covered were as follows:

1. Welcome & Inaugural Speech: Dr. Sohail Naqvi, Executive Director, HEC

2. Introduction to HEC & PERN, Journey to PERN2, Challenges & Strategy: Mr. Anwar Amjad, Director of PERN2.

He emphasized the need for serious planning, and getting all the stakeholders involved in the planning process, importance of becoming independent as much as possible from the service providers, and the need for innovative tender procedures.

3. Strategic Planning: Mr. Abdullah Fayyaz Chattha

He reiterated the need for serious planning, roughly about 30% of the total effort. Challenges were met and difficulties were overcome with the help of SWOT Analysis and Rolling Wave Planning (i.e. learning from your own mistakes). It is also important to train your staff to be all rounders first, and then allow them to specialize in some area, depending on their skills. The PERN team which is largely a technical team had to gain procurement and management expertise to overcome the difficulties. Crashing and fast-tracking are also necessary in some situations.

He pointed out that people are the greatest asset of any organization. Each person in the team is given a primary responsibility, and a secondary responsibility, with everyone able to contribute in areas that are not their primary or secondary responsibility if they so wish.

Leasing of fiber is always preferred to laying own fiber. In order to overcome difficulties in the procurement process and the tendency of vendors to find loopholes in the specifications, the team had to seriously study the architecture of the routers of prospective bidders, and draft specifications so as to not leave any loopholes.

4. PERN2 Network Infrastructure & Services, i.e Video conferencing, IP Phone: Mr. Nazeer Hussein

This presentation covered the uses of codecs, and the roles of gatekeepers and gateways. In procuring equipment, it is advisable to choose equipment that not only have IP connectivity, but also ISDN connectivity as a backup.

Room aesthetics, acoustics, lighting, and furniture in the video conferencing rooms are also very important considerations. Audio problems are often solved with the proper use of audio mixers and amplifiers. Multiple cameras and camera controllers provide ways of covering the entire room, in ways not possible with a single camera. Routing of cables/wiring, electrical wiring, placement of LCD displays in the room also need to be given due consideration.

5. PERN2 Low Level Design: Mr. Jawad Raza

Jawad covered the deployment of Interior Gateway Protocols (IGP) within PERN in this presentation. He discussed in detail the features of routing protocols such as RIP, OSPF and IS-IS and explained why PERN chose IS-IS.

6. Overview of Routing Implementation: Mr. Jawad Raza

This presentation covered the basics of MPLS Design and Implementation, and the routing implementation within PERN. The PERN network has been segmented as North and South for administrative purposes and routing. Separate commodity Internet connections are provided for each of the two segments. Using AS-PATH prepend the incoming traffic to each segment is directed through the respective outside link. There are three separate VPNs in operation within PERN, for internal traffic, commodity Internet traffic, and academic Internet traffic through TEIN3.

7. Optical network transmission and its significance in NREN: Mr. Itrat Rasool Quadri

The presentation covered the details of Optical fiber technology, DWDM and SDH and laid the foundation for the next presentation on PERN2 optical network design.

8. PERN2 Optical network transmission (From Designing, Commissioning to Management): Mr. Itrat Rasool Quadri

The presentation covered PERN2 Optical Network Design, PERN2 Optical Network Commissioning and PERN2 Optical Network Management. The network design process has gone through three iterations for refinement and optimization. The capital cost has been minimized and transformed into recurrent cost through the leasing of DWDM equipment from the service providers.

9. Campus visits: Mr. Naveed Tahir/Mr. Jawad Raza/Mr. Abdullah Fayyaz Chattha

The following three sites were visited in the morning of the third day of the workshop.

- National Center for Physics (NCP)
- National University of Science and Technology (NUST)
- HEC Data Center, PERN2 NOC, HEC videoconferencing rooms

10. PERN2 Applications: Mr. Noman Saeed/ Mr. Ali Raza/Mr. Hasan Zaidi/Ms. Syeda Tamkanat

This session was a demonstration session showing two key applications within PERN.

Deployment of Video conferencing

- Digital Library

11. Hosting & NOC Services: Mr. Abdullah Fayyaz Chattha/ Jawad Raza

Due to time constraints this session did not take place but the presentation is on the SERENE website. The topics covered in the presentation included the following:

- Data Center Designing (Tier2, Tier3)
- Disasters Recovery (Comprehensive Approach)

12. Closing session: Dr. Sohail Naqvi, Executive Director, HEC, and Mr Anwar Amjad, Director, PERN2

The workshop ended with the concluding ceremony where Mr. Anwar Amjad gave a brief summary of the activities of the workshop and Dr. Naqvi making the concluding remarks. Certificates and plaques were presented to all the participants as well as to all of the resource persons. Dr. Nimal Ratnayake , CEO of LEARN, and participating on behalf of the SERENE team thanked the hosts for the enthusiasm, openness and generosity of sharing their experience in making PERN a world class academic and research network.



Dr. Sohail Naqvi Executive Director, HEC and Mr. Anwar Amjad, Director, PERN with workshop participants and team at HEC, Islamabad July 5-7, 2010.

Outcomes of SERENE program

Country Policy guidelines on 15 key questions regarding an NREN

1. **Type of organization:** Not for profit/for profit company, Government agency, Public-Private Partnership (PPP).
 - a. **Afghanistan**
AfREN will be located within the Ministry of Higher Education as a Government agency.
 - b. **Bangladesh**
initially being established by the University Grants Commission (UGC) as a government project. Planned to evolve as a not-for-profit organization.
 - c. **Bhutan**
DrukREN will be a non-profit organization.
 - d. **Nepal**
Established as a not-for-profit non-government organization.
2. **Governance and Organizational Structure:** Membership of board by position type, staffing structure.
 - a. **Afghanistan**
Ministry of Higher Education has an IT department which works for all Afghanistan universities, The IT department will undertake the technical work. The AfREN board will be chaired by the Deputy Minister to work for improvement, support and good relations between the various organizations. The Board will include the Deputy Minister, Chancellors of four Kabul based universities, the Dean of the Computer Science faculty and the IT director.
 - b. **Bangladesh**
A trust will be formed under the auspices of UGC. The trustee board will be formed under the chairmanship of UGC chairman and will comprise of members from UGC, Vice-Chancellors of public and private universities, representatives from MoE, other stakeholders and the CEO of BdREN.
 - c. **Bhutan**
The Executive Committee will be drawn from various Ministries and from the Royal University of Bhutan (RUB).
 - d. **Nepal**
Board comprises 11 directors from the member organizations and a secretariat to run the day-to-day operation.
3. **Membership scope and focus:** Higher education, secondary education, public & private, research, health, libraries, museums, science centers, govt. departments. Which of these will the NREN serve?

- a. **Afghanistan**
Initially 24 Public universities, then 31 private universities, then public schools, hospitals and libraries.
 - b. **Bangladesh**
Initially all higher education institutions, public and private, research organizations. Health institutions, libraries, and other educational institutions may be included in the later stages.
 - c. **Bhutan**
Members will be RUB, Department of Disaster Management, Department of Medical Services, Higher Secondary Schools, Agricultural organizations, others as appropriate.
 - d. **Nepal**
Public and Private universities and Health organizations.
4. **Operational model:** Buying club, outsourcing of services, full service provider, hosting services, owner or leaser of network infrastructure.
- a. **Afghanistan**
Currently satellite services are used for most while two universities are already using fiber. Most universities already have fiber connections but are still not using these. Exploring ways to acquire dark fiber on the recently laid fiber ring around the country. The fiber ring is active in North, West and East of the Afghanistan.
 - b. **Bangladesh**
BdREN will own the network infrastructure and provide services to the end users. Maintenance of some of the backend infrastructure (e.g., fiber, radio links) will be outsourced.
 - c. **Bhutan**
Currently a Wide Area Network based on IP-VPN technology. Plan for high capacity connections between members using fiber that is currently being laid.
 - d. **Nepal**
The Core Network is owned and operated by NepalREN and the fiber or the layer 2 links is leased from a service provider.
5. **Engaging with the private sector, telcos/ISPs:** Are there opportunities, e.g., wireless/mobile services, network capacity?
- a. **Afghanistan**
Exploring access to fiber via Afghan Telecom. In some areas this will need to be augmented by WiMAX and microwave connectivity.
 - b. **Bangladesh**
Private sector organizations will be engaged where appropriate, eg for last mile connectivity. Capacity and services will be taken from mobile/PSTN service providers where leased fiber is not available.

- c. **Bhutan**
Pending.
 - d. **Nepal**
Engaged with the local service providers for the data links from NepalREN NOC to the members.
6. **Staffing and capacity building:** Strategies for sourcing experienced staff, sources of training and access to these, retention of good and trained staff.
- a. **Afghanistan**
Pay structure will be different from usual government arrangements. Pay structure will allow for higher pay and performance-based payments necessary to retain good staff. Some official employees have already been engaged, but these will be not enough. Training in managing a large network is a high priority.
 - b. **Bangladesh**
Pay structure will be different from usual government. Pay structure to allow higher pay and performance-based payments necessary to retain good staff. Provision of training programs already in place.
 - c. **Bhutan**
Pending.
 - d. **Nepal**
Currently have 2 System Administrators and a Network Engineer for the day-to-day operation of the network. Regularly send at least one technical person to training and events like SANOG and APRICOT supplemented with regular in-house technical training.
7. **Funding Sources:** Government Departments/HEC/UGC, member charges. External sources (World Bank, European Commission, ADB, US agencies) - which of these apply?
- a. **Afghanistan**
Afghanistan Ministry of Higher Education published a new strategic plan for higher education. Developing AfREN is one important part of this strategic plan. But the establishment of AfREN will not be possible without support of external sources such as the World Bank, European Commission , NATO, and US agencies.
 - b. **Bangladesh**
For establishment of BdREN, a combination of government grant and World Bank loan. Ongoing operational costs will be met by a combination of member charges and a government endowment fund.
 - c. **Bhutan**
Pending.

- d. **Nepal**
Membership based. The government has been approached for funding for the TEIN 3 connectivity but still waiting on a decision.
8. **Networking options:** dark fiber, leased circuits (fiber/copper), wireless.
- a. **Afghanistan**
Dark fiber from Afghan telecom and some parts which are not in the ring of fiber needs WiMAX, Microwave .
 - b. **Bangladesh**
Dark fiber from the Power Grid Company of Bangladesh will be used for the backbone. Fiber leased circuits or wireless media from service providers will be used for the last mile.
 - c. **Bhutan**
Migrate from IP-VPN to high capacity services based on new fiber network currently being rolled out.
 - d. **Nepal**
A combination of dark fiber, wireless and leased circuits.
9. **International connectivity:** Commodity and academic, and how to fund it.
- a. **Afghanistan**
The fiber ring that connects most Afghanistan provinces also has connections to Tajikistan, Uzbekistan, Pakistan and Iran. Afghanistan is landlocked (like Bhutan and Nepal) so, other than satellite connectivity, cross-border fiber is essential for international connectivity.
 - b. **Bangladesh**
Initially BdREN will be connected to TEIN 3 PoP with a 45 Mbps links and to commodity Internet through a 100 mbps link from an Internet Service provider. As the use increases, multiple diverse connectivity for both academic and commodity bandwidth will be implemented. It will be funded from a combination of member fees and government allocations.
 - c. **Bhutan**
Exploring cross-border connection to ERNET (India).
 - d. **Nepal**
Currently connected with APAN-JP and TEIN3.
10. **Regional and global engagement:** Connectivity to and collaboration with countries in the region and around the globe.
- a. **Afghanistan**
The fiber ring which connects most Afghanistan provinces also has connections to Tajikistan, Uzbekistan, Pakistan and Iran. Through this links AfREN can access TEIN3 and APAN.

b. **Bangladesh**

BdREN will be connected to the regional as well as global RENS through TEIN 3. It will provide the platform, the basic infrastructure and facilities upon which human level collaboration can be built. UGC and the BdREN community will actively engage on global, regional and one to one collaboration between countries, universities and individuals.

c. **Bhutan**

Exploring accessing the region via ERNET.

d. **Nepal**

Using TEIN3 and APAN.

11. **Peering exchanges and cloud service providers:** Plans on how to work with these.

a. **Afghanistan**

Too early.

b. **Bangladesh**

Pending

c. **Bhutan**

Pending

d. **Nepal**

Peering with the local Internet Exchange , Nepal Internet Exchange Point (NpIX)

12. **Engaging user communities:** Plans for promoting the benefits of an NREN, demonstrating what can be achieved.

a. **Afghanistan**

Identified in Ministry of Higher Education's strategic plan and illustrated in the several workshops and conferences

b. **Bangladesh**

A number of workshops, to promote the benefits of BdREN have been held. They were enthusiastically received. Plans to hold further workshops and demonstrations are being scheduled.

c. **Bhutan**

Pending.

d. **Nepal**

Currently the focus is on Telemedicine.

13. Applications: Key users of the network, have they been identified, and what do they want to do? Early demonstration applications that are waiting for the network.

a. **Afghanistan**

Access to International Internet Bandwidth, access to digital libraries, journals and other online resources. Broadband link from MoHE to Afghanistan universities and international universities, videoconferencing, sharing of large-size data amongst universities, full-fledged hi-tech video lecturing facilities, web streaming service for video lectures, and video Reflector service for multipoint videoconferencing with international researchers, centralized and distributed content servers for information sharing. This will include text and multimedia objects, Voice Over IP (VOIP) services for communication between universities, computer and test equipment resource sharing across universities .

b. **Bangladesh**

Key application areas are: virtual classroom (distance learning/education), telemedicine, attending workshops remotely over video conferencing facilities, accessing libraries and global repositories.

c. **Bhutan**

Access to journals, teaching and learning environments, videoconferencing, health applications.

d. **Nepal**

Currently the network is used mainly for international and national telemedicine collaborations. Katmandu Model Hospital is the hub of NepalREN for Telemedicine.

14. Business plan (three year rolling): Plan for the evolution and sustainability of the network and services.

a. **Afghanistan**

Under development. Plan to make all the IT projects to have income then spend that income for developing and extension of that project. AfREN also can have income for the internet services, data center, libraries, E-learning, conference, training and technical support. This income will aid the sustainability of AfREN.

b. **Bangladesh**

A work in progress. Trying to build some capacity / resources / facilities other than basic connectivity services which will generate additional revenue to supplement the subscription. This may include – hosting services, data center services, mail services, video conferencing services.

c. **Bhutan**

Broad way forward set out.

d. **Nepal**

Current plan is to engage the government in NepalREN and move towards a public private partnership model between the government and private parties like local service providers.

15. **Start up requirements:** equipment, funds.

a. **Afghanistan**

Startup funds are being provided with support of NATO, 11 public universities are under support of NATO and we are looking for funding of other universities, hospital and some schools.

b. **Bangladesh**

Start up funds are being provided by the Government of Bangladesh and a World Bank loan.

c. **Bhutan**

Pending

d. **Nepal**

NepalREN started with the initiation of the like minded people in the academic sector and the Startup Equipment was funded by the Network Startup Resource Center (NSRC), University of Oregon, USA.

Participants' evaluation

The feedback from the participants in all of the activities was very positive and the proof of that is that each member of each delegation is convinced of the need for an NREN for their country and they are determined to convince their governments of the efficacy of an NREN for the development of their higher education and research sectors.

The Vice Chancellor of Kabul University, Professor Hamidullah Amin, summed up the mood of the participants when stated: "One of the best knowledge exchanges I have ever attended. I can say that after participating in many before. It was wonderfully organized and the program was great and productive. We have learned quite a lot. Also it was wonderful to meet people from different countries in the region who normally we do not have a chance to meet. This is the most important part of the experience for me. On the technical side, I have learned quite a lot about NRENs and the importance of one for Afghanistan. I have come to the conclusion that we need to develop an NREN and dedicate the resources to get it done with support from our government and the World Bank."

Feedback by country:

Bhutan

Good opportunity to learn about NREN's but the communication among the group proved as important in the sense of creating a sense of community and exchange.

Enhanced my understanding of the role of research and NREN's in society (Vietnam, Thailand).

We knew we had some type of NREN in place in Bhutan and we needed to validate it through comparison with other experiences out there.

Bangladesh

NREN is important. There are many types of NREN's depending on the needs of the country. Setting one up can be a gradual approach or a one-time effort. It can be customized and this is an important lessons.

In terms of management, it should be out of the government but the government needs to be involved.

We need to know more about the failures and how they could be useful to BdREN. Human-level collaboration is key.

Nepal

I learned that an NREN is a good means for sustainable development of the country. It is good for everyone to be all on board with the idea of NREN. The study visit has been a very good opportunity to know each other. In Nepal we have a good opportunity for and NREN to be developed through PPP's.

This study visit was an excellent opportunity to learn about the technical aspects of an NREN, the possibilities, and the technical applications that are possible with it.

I learned one key thing per country; in Sri Lanka I learned how to start an NREN; in Vietnam I learned about how to manage an NREN; in Thailand I learned about the applications that can be had with NRENs.

I learned a lot, but realized that we need a long-term plan (connectivity is not enough). And I got a better understanding of how to get the most out of the applications that are possible on an NREN.

Afghanistan

For us, the study visit has been a great opportunity to understand NREN's and to get the details and realize what has been done in this area in other countries like Vietnam, Thailand, Pakistan, and Sri Lanka. And to learn the status of NREN's in other countries in SAR. Participation in these study visits will have a good impact for us in developing and NREN. Compared to other countries we need to be very serious moving forward. Fortunately we established a new strategic plan for the higher education in Afghanistan and AfREN is one of important part of that strategic plan.

I learned that an NREN has two sides, the social, where we exchange a lot of information and learn about characteristics of other people's in the region (I have never met in person someone from Bhutan for example), and the technical side where I have learned about what other countries are doing and how it helps. I also learned a lot and enjoyed the videoconferences.

Annex: The people involved

Program Team

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Resource persons:

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