### Project factsheet information

<table>
<thead>
<tr>
<th><strong>Project title</strong></th>
<th>Empowering mountain community to maintain and build wireless network through localized support kit and training</th>
</tr>
</thead>
</table>
| **Grant recipient** | E-Networking Research and Development (ENRD)  
Lajimpat 304, Shivabhakta Marg, Kathmandu, Nepal  
Phone, fax: 977-1-4428090  
Website: http://www.enrd.org |
| **Dates covered by this report** | 01 – 04 – 2010 / 28 – 02 – 2011 |
| **Report submission date** | 04 – 03 – 2011 |
| **Country of implementation** | Nepal (NP) |
| **Project leader name** | Mahabir Pun <mahabir@himanchal.org> |
| **Team members (list)** | Rajendra Poudel <enrd@wlink.com.np>  
Ambika Timila (Finance administrator)  
Santosh Baral  
Subash Gurung  
Raju Sunachouri  
Takbahadur Pun  
Sagar Gnawali  
Bikram Acharya  
Dambar Pun |
| **Partner organizations** | 1. Digital Empowerment Foundation, India  
2. Asian Institute of Technology, Thailand  
3. Help Nepal Foundation, Nepal  
4. Nepal Research and Education Network |
| **Total budget approved** | 40,000 AUD |
| **Project summary** | The goal of the project was to empower wireless technicians of mountain communities to maintain and build wireless network through localized support kit and training. It was highly needed because the wireless network built by Nepal Wireless in high altitude mountains needed to maintain regularly by local villagers. To accomplish the goal, the project organized non-residential training on seven sites providing trainees the opportunities to work on the real network and relay installation. The residential trainings were organized in four sites that gave more of the theoretical knowledge and practice, and training on the uses of Internet. The project produced a handbook in Nepal language as the localized support kit, which is available both in hardcopy and online in the wiki. Moreover, the project has been able to develop a Wiki page with 383 information in Nepali Language, which are useful for the students and villagers. Thus the training program has helped for the technical independency of local community to build, troubleshoot and expand the internet services in mountain region of Nepal and has assured better quality of internet services in the mountain for delivering basic social services such as communication, health and education. |
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Project Summary

E-Networking Research and Development (ENRD) has been running the Nepal Wireless Networking Project since 2002 from the grassroots level with the technical support of national and international volunteers. The people from the rural communities served by the project have the full responsibility for the maintenance and operation of the network and only look for additional/external support when a highly technical issue might arise. The training project supports the expansion of the wireless connectivity to many more villages in the mountain region of the Himalayas.

The main objectives of the project are:

✓ To enhance the capacity of the mountain community for building, maintaining and troubleshooting the wireless Internet services independently by themselves.

✓ To assure the quality of service (QoS) in the wireless Internet services of mountain for delivering basic social services such as communication, health and education.

The project trained new and current communication service operators and community volunteers from 15 villages on wireless networking maintenance and operation, including: installation and maintenance of alternative power supply sources using solar, wind and small hydraulic systems; installation of lightening and power surge protection systems; and construction of antennas using locally available materials. All these aspects are essential to offer affordable, reliable and safe connectivity in the current Nepalese context. The training had a practical focus to solve real-life situations by deploying real community networks.

The project team developed localized training kits and handbooks so the trainees will gain a better understanding of the technical issues. The materials also provided theoretical background. Training was provided in different modalities to groups with different skills and experience.

A team of two technical engineers, three outreach assistances, and an OM expert was hired to support the training program.

The project practical methodology provided the opportunity for trainees to learn how to interconnect a wireless network to other networking technologies such as optical fiber cables where the network topology permits, aiming to reduce costs and increase reliability.

The project team got involved also in the implementation of additional services to make the most out of the wireless network such as local weather stations; alternative solutions for 2 training laboratories using LTSP system (Linux Terminal Server Project) and Thin Client system; administration and management of community communication centers to achieve financial sustainability through introduction of services such as Internet phone, e-commerce, e-medicine, and secretarial services etc.
The community members were actively involved, providing support during the project period including financial support, as the local communities covered many of the local expenses to conduct the training programs.

**Justification**

Like safe drinking water and safe shelter as basic need for human life, Information and Communication Technologies (ICTs) are becoming an essential part for daily life. However, such services and facilities are accessible to only one-tenth of the world’s population.

ENRD is an implementing and support organization that helps to bring the benefits of information technology for the rural population by building wireless network to connect the villages and then providing training for the villagers on how to use the technology to get the most benefit out of it. In order to do both research and implementation activities, ENRD has developed a simple management system to look after both issues.

E-Networking Research and Development (ENRD) has been running the Nepal Wireless Networking Project since 2002 from the grassroots level with the technical support of national and international volunteers. The people from the rural communities served by the project have the full responsibility for the maintenance and operation of the network and only look for additional/external support when a highly technical issue might arise. The training project supports the expansion of the wireless connectivity to many more villages in the mountain region of the Himalayas.

The broadband wireless internet network has been connected more then 50 villages and carrying emergency services such as communication and tele-health to the communities living in mountain of western region of Nepal since 2003. There are different wireless networks operating at Mygdi, Mustang, Makwanpur and Dolka regions.

The villages are located high in the mountains slopes, far from the city where basic services such as transportation, communication and primary health services are not available.

The majority of the wireless relay stations have been located high in the mountains, such as Moher (3320 meters) and Khopra (3650 meters), to cover a wider area with the signal.

The base station is located in the Dip of Pokhara (980 m). The station can successfully transmit the signal over 30 miles to the next relay station located in Moher hill (3320 m). Initially the network has achieved Maximum 8 Mbps of data bandwidth in the network.
The majority of the wireless relay stations have been located high in the mountains, such as Mohere (3320 meters) and Khopra (3650 meters), to cover a wider area with the signal.

Initially, the network used 2.4 GHz (802.11b) wireless radios having 100mw of power and 24dBi grid antennas. Later on, the network needed to be upgraded due to support services such as tele-medicine, tele-education and local VoIP call. The radios were replaced to 5.8 Ghz radio using OFDM technology. After upgrading the equipment, the network now provides a maximum 20 Mbps of data bandwidth. Many of the wireless radios have been hanging in tall trees to pass the signal from one wireless radio to another.

As of 2007 Nepal Wireless connected 10 villages of the Makawanpur district using 5.8 Ghz frequencies radios. This network is fully managed by the local villagers, with a district administration office located at Hetauda.

The villagers, local school teachers and yak farmers living in those areas have been taking care of the relay station, but lack the ability to troubleshoot technical problems affecting their networks due to limited English and technical knowledge. Due to the remoteness and altitude of the locations, the technical experts living in the city can’t reach the villages as soon as a problem arises. The experts not only need the resources to organize the trip from the city to the villages experiencing the technical difficulties, but also the time to recover and adapt to the high altitude, which in some cases can take days.

<table>
<thead>
<tr>
<th>S.N</th>
<th>Places</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mohare Relay Station</td>
<td>28°22’14.56&quot;N</td>
<td>83°40’43.73&quot;E</td>
<td>3,250</td>
</tr>
<tr>
<td>2</td>
<td>Larke Relay Station</td>
<td>28°39’47.37&quot;N</td>
<td>83°36’22.20&quot;E</td>
<td>2,988</td>
</tr>
<tr>
<td>3</td>
<td>Dhakarjung Relay Station</td>
<td>28°48’18.72&quot;N</td>
<td>83°44’35.88&quot;E</td>
<td>3,452</td>
</tr>
<tr>
<td>4</td>
<td>Jomsom</td>
<td>28°47’0.28&quot;N</td>
<td>83°43’46.61&quot;E</td>
<td>2,750</td>
</tr>
<tr>
<td>5</td>
<td>Kagbeni</td>
<td>28°50’11.91&quot;N</td>
<td>83°46’59.22&quot;E</td>
<td>2,837</td>
</tr>
<tr>
<td>6</td>
<td>Marpha</td>
<td>28°45’3.30&quot;N</td>
<td>83°41’10.06&quot;E</td>
<td>2,692</td>
</tr>
<tr>
<td>7</td>
<td>Tukuche</td>
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<td>83°38’44.94&quot;E</td>
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</tr>
<tr>
<td>8</td>
<td>Kobang</td>
<td>28°41’15.83&quot;N</td>
<td>83°36’47.35&quot;E</td>
<td>2,552</td>
</tr>
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<td>9</td>
<td>Kalopani School</td>
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<td>83°35’52.44&quot;E</td>
<td>2,510</td>
</tr>
<tr>
<td>10</td>
<td>Lete Clinic</td>
<td>28°38’7.69&quot;N</td>
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</tr>
<tr>
<td>11</td>
<td>Arthunge Relay Station</td>
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</tr>
<tr>
<td>12</td>
<td>Aulo</td>
<td>28°24’58.00&quot;N</td>
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</tr>
<tr>
<td>13</td>
<td>Kaphaldanda</td>
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<tr>
<td>14</td>
<td>Lopre</td>
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<td>83°36’18.41&quot;E</td>
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<tr>
<td>15</td>
<td>Paudwar</td>
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<td>16</td>
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<tr>
<td>17</td>
<td>Nangi</td>
<td>28°22.300N</td>
<td>83 38.306 E</td>
<td>2,650</td>
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<tr>
<td>18</td>
<td>Ramche</td>
<td>28 22.876 N</td>
<td>83 38.306 E</td>
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</tr>
<tr>
<td>19</td>
<td>Tikot</td>
<td>28 25.836 N</td>
<td>83 37.232 E</td>
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</tr>
<tr>
<td>20</td>
<td>Khibang</td>
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<td>83 39.010 E</td>
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</tr>
<tr>
<td>21</td>
<td>Sikha</td>
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<td>83 40.500 E</td>
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</tr>
<tr>
<td>22</td>
<td>Ghorepani</td>
<td>28 24.108 N</td>
<td>83 41.935 E</td>
<td>2,875</td>
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</tbody>
</table>
Nepal Wireless developed a previous study that identifies to 2 specific challenges that needed to be addressed through a training program: 1) how to provide training for networks located in high altitude areas with difficult access; and 2) how to provide training for operators who have a low education level and have difficulty to understand English language.

The study concluded that in order to keep the wireless network up-to-date and make zero down time for maintaining QoS (Quality of Service), it is necessary to provide appropriate training for maintaining and troubleshooting the wireless network to the villagers, school teachers and yak farmers of these areas in the language they speak. Even if the local operators could not fix the problem, they will be in a better position to explain the problem to an expert and be advised about relevant techniques to fix the problem.

As the network grows continuously and equipment is replaced accordingly, the major technical difficulties for operators are Internet Protocol and IP Addressing issues (DNS, DHCP, NAT etc); IP Routing issues; and Wireless Frequency and signaling issues. After the training, operators will able to understand the problems and explain how it can happen and how it can solve.

The study recommended that the training should be limited to the management and troubleshooting of the installed wireless network in the mountain region and should focus on how to identify the source of the problem and understand errors reported or generated by network equipment around their stations.
Project objectives

**Objective 1.** To enhance the capacity of the mountain community for building, maintaining and troubleshooting the wireless internet services independently by themselves: The project supported the training of 24 wireless technicians, which is a higher number of trainees than the number originally planned. The trainees have been able to receive training not only in the wireless networking and equipment configuration area but also in the area of solar power installation and maintenance, lightening and surge protection installation, relay tower installation, weather station installation, and antenna building.

ENRD had not originally planned to send trainees to provide wireless training in India or to get wireless and telemedicine training in Bangkok, but these opportunities enhanced the capacity of our technicians from the rural areas for building and maintaining wireless networks.

**Objective 2.** To assure the quality of service (QoS) in the wireless internet services of mountain for delivering basic social services such as communication, health and education: Quality of Service has certainly improved because the wireless technicians and communication center operators are now able to troubleshoot and solve minor to medium level technical problems by themselves without being dependent to wireless engineers living in the cities.

However, there are still more work needed to be done to improve the quality of services provided such as telemedicine and tele-training services. For example, improve video quality for video conferencing to multiple destinations. In order to achieve this, the team is working towards an update of the network routers and the development of multi-destination video conferencing software using open source for tele-teaching and tele-medicine purposes.

Project implementation

Normally, most of the people think that building a wireless network in remote rural areas to provide e-services to the villagers and maintaining the network is something only the smart and technically qualified persons can do. Our goal is to prove that low-tech people can do it as well. Therefore the rationale of the project is that people living in the rural areas are also capable of building and maintaining small-scale rural wireless networks. Even if it requires high skilled professionals for designing a network and addressing the routing issues for building/maintaining a good size wireless network, our experience tells us that ordinary villagers with high school background and good technical training can also build a small scale wireless network, maintain the network, and provide wireless Internet services to the rural customers.

The problems the project implementation addressed are described below:

1) Our several years of experience tell us that educated or ordinary villagers hesitate to work with computers, wireless and any other kind of technology, because almost all the manuals and

This work has been developed with the financial support provided by the Information Society Innovation Fund – 2010.

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instructions available are in English. We believe that if the villagers are taught in local language using simple strategies, and manuals and instructions are prepared and printed in local language, the villagers are more receptive and willing to engage.

2) Consolidate a local work force to support the networks operation is a key to the networks sustainability and reliability. Rather than depending upon the skilled work force graduated from the IT colleges in the cities which are more interested to study abroad, find a high salary job, stay or return to the city life, the project focused on providing specialized training to the people from the rural areas with a high school degree so they become part of the local work force committed to stay and support their communities.

3) Identify the best way to protect the equipment from power surge and from lightening strikes, in order to keep the network running all the services uninterrupted and obtain the best performance from the equipment in use.

4) Implement alternative ways to upgrade equipment, as the costs for the wireless equipment and the antennas are too high for the communities been served. Training covering theory and practice about how to build omni-directional and flat panel antennas cheaply in the villages were provided.

Despite any financial problems that may arise to develop a rural wireless networks, many of the people from the rural community are motivated to bring the information and communication technologies to improve the education of their children and to access Internet-based phone services. They have raised financial resources to assist and support the wireless networks.

The training program was designed based in the bottom up approach, which has lead ENRD efforts since it's beginning. There is always major demand from the grassroots for technical training so that they can expand the wireless network to other areas and maintain the networks by themselves, looking for technical sustainability, which is very important for the financial sustainability of the project. To achieve these goals we have come through various steps and processes all of which are based on our learning experiences.

ENRD have been using the Outcome Mapping (OM) methodology since 2007 to design, monitor and evaluate project activities and programs. This tool allows identifying behavioral changes in the communities we work with during the project implementation. These changes are very important when selecting project partners and adjust the course of the project to reach the objectives planned. A detailed report of the Outcome Mapping Framework is included at the end of this report, in the annex titled “OM intentional design ISIF-ENRD”.

In order to organize the training program for mountain areas, we followed three steps.

**Step 1- Intentional Design:** Defining the mission and vision of the training program is one of the major tasks. After several rounds of discussion with our former partners, government policy makers and program beneficiaries we had defined the training program’s vision and mission (as
follows). A baseline survey was conducted to support the OM intentional design and to identify the locations, number of people interested to join the training, to finalize project activities and identify potential boundary partners.

**Vision:** People living in the mountains have the skills to build and maintain wireless network by themselves and provide training manual in their own language. The network provides access to communication and information services on education and health among other relevant issues for the community’s development.

**Mission:** Provide training:

- ... to people living in the rural areas to build and maintain a broadband wireless network
- ... in Nepali language, which is the common language in Nepal
- ... to support operators and community members with training manuals that allow them to replicate the experience and build broadband wireless network in different parts of Nepal
- ... manuals online in local Wiki hosted in local network server
- ... to run various online services by utilizing the wireless network

**Boundary Partners:** ENRD has already been working with local village development committee, local mothers groups, community schools and district government of Nepal. The project selected school teachers, telecenter operators and unemployed youths for the training and they will be the main beneficiaries of training. For the training programs we explored following boundary partners.

- Local community schools
- Local community groups such as mothers groups
- Training team of ENRD
- Telecenter operators
- Funding agencies (ISIF) and other local supporters

**Outcome Challenge:** The program intends to see local telecenter operators, school teachers, community groups recognize the importance of the internet, and become involved in building/maintaining broadband wireless network in their villages. The operators will gain confidence to teach other people, to make successful plan and to develop training materials in Nepali language. The operators trained during the project life will be able to manage activities and to motivate others to become partners.

Local telecenter operators, school teachers, representatives of local community groups have actively joined in the following activities to achieve the target goals. The frequencies of such activities are considered as Progress Markers of the training program.

1. Participating in the regular meeting at the telecenter.
2. Expressing interests to gain knowledge and skills for maintaining broadband wireless network in their villages.
3. Acquiring new skills and giving their time to the project.
4. Contributing locally raised funds to support wireless network deployment and some training activities to be conducted in their villages.
5. Collecting feedback about the training and wireless network expansion program.
6. Requesting external expert when facing difficult technical problem and learning from the troubleshooting.
7. Encouraging others to participate in the training program.
8. Supporting to development of a localized training handbook in Nepali language.
9. Collaborating with other groups and individuals.

After going through the Progress Markers we identified the following outcomes:

1. Training was organized in 7 districts.
2. Documentation of the training and troubleshooting facts was prepared.
3. Training kit in local language was produced.
4. A wireless network was deployed in 7 different locations places.
5. A collaboration strategy has been established to maintain and operate the wireless networks.

ENRD has tried to increase women's participation in the training program, but some aspects of the social structure and cultural traditions in the rural areas make this task difficult, as most people still think that women cannot travel in the mountains with men to build wireless network or can't do physically challenging works.

However, the project became successful to increase the numbers of female telecenter users to access Internet and e-mail as well as to participate in tele-teaching and tele-medicine activities.

The project has successfully involved a mother’s group as one of the boundary partners to organize training at the villages of Gorakha and Siklis of the Kaski district.

**Step 2 – Performance Monitoring:**

From the organizational practice section of Step 1, we are practicing regular documentation and record keeping of the best practices and issues that arise during the training programs. The documentation effort has produced valuable materials that will serve for monitoring. Data has been collected through a baseline survey conducted during the first phase of the program; focus groups and interviews to boundary partners; and sheets filled by the project staff identifying the organizational practices.

Monitoring priority has been given in the following points:
1. Number of activities performed by the telecenter operators, local school teachers and representatives of local community based organizations.
2. Number of end users that have utilized the wireless broadband network infrastructure and behavior changes on them.
3. Achieved product (Localized training Kit) and its feedback

**Step 3 - Evaluation of the project:** To be able to understand long-term outcomes and achievements, ENRD has set an evaluation statement and will track progress and changes in the future.

To get the result of the evaluation the project implementing organization will conduct the evaluation survey and produce the research report based on the given evaluation statement as follows, “How the people from the high mountain villages have accessed the ICT and benefited from it in underserved rural community?"
<table>
<thead>
<tr>
<th>Project objectives</th>
<th>Activities</th>
<th>Time required for activities implementation</th>
<th>Overall assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>To enhance the capacity of the mountain community for building, maintaining and</td>
<td>Formation of technical team members.</td>
<td>April 16, 2010</td>
<td>A team of eight members for the implementation of the program was conducted. The</td>
</tr>
<tr>
<td>troubleshooting the wireless internet services independently by themselves</td>
<td></td>
<td></td>
<td>team members were: Mahabir Pun (Team Leader); Santosh Baral (Technical Engineer);</td>
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<td></td>
<td></td>
<td></td>
<td>Subash Gurung (Technical Sub-Engineer); Raju Sunouchour, Maite Pun and Basanta</td>
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<td></td>
<td>Bishwokarma (Out Reach Assistance); Rajendra Poudel (OM Expert and Technical</td>
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<td></td>
<td></td>
<td></td>
<td>Engineer) and Umesh Wagle (Baseline Survey Researcher).</td>
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<tr>
<td></td>
<td></td>
<td>April 20, 2010</td>
<td>For professional services we selected the following persons during the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May, 2010</td>
<td>period: Bikram Acharya (Wireless Network Engineer); Gaurab Raj Upaddhyaya and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>May, 2010</td>
<td>Indiver Badal (Network Designing and Routing Specialists and Trainers); Chandresw</td>
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<td></td>
<td></td>
<td>May, 2010</td>
<td>o Choudhari (Solar Power Installation and Maintenance Expert); Srikrishna Shresth</td>
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<tr>
<td></td>
<td></td>
<td>May, 2010</td>
<td>a (Tower installation, grounding and lightening protection); Tej Ghale, Rajesh</td>
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<tr>
<td></td>
<td></td>
<td>June 2010</td>
<td>Basnet, Takbahadur Pun, Dipendra Mandal, Suresh Joshi, Maite Pun, Sagar Gnawali,</td>
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<td>Prabah Dhimjung, Narayan Sharma (Outreach Assistance); Saroj Dhakal, Gyaneshor</td>
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<td>Bogati (Wiki software and application developer); and Dambar Pun (System</td>
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<td>administrator).</td>
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<td>In order to design the project based upon the proposal that ENRD had submitted,</td>
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<td>the team members conducted the survey of the project sites and collected data from</td>
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<td>the village communication centers and schools at the districts of Mustang, Myagdi,</td>
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<td></td>
<td>Parbat, Baglung, Gulmi, Kaski, Makawanpur, Gorakha, Kavre and Ramechhap.</td>
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<td></td>
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<td>It took more than a month to visit all of those sites, discuss with the</td>
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<td>villagers and collect the data. The survey was done to choose rural training</td>
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<td>centers, select the training sites and to find the potential staff of the</td>
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<td>communication centers, who could become reliable wireless technicians in the</td>
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<td>rural areas.</td>
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<td>Meetings with the community members and stakeholders in each of those districts</td>
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<td>were organized in order to collect data and ideas to make communication centers</td>
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<td>as useful as possible.</td>
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<td>Frequent meeting were conducted with the operators, villagers and other</td>
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<td></td>
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<td></td>
<td>stakeholders, who were directly or indirectly involved in the project. Thus the</td>
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<td>vision and mission statement was set after the rigorous discussion and debate</td>
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<td></td>
<td></td>
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<td>among the interested parties.</td>
</tr>
<tr>
<td></td>
<td>Baseline survey conducted.</td>
<td>May, 2010</td>
<td>The project also conducted baseline survey and collected data from 4 major</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sources: Data collected directly from various discussions and meetings with the</td>
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<tr>
<td></td>
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<td></td>
<td>villagers; Questionnaire survey from telecenter operators; Previously collected</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>data for other proposes from the similar project area; and</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Previously published reports, case studies, and meeting report from the</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>implementing organization.</td>
</tr>
</tbody>
</table>
### Project objectives

To enhance the capacity of the mountain community for building, maintaining and troubleshooting the wireless internet services independently by themselves.

<table>
<thead>
<tr>
<th>Activities</th>
<th>Time required for activities implementation</th>
<th>Overall assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay station installation training programs organized</td>
<td>June 2010</td>
<td><strong>ENRD organized seven field-training programs (non-residential training) in June, July, November and January for the rural trainees and outreach assistances. Those trainings were on-the-spot practical cum installation training for setting up relay towers, putting lightening arrestors and surge protectors, and configuring Motorola Canopy backhaul radios, configuring Mikrotik, EnGenius, Ubiquity and TP Link Access Points and client radios. Training on how to configure wireless routers, manageable switches, manufactured by Mikrotik, TP Link, Linksys, and Dlink were also provided to the trainees.</strong></td>
</tr>
<tr>
<td></td>
<td>July 2010</td>
<td>For the installation of relay towers and lightening protection system, Srikrishna Shrestha from Swoyambhu Electronics provided training to the trainers. The followings are the details of what each group did during the training program.</td>
</tr>
<tr>
<td></td>
<td>August 2010</td>
<td>For the training program, we divided the trainees in seven groups and they were sent to different sites for the installation of relay towers. It took from one week to twelve days for the installation of relay stations and for connecting different villages from there. Each group contained from four to five trainees from the selected villages. Moreover, there were students from the engineering college of Pokhara as well during the non-residential training. The on-the-spot trainings were led by technical people such as Bikram Acharya, Santosh Baral, Subash Gurung, Dipendra Mandal, Narayan Sharma, Takbahadur Pun and Narayan Adhikari.</td>
</tr>
<tr>
<td></td>
<td>November 2010</td>
<td>The first group led by Bikram Acharya built relay station at Charikot of Dolakha and Manthali of Ramechhap district.</td>
</tr>
<tr>
<td></td>
<td>January 2011</td>
<td>The second group led by Santosh Baral built relay station at Lumpek of Gulmi district, Ghodabandhe and Hatiya of Baglung district.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The third group lead by Subash Gurung built relay station at Pritam Deurali and Dhampus of Kaski district.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The fourth group led by Takbahadur Pun built relay station at Niskot and Bima of Myagdi district.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The fifth group led by Dipendra Mandal build relay station at Salme Chakal of Kavre district.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The sixth group led by Narayan Sharma and Takbahadur built relay station at Kolma and Nuwakot of Syangja district.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The seventh group led by Subash Gurung built relay station in Kalika of Kaski district and Lamagaun of Tanahun district.</td>
</tr>
</tbody>
</table>

1. Tower installation at Pritam Deurali, Kaski  
2. Power and radio Installation at Bhaadure  
3. Relay station built by trainees in Kaplivastu  
4. Relay tower installation training in Kaski

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This work has been developed with the financial support provided by the Information Society Innovation Fund – 2010.  

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## Project objectives
To enhance the capacity of the mountain community for building, maintaining and troubleshooting the wireless internet services independently by themselves

## Activities
Solar Power Installation and Maintenance Training was conducted.

## Time required for activities implementation
June 2010 - August 2010

## Overall assessment
There are five major wireless repeater stations on the mountain tops above 3,000m that run entirely on solar power. Therefore it was necessary to provide solar power installation and maintenance training for the wireless technicians from the villages. Chandreswor Choudhari from Sunpower Company, who is a solar power installation expert, provided one week long training to Subash Gurung, Raju Sunachouri, Bikaram Acharya, Tambahadur Pun, Gamprasad Purja and Kisan Pun at Mohare, Khopra, Larke and Dhakarjung relay station of Myagdi. The practical training included on how to connect the solar panels and storage batteries in series and parallel, how to protect the batteries from overcharging and how to maintain in the solar panels and storage batteries etc.

<table>
<thead>
<tr>
<th>Four residential training programs were organized in four districts</th>
<th>ENRD organized four residential training programs during the project period. The original format of the residential training program was to conduct the training in a city by bringing all the trainees. However, the plan was changed because the villagers suggested conducting the residential training programs in their districts during the meeting and discussion. Therefore, the residential training programs were conducted in the districts of Mustang, Gulmi, Makawanpur, and Gorakha. The brief details of the residential training program are as follows.</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2010</td>
<td>The first training was organized in Jomsom village of Mustang district, where 15 people from schools, and communication center, and offices were trained for ten days on basic networking and computer training. Narayan Sharma and Raju Sunachouri conducted the training in Mustang for 10 days.</td>
</tr>
<tr>
<td>October 2010</td>
<td>The second training program was conducted in Gulmi district, where 12 people from schools, and communication centers were given training for 10 days in basic wireless and computer networking. The training was conducted by technical staff, Santosh Baral, and outreach assistants, Sagar Gnawali and Amrit Kharel.</td>
</tr>
<tr>
<td>December 2010</td>
<td>The third training program was conducted in Chhatiwan village of Makawanpur districts for eight days, where 15 trainees from schools, communication centers, and a rural clinic were given trainings on wireless networking, basic computer networking, and the use of Internet and Wiki. It was conducted by Basanta Bishwakarma and Tej Ghale.</td>
</tr>
<tr>
<td>January 2010</td>
<td>The fourth residential training was given in Makaising village of Gorakha district for 10 days. There were 12 participants from different schools, and communication centers, who got training on basic wireless networking, computer networking, and the use of Internet and Wiki. The training program was conducted by Tej Ghale and Umesh Wagle.</td>
</tr>
</tbody>
</table>
### Technical report No. 2

<table>
<thead>
<tr>
<th>Project objectives</th>
<th>Activities</th>
<th>Time required for activities implementation</th>
<th>Overall assessment</th>
</tr>
</thead>
</table>
| To enhance the capacity of the mountain community for building, maintaining and troubleshooting the wireless internet services independently by themselves | Technical handbooks in Nepali completed | 4 months (2 months research and 2 month edition) | A technical handbook in Nepali titled “Handbook for Network Operators of Nepal Wireless” (140 pages). The handbook was structured based on the input obtained from the discussions with the rural technicians and operators and counted with the professional support from Subisu Cable Net, Data Space Center, Radius Communication, Nepal Research and Education Network, and Sastra Network Solution and individuals. The handbook includes screen shots to illustrate the actions to follow. The handbook covers the following topics:  
- Networking basics, which includes Internet protocols, IP addressing, submasking, subnetting, gateway, DHCP, DNS, routing and NATs, tracing routes etc.  
- Wireless radio configuration basics which includes configuration tips of some of the wireless radios such as Mikrotik, EnGenius, Motorola Canopy, and Linksys Router etc.  
- How to make cables, connectors and switches  
- How to use SIP phones, IP phones, Skype?  
- Troubleshooting network connection  
- Basic Radio Physics and some simple theoretical information about radio waves, frequencies etc.  
- How to design a wireless network?  
- How to build relay towers?  
- How to estimate link capacity and link planning?  
- How to use Radio Mobile software for link estimation?  
- How to protect the radios from power surge and lightening?  
- How to maintain storage batteries?  

| Wiki in Nepalese created | September 2010 | Content development in local language for the benefit of the villagers. Technical specifications:  
- Domain Name : http://www.nepalwireless.com.np/wiki  
- Server IP: internal (192.168.254.2)  
- External IP: (202.79.51.206)  
- Mysql Version: [protocol: 10 , v5.0.67-0ubuntu6]  
- Apache Version: Apache 2.2.9 (Ubuntu)  
- Media Wiki Version:1.16.0  
- The wiki page theme was changed and localized to Nepali language. 370 information pieces in Nepali language on different topics such as health, agriculture, science and technology including the handbook for the wireless technicians have been added on the Wiki. The wireless technicians, schoolteacher and the communication center operators are using it and they are also teaching the villagers how to use the Wiki  
- Developers: Saroj Dhakal, the wiki developer of Nepal Wireless created Wiki in Nepali language and installed it in Pokhara server. The names of the Wiki development team members are Santosh Baral, Kristina Thapa, Suresh Joshi, Pragya Khatiwada, Dipendra Mandal, Gyaneshor Bokti and Dambar Pun. |

<p>|            | November 2010 |                                      |
|            | December 2010 |                                      |
|            | January 2011  |                                      |
|            | February 2011 |                                      |</p>
<table>
<thead>
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<th>Project objectives</th>
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<tbody>
<tr>
<td>To assure the quality of service (QoS) in the wireless internet services of mountain for delivering basic social services such as communication, health and education</td>
<td>Weather station installation training done</td>
<td>August 2010</td>
<td>Climate change monitoring is a new field ENRD started to explore with support from the Asian Institute of Technology (Thailand) and equipment donated by The National Trust for Nature Conservation (NTNC) from Nepal and Dr. Kiyoshi Honda (AIT). The AIT researchers, Dr. Kiyoshi Honda and Mr. Aadit Shrestha, supported the deployment of solar powered weather stations located in Larke and Khopra (Nepal Wireless relay station). The installation of these weather stations in the Mustang district was organized, as a hands-on training workshop, were 3 of the ENRD wireless technicians received training to deploy weather stations.</td>
</tr>
</tbody>
</table>

Wview Open source software being used to collect real time weather data at Larke, Mustang.¹

The weather stations are connected to the network through a switch. Password protected outdoor cameras at Larke and Jomson offer 360 degree views of the Himalayas. This information is accessed by air traffic controllers in Pokhara and Jomsom to help them decide whether to take off/land from Pokhara. Larke camera: [http://202.166.211.245](http://202.166.211.245) (user admin, password airlive). Jomson camera: [http://202.166.211.244](http://202.166.211.244) (user - admin, password - admin).

An additional research will be conducted with support from Dr. Arnico Panday (University of Virginia, USA), where a network of wireless sensors connected to the Internet will be installed in the Mustang region to monitor the climate including the dust particles in the atmosphere.

Weather information at: [http://203.159.10.20/weather/LarkeStation/](http://203.159.10.20/weather/LarkeStation/)

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¹ Wview is a collection of linux/unix daemons which interface with a supported weather station to retrieve archive records (if generated by the station) and current conditions. If the station does not generate archive records internally, Wview will auto-generate archive records based on the sensor readings collected for that interval. The archive records and High/Low (HILOW) data are stored in PostgreSQL databases. At a configurable interval, wview utilizes the archive history and current conditions to generate weather images (buckets, dials and graphs) and HTML web pages based on user-configurable HTML templates. Online User Manual of Wview is available at [http://www.wviewweather.com/release-notes/wview-User-Manual.html#Introduction-whatis](http://www.wviewweather.com/release-notes/wview-User-Manual.html#Introduction-whatis)
<table>
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| To assure the quality of service (QoS) in the wireless internet services of mountain for delivering basic social services such as communication, health and education | Telemedicine training was done in five clinics | August 2010  
October 2010 | During the non-residential training period in the villages, the technical team members also worked with some of the rural health workers and provided training on how to use video conferencing software and contact the doctors in the city hospitals.  
Training was provided at the following clinics: Tikot Clinic, Ramche Sub-health post, Pharping Community Hospital, Dolakha Community Hospital and Kaski Model Hospital.  
Currently the project is using the Polycom software for video conferencing. However, as the costs of the licenses for this software are so expensive, an international team of volunteers have started to develop a multi-destination video conferencing software using open source software. |
| LTSP and Thin Client installation training organized | September 2010 | A training and installation program of LTSP (Linux Terminal Server Project) system was organized with the technical support of Help Nepal Foundation. The training was offered at Bhakimli village of the Myagdi district. A second training for Thin Client installation was offered at the high school of Rima Village where 3 teachers and 2 wireless technicians were trained.  
These training programs were organized to offer a cheaper alternative to build computer labs in the schools and village communication centers. The LTSP server use Linux and the client machines of the do require less memory and have no hard disk at all. The Thin Client system does not need any extra CPU box, which offers an additional benefit. So far both the LTSP and Thin Client systems are working well. ENRD is going to provide more training for the computer teachers and wireless technicians on how to install these systems. |

1 Wireless radio installation training in Bhakimli  
2 Omni antenna (Green) made by our team  
3 Putting grounding plate at Kalika  
4 LTSP system installation training in Bhakimli
## Project outputs and dissemination

<table>
<thead>
<tr>
<th>Project outputs</th>
<th>Status</th>
<th>Assessment</th>
<th>Dissemination efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training for Trainers</td>
<td>Completed</td>
<td>ENRD has completed Training for Trainers (TOTs) for 3 technical engineers and 8 outreach assistants. Also 2 of our trainers, Subash Gurung and Dambar Pun got opportunity to attend a 5 days wireless networking training organized by the WirelessU project, called “Wireless Internet for Connectivity Workshop” held at the Asian Institute of Technology in Thailand from 7-11 February 2011. The training program provided very good opportunities for our technicians to learn more skills and knowledge about wireless networking. Our trainees also gave presentation about the activities of Nepal Wireless Project.</td>
<td>The Digital Empowerment Foundation based in New Delhi requested ENRD to provide a wireless networking training to their rural technicians in 3 different locations: Chanderi, Gahati and Champaran. The trainers Rajendra Prasad Poudel and Bikram Acharya went to Chanderi and provided a one week wireless networking training to people at the grassroots level. After the formal training, they supported the community to built a small wireless mesh network there. A brief report of the training program in India has been attached in the annexes section of this report. In December, our technical engineer Santosh Baral provided a refresher training for the wireless technicians in Gahati (India). The training and wireless network deployment for the Champaran district (India) is currently under planning. ENRD has received requests for help to build wireless networks in Tanahun, Lamjung, Gorakha, and Solukhumbu districts of Nepal. Using the trained human resources that we have now, we will be running similar type of on-the-spot training programs on wireless networking for the people of those districts during the time of installation as well.</td>
</tr>
<tr>
<td>Wiki in Nepali language has been developed and is available now for the villagers</td>
<td>Completed</td>
<td>Under the technical guidance of Saroj Dhakal, the professional Wiki Developer, our Wiki developer team collected more than 370 information pieces in Nepali language and upload them to the Wiki. We will keep adding more content useful for the villagers, as there is are not many content available in Nepali language in the Internet so far.</td>
<td>Now the schoolteachers and the wireless technician have started using the Wiki in Nepali language to get information. They have also started teaching how to use the Wiki to the villagers as well.</td>
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<table>
<thead>
<tr>
<th>Project outputs</th>
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<th>Assessment</th>
<th>Dissemination efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>A handbook in Nepali language for the wireless technicians and communication</td>
<td>Completed</td>
<td>This is one of the major goals of the project and is a useful output. Now we have prepared the handbook in Nepali language with lots of screenshots of the wireless radios and computer configuration techniques.</td>
<td>The materials are available in Nepali Wiki as well. Also hard copies of the handbook has been printed and distributed to the wireless technicians and rural operators.</td>
</tr>
<tr>
<td>center operators</td>
<td></td>
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</tr>
<tr>
<td>Nepal Wireless provided internship to college students</td>
<td>Completed</td>
<td>Each year, the final year students of Kathmandu University and Tribhuvan University do their internship with ENRD on wireless networking and on the use of the information and communication technology for the benefits of rural population. This year five students completed their internship program with Nepal Wireless. They got wireless networking training during our non-residential training period. After they finished their final year, two of the students helped ENRD to collect contents on science and health, and put them in the Nepal Wireless Wiki.</td>
<td>ENRD is going to continue providing internship opportunities to more college students in the coming years as well.</td>
</tr>
<tr>
<td>Our technicians learned how to install weather station equipment</td>
<td>Completed</td>
<td>This is something we had not planned when we prepared the project proposal. The installation of the weather station for climate monitoring was a pilot project to collect data about air quality and climate through wireless sensors connected to the Internet. Now the researchers have been able to collect real time data. 3 of our technicians learned how to install a weather station and how to make it available online through a field server. The hands on training allowed the Vaisala weather station to be deployed (Larke village, at the Mustang district).</td>
<td>Please specify what dissemination efforts were made, with special attention to those intending to reach target groups by gender, age, ethnic and socio-economic profiles to impact marginalized and disadvantaged groups.</td>
</tr>
<tr>
<td>Nepal Wireless network monitoring system has been set up</td>
<td>Completed</td>
<td>With the technical support from the Nepal Research and Education Network, our technical engineers have been trained to deploy a network monitoring system using traffic graphic software called Cacti and Network Traffic Monitoring. With the implementation of this system, our technicians have been able to monitor the status of the routers and wireless radios in each of the relay stations in the network. The following is the screenshot of the graph taken by using the network monitoring tool.</td>
<td></td>
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</table>
### Project outputs: Promotion of Nepal Wireless activities in Japan and India (Mahabir Pun)

<table>
<thead>
<tr>
<th>Status</th>
<th>Assessment</th>
<th>Dissemination efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed</td>
<td>Our Team Leader, Mahabir Pun, was invited to do a presentation about the activities of Nepal Wireless Networking Project at the &quot;Knowledge Transfer: Modern Technologies for Nation Building&quot; symposium organized by the Kyushu University in Japan. It was a very good opportunity for ENRD to share knowledge with people abroad.</td>
<td>During the visit, Kyushu University has shown interest to work together with ENRD on research projects such as developing sensors for collecting climate data, and developing wireless surveillance system for monitoring the poachers in the national parks of Nepal. It will be very helpful to save the endangered species like tigers, rhinos and others in the national parks of Nepal if such a surveillance system can be developed. Every year poachers kill many wild animals. The Department of National Parks of Nepal has also agreed to build a surveillance system for pilot testing. Actually we have formed a technical team with members from Japan, the US and Nepal and we are working together to come up with an idea to set up a pilot project within a few months. KDDI Japan showed interest to help us install Femtocell technology in the rural areas of Nepal to expand the coverage of mobile network in remote areas using the wireless network build by Nepal Wireless. SoftBank is interested to work with Nepal Wireless on their plans to expand their business in Nepal and conduct software outsourcing in Nepal. Similarly, NICT Japan is interested to work with Nepal Wireless Networking Project to do field test of the next generation networking technology they are developing. ENRD has been able to disseminate the knowledge and skill of wireless networking and its application with people in foreign countries as well.</td>
</tr>
</tbody>
</table>

**Mahabir Pun at (NICT), Japan**

The project leader also gave presentations about the activities of wireless networking project in November 2010 and February 2011. One of our wireless technicians was also invited to put stall and display posters of our activities during the exhibition. The first exhibition was organized by Digital Empowerment Foundation in New Delhi and the second was organized by Businessworld initiatives in Kolkata, India. The event in Kolkata was “the largest congregation of ICT professionals, buyers-sellers, corporate leaders, academicians, visionaries, and policymakers in India”. Those conferences and exhibition provided good opportunity for ENRD.

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Lessons learned from project implementation

Nepal Wireless was born in 2002 with almost no technical knowledge about deploying wireless networks. We started the project from scratch and had to learn everything by doing it. Now, after all these years, we have many lessons to share:

- **Capability of Wireless Devices:** We had learned that the throughputs and range of Wi-Fi devices can be exceeded in the remote areas, where there is very little or none interference and the mountains can be used to achieve line-of-sight from a high mountaintop to other mountain. These set of circumstances offer good clearance for the radio waves to travel.

- **Usefulness of Wireless Device:** We have learned that a wireless device can be use not only to expand connectivity to the Internet but to deliver bandwidth-consuming activities like telemedicine, and tele-education through video conferencing at cheaper costs.

- **Wi-Fi is good for network backbone:** Wi-Fi equipment is a good option to build long-range wireless network in the rural remote areas, without the need to pay for licensed spectrum use. Different brands offer devices that operate in the 2.4 GHz and 5.7 GHz bands that can be used to build a wireless network backbone.

- **Local people with high school education can be trained as Wi-Fi wireless technicians:** Our experience tells that we don’t need a trained IT professional or a college graduate to install community Wi-Fi wireless networks. With training and guidance, villagers with high school diploma can setup and operate a community wireless network. A localized handbook for the wireless technicians has proof to be very useful.

- **Power needed at the Relay Stations is the most challenging and expensive part for building a wireless network:** Producing power at the isolated relay stations to run the wireless equipment is very challenging. ENRD has explored a variety of power sources from solar, wind and hydro to the human operated bicycle generator.

- **Record keeping of the equipment and their configurations is required:** While building wireless networks in the rural areas it is very important to keep manuals for every piece of equipment in a central location and a digital copy of them in a local server. It is necessary to maintain a record of all passwords used and backup the configurations for all devices and computers. It is good to have duplicates of every piece of equipment on the network and document, even with just simple notes, about every failed experiment. Building a Wiki page to put all the information of radio configuration and equipment inventory is necessary.
During the implementation of this project, our team members have done the followings findings. The information is useful for building wireless network in rural areas.

- **Identify the best surge protection equipment for your needs:** Protecting the equipment at the relay station and at the end user's home from power surge and lightening is one of the biggest technical problems that wireless networks have to address. As part of our research program, our team members Dipendra Mandal and Suresh Joshi did a thorough research on finding the best power surge protection system for the wireless devices. They found four equipment made by Legrand, TOR, Reyun and Hager available in the Nepali market. Our project now is using surge protector made by Hager in every relay station we built during the non-residential training period. The report on the surge protection system is included in the annexes section of this report. However, it is important to remember that the surge protector won’t work at all if the lightening arrestors and electrical wiring is not grounded properly.

- **Explore the wireless radios market and decide which ones to use according to your needs:** There are many brands of 802.11 a/b/g/n wireless equipment available in the market at affordable prices offering different capabilities. During our training period, we used radios built by Mikrotik as the access point, which offers a multi-wireless card router board that can be configured at 2.4 GHz and 5 GHz frequencies based upon the needs and includes a complete package for monitoring and maintaining the networks. For the last mile connectivity, we used cheaper Wi-Fi equipment that is easily available in the market such as Ubiquity, EnGenius, TP Link and many more equipment.

- **Omni directional antenna can be built easily using local material:** Our technical team members have been able to build 5 Omni-directional antennas by themselves during the training period, operating at 2.4 GHz and 5.8 GHz, and for 50% less of the market cost (50%). The antennas are in use at Mustang and Myagdi.

- **Micro-hydro system would be the best options for power if it is available:** While building relay station in an area without power from grid line, we have found that it is cheaper and cost effective to use micro hydro power in the rural areas if there is a stream nearby with good head. It is because a small hydro generator (say 1 KW) provides electricity for 24 hours for the village whereas solar panels can charge storage batteries for about five to six hours a day on average depending upon the time of the year. During the monsoon time in Nepal, the photo voltaic solar panels can charge the batteries only for a couple of hours with minimum charging amperage. We are using power from small hydro generators in some villages.

- **LTSP and Thin Clients system are the low cost solution to build computer labs and communication centers:** Although computers are getting more affordable, Thin clients and LTSP systems are the cheapest ways to build computer lab in schools or communication centers that facilitates maintenance and monitoring. Our technical team helped to set up a computer lab in Rima village with Thin Clients. Also they installed LTSP system at Bhakimle village. One technical problem that our team members found was that all the BIOS do not
support booting from LAN, which is required to run LTSP system. They learned that the BIOS of American Megatrends Inc. (AMI) and Phoenix Technologies can support boot from LAN.

- **A combination of wireless and optical fiber network can be built in rural areas:** When ENRD submitted the proposal we had not planned to provide training on building a hybrid network using wireless and optical fiber technology. During the non-residential training period in Gulmi district, we found that a combination of wireless and optical fiber can also be built. Using the optical fiber line leased from private cable operators, we have now built a hybrid network of optical fiber and wireless technology and it is working very well. Therefore we also provided similar non-residential training to some of our trainees in Myagdi to build a hybrid network of optical fiber and wireless technology. The schematic diagram of the wireless and optical fiber network is given below.

![Sketch showing how wireless and optical fiber technology can be integrated to build a network in rural areas](image)

- **The uses of Internet in various social networking has empowered the rural community:** The connectivity provided by the wireless network not only provides access to basic communication services, education or health information but also they are freely expressing their voices using social networking tools. The e-bulletin facility has provided the opportunity for people from different communities to share their thoughts, post their news. The community has also been has also been learning how to provide information about their products through on line local e-commerce site.

- **Community members are more aware about the Internet can provide access to information and the benefits for their communities:** Once we started to organize training in villages, we receive large numbers of requests to deploy wireless networks to provide communication and information services. Requests came from both genders, different age levels and from various communities. We have found that the younger generations in the rural areas, like their counterparts in the cities, are more inclined to use the computers and the Internet.
Best Practices

ENRD has learned that the capacity and working style of community members from different ethnic groups or different villages or different regions are not the same all the time. If one implementation plan works for one community, there is no guarantee that the same plan will work in other communities. Therefore we need to adopt the project accordingly by making changes in the project implementation procedures depending upon the characteristics of the community being supported, their capacity and needs. The community members must be involved in the decision-making process from the very beginning and give them as much responsibility as possible to implement the project and manage it. ENRD is exactly working this way to build wireless networks in different villages of Nepal and to make it run successfully.

We have also learned that the best person to operate the network and maintained is a local person, that understands the community needs and is committed to support the community development and want to stay and serve its people. We request the villagers to select a couple of people with high school diplomas, who have expressed interest in wireless and Internet. ENRD provides them field training from the very beginning by making them involved in wireless equipment installation process. They will need a couple of months to become reliable wireless technicians, if they have deep interest to learn about the technology. We don’t see the need to hire IT college graduates for that. We consider that is a best practice to train and support local technicians, specially in remote areas.

Capacity building

The goal of this project was to build local capacity for the installation, daily operation and maintenance of wireless networks. As the network keeps expanding, ENRD need more trained people. The project goals were to support at least 15 new wireless technicians from the rural areas of Nepal and to provide advance training to 8 rural communication center operators, who have been already working for the project. We have met this goal and have produced 22 wireless technicians in total from different villages. The names of the villages from where we have produced trained operators are: Nagi, Tikot, Paudwar, Narchayng, Shikha, Jomsom, Kolma, Lamagaun, Bange, Tolka, Bhadaure, Chandrakot, D Burlung, Hatya, Baletaksar, Dandagaun, Chhatiwan, Makaising, Hetaunda, Barpak, Charikut, and Manthali.

This project has helped us to provide higher level of technical training for the Nepal Wireless project team, as two of our technicians were able to attend a 5 days wireless and telemedicine training organized by WirelessU. The “Wireless Internet for Connectivity Workshop” was held at Asian Institute of Technology Thailand from 7-11 February 2011. The training program offered very good opportunities for our technicians to learn more skills and gain knowledge about wireless networking.
After the wireless training at AIT, Subash and Dambar visited the Hospital-OS project\(^5\), currently working on the development of hospital management software for small hospitals, using open source to support small hospitals. The Thailand Research Fund financially supports the initiative. A 3 days training workshop was provided and further training will be provided in the near future. ENRD is planning to use this software to support hospitals and rural clinics in Nepal where we have started telemedicine services, customizing the software based upon the local needs.

The training provided from our technical staff to the Digital Empowerment Foundation initiatives in India (Chanderi and Gauhati) provided a great opportunity to build capacity in our technicians by sharing ideas and thoughts.

ENRD has assigned a high priority to support women and marginalized groups, such as indigenous communities. Opportunities have been provided through the selection process and training provided to become communication center operators and wireless technicians, positions that have been taken by members of such marginalized groups.

Women participation, however, has been confined to computer lab operators in the schools. Although ENRD has tried to support women to become wireless technicians, the social and cultural barriers have put them off, as is not accepted that a woman travel alone to different villages, or take physically demanding tasks such as climb mountains to build and repair relay stations of wireless networks.

\(^5\) http://www.hospital-os.com/en/
Project management and sustainability

ENRD is an implementing and support organization that helps to bring the benefits of information technology for the rural population by building wireless network to connect the villages and then providing training for the villagers on how to use the technology to get the most benefit out of it. In order to do both research and implementation activities, ENRD has developed a simple management system to look after both issues.

Initially all of our team members were volunteers from abroad and Nepal. Once the project started to expand on larger scale from 2006, ENRD had to develop the management team. ENRD is a small organization with a few full-time researchers and administrative staff. Many of our technicians and technical engineers are working as volunteers. IT college students join the team as volunteers or through internships every year to support research and project implementation activities.

ENRD is working to bring down the costs for the end customers. In order to achieve that, research experiments are conducted on specific hardware available in the market to determine its reliability and robustness; and to assemble cheaper radios with homebuilt antennas.

ENRD conducts research to identify useful applications and online services that can be provided to rural people to support their communication and information needs (e-education, e-health, e-commerce, etc.). The team also supports the development of online applications to address specific needs of the project or those from its community partners.

As for managing the project implementation issues and financial record keeping, ENRD has an administrative team that consists of an administration officer, a member secretary and a financial officer. The administrative team offers support to communities interested to start a new wireless project. Once the communities have a clear understanding and are ready to allocate financial resources to connect their villages to the wireless network, an MoU is signed between ENRD and the villagers.

Then the technical team visits the new sites and do details survey of the area. The team first determines if Line of Sight (LoS) can be reached from the site to an existing access point and registers the coordinates of potential sites for relay stations to connect end users. They also record the coordinates where end users will be located. Once the data is collected, the technical team designs a detailed plan, including the estimated cost for the implementation. Once the villagers approve the budget and are ok to start the project, the technical teams are mobilized to deploy the wireless network.

As for the scientific and technical management of the project, a group of 2 senior engineers and 2 system administrators are systematically managing the technical issues of the project. A
restricted access wiki page\(^6\) has been implemented to keep the technical documentation for the whole network. This page is accessible only to the authorized persons of the project.

The responsibility for managing, maintaining and operating each community wireless network lays in the hands of a management committee established in each village. Since the committee members are locals, the local technical staff has very good support to understand the local situation including people and their culture. This form of administrative and management system is helping ENRD to fulfill the objectives of the project.

**Project Sustainability**

ENRD is very much aware of the sustainability issues, which is the greatest challenges to be met by any projects. For project like ours, there are two sustainability issues we need to address when we build wireless networks and introduce information and communication technology in the rural areas with most of the people with almost no technical knowhow.

The two issues that need to be addressed are technical sustainability and financial sustainability. We would like to tell that both of those sustainability issues are very important in order to make a technical project like ours sustain for long terms. Actually technical sustainability is a must to make a wireless networking project financially sustain. In clear term, technical sustainability and process sustainability can mean the same thing. The process of providing e-services smoothly and effectively to generate income is possible only when a wireless network is technically sustained. If a wireless network is not technically sustained, we will not be able to run e-services smoothly. Thus there is no chance for a project like ours to sustain financially.

This is something we have been facing as problem for several years because we did not have well-trained technicians for our project. That is why we proposed ISIF for support for capacity building. With the non-residential and residential technical training that our technicians got, Nepal Wireless Networking Project will sustained technically without much support from outside technical assistances at least for some times. However, technical training for one time is not enough and ENRD will keep providing refresher trainings for the technicians in coming years.

Based upon our experience, we can tell that hiring local technicians for a rural project is very important for the technical and overall sustainability of a project. It is because if we hire people from distant villages as a wireless technician, he or she may not be available all the times. On the other hand, a local technician will be available and will be able to fix technical problem whenever it is needs.

Moreover, giving full management responsibility is the key for the sustainability of a wireless network. If local people are given management responsibility, the villagers will provide community contributions and support such as menial labor work for building wireless repeater station or for carrying and installing equipment in the villages from the nearest highway or for

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\(^6\) https://ns.nren.net.np/wiki-nwp/index.php/Main_Page

This work has been developed with the financial support provided by the Information Society Innovation Fund – 2010.

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arranging training programs in the villages. The communication centers and the wireless network that we have built has sustained financially because the management responsibility has been given to the local management team from the very beginning.

Now we hope that Nepal Wireless will be able to sustain technically and financially. It is because we will be able to provide e-services effectively with the help of the trained wireless technicians and communication center operators. The smooth operation will bring more people to get services, which will bring income for the wireless project. Once the project becomes financially and technically sustainable, the retention of staff will increase because they will feel secured to stay and work in the rural areas.

**Impact**

ENRD has been able to accomplish the project objectives during the project timeline. The technical team, including the outreach assistants, has been able to receive and provide several training opportunities to build the capacities of 22 people.

The on-the-spot training program was our most successful strategy for capacity building. The rural network operators have been able to get practical training in the field, learning by doing and gaining confidence on their abilities. They were able to set up relay stations, put lightening and surge protections at the relay towers, and configure the wireless radios as access points and client radios. We are confident that the human capacities that have been nourished during the project cycle will certainly help ENRD to meet the shortage of qualified technicians in the rural areas of Nepal.

As this type of training was designed as a response to the request of the rural technicians for more technical training, they were already motivated to get the best out of the training opportunity to work for the wireless networking project.

The residential training on wireless networking and Internet usages that was provided in four districts to 54 rural people from different backgrounds has certainly been very useful for them. Those people were selected during our research period for the training because they were self-motivated to get wireless networking and Internet training, and apply the knowledge in their lives.

We anticipate that the training provided through this project will have long term and positive impact to the beneficiaries listed below:

- Network operators from local community, who will have some job opportunities in the villages.
- School students and teachers in rural areas through e-learning opportunities.
- Villagers, who frequently use the Internet to communicate with their relatives in abroad,
- Villagers, who will get health services through telemedicine program of our project.
- Tourists, who want to access Internet in the cybercafés located in the mountain villages.

This work has been developed with the financial support provided by the Information Society Innovation Fund – 2010.

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Local businessmen and organization that are using Internet services to promote their business.

Overall Assessment

The grant of AUD 40,000 to ENRD was certainly a great support for empowering the mountain community to build and maintain wireless network through training and localized support kits.

Since the set up of the first wireless link back in 2002, the demand for help to connect remote villages to the Internet has been increasing very fast, reaching more than 150 villages of the 13 remote districts of Nepal. Most of the rural projects were initiated with the financial contribution of local villagers and local governments and ENRD has been providing technical supports only.

Although ENRD has been running small-scale training program informally for the wireless technicians and network operators since 2004, this is the first time ENRD conducted a training program formally in such a large scale. Therefore we regard this support as timely and very helpful.

The training project supported 6 highly trained local technicians, who would be the core force to complete the expansion of the wireless network in the rural areas and conduct appropriate technical maintenance so the services are reliable. The project also supported 22 villagers and local staff, who have fairly good knowledge about wireless technology, local area networking, Internet, computer hardware and software installation.

The project set the basis for an structured training program available offering support to information center operators living in high mountain villages, through the use of a localized wireless handbook and online Wiki.

Trainees have knowledge to collaborate with local organizations and individuals and handover their skills to younger generation in order to keep wireless network running and provide the benefits to the communities. The model, the techniques, the experiences, and the methodologies developed by our project are being replicated in other areas of Nepal and in some parts of India.

The program encouraged equal participation to the community and organizations for accessing the technology and improving the quality of services through the wireless network.

As for the overall assessment of the project, we would say that the project has been quite successful for the following reasons:

- The project provided practical hands-on and field training for building wireless broadband network to 22 technicians from 15 villages.
- The trainees successfully setup wireless networks in 7 places during the training period.
- A localized handbook to help the wireless technicians and rural operators was produced.
- A localized Wiki and content available in Nepali language has been produced for the benefit of the villagers and hosted in the local network securing access to all the villagers.
The project becomes able to improve the network’s Quality of Service offering faster and reliable services in the newly connected and already connected villages.

The project supported provided technical training for Digital Empowerment Foundation (DEF) with the grant support of Internet Society (ISOC) to build rural broadband wireless networking in Chanderi (India).

The monitoring journal sheet in the Outcome Mapping (OM) framework of stage 2 has shown that the overall achievement of the project is in high level and fulfilled the objectives of the project. From the reference of monitoring journal sheet, the local participation is very high to organize the training program and build wireless network. In the last 10 months the community people have utilized their time, effort and local resources to build wireless network in their village and have received technical training to maintain and run the wireless project. An in-depth research and study in future will be necessary to explore the impact of the training project and all the contribution made by local level to complete the project successfully.

Another strength of the project is that the 10 months timeframe was sufficient to implement the project activities. The team had enough time to conduct the baseline survey, to interact with people, to choose sites for the trainings, to prepare training handbook by discussing with the villagers and to run the training program. There was enough time to send our trainees to the project sites and provide field training in the real situation. The structured and consultative planning process was the base to organize 7 non-residential training programs successfully.

The second strength of the project is that all the trainees were from the villagers. None of them are living in the cities. This will make the wireless technicians available in the villages whenever they are needed.

Therefore the ISIF support has certainly reinforced us to improve skills, and knowledge of our institutions and to support the local community to own their infrastructure and the knowledge required to operate it and offer a reliable service.

**Recommendations**

- Scope of the training subjects and content should be expanded to energy production and utilization as well because the majority of the rural areas requiring ICT access have no power available.

- ICT should not be taken as a tool only for other economic activities but it should be adopted as an independent area, which has higher potential for improving rural economy.

- Encouragement programs for the rural communities to adopt ICT are necessary.

- Funding agencies should allocate separate fund for the impact assessment study and evaluation study of project supported by them.
✓ Support to establish links with different organization around the world in order to share knowledge and learn from each other should be considered.

✓ Additional programs should be organized to empower and strengthen the implementing organization.
Annex 1: OM intentional design ISIF-ENRD
E-Network Research and Development (ENRD)

OUTCOME MAPPING FRAMEWORK
Prepared by: Mr. Rajendra Prasad Poudel, OM Experts

Stage 1- Intentional Design
The Information Society Innovation Fund (ISIF) Grant – 2010
January, 2011

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OUTCOME MAPPING FRAMEWORK
Stage 1- Intentional Design

The Information Society Innovation Fund (ISIF) Grant – 2010
Empowering mountain community to maintain and build wireless network through localized support kit and training (ENRD)

Introduction
E-Networking Research and Development (ENRD) has been supporting to run Nepal Wireless Networking Project that was started in 2002 by Himanchal Higher secondary school, Nangi from the demand of the grassroots level with the technical support of international volunteers. Except the highly technical issues, the rural people are taking the full responsibility for the maintenance and operation of the network, which is very important for the technical and financial sustainability of wireless networks. However, the wireless network is expanding in many more villages in the mountain region of the Himalayas. Therefore more technical staff from the villages was greatly needed to be trained. With the financial support from, The Information Society Innovation Fund (ISIF) Asia, ENRD ran wireless networking training programs for the rural wireless operators and has been able to produce highly skilled and qualified trainers and local technicians in the mountain villages. ENRD has selected 15 villages for this training programs and provided to the training to the 24 people who are directly working in Nepal wireless network.

The main objective of the project was to enhance the capacity of the wireless operators of Nepal Wireless Networking Project for building, maintaining and trouble shooting the wireless internet services. Almost all of the trainees were has some or almost no technical backgrounds. Therefore localized training manuals, handbooks and kits were developed for making the project as beneficial as possible for the rural operators. The project provided basic theoretical trainings, however, it focused more on practical training in order to address the developmental problem and to meet the objectives of the project. By practical training, we mean the training organized in the field where we were setting up real wireless network. To make the practical training more effective, the project prepared a handbook in simple Nepali language that was used by the wireless technicians and operators during the training period. During the training-cum-installation period our technical team also built Omni directional antennas by using locally available materials, which turned out to be much cheaper than the ones available in the market. Beyond wireless training there has been organized end users training in various tele-center and computer lab owned by community. This training has encouraged rural community to use the benefits of the internet technology.
### Design worksheet 1- Program Framework

#### Vision Statement:
The Tele-center operators living in high altitude use localized wireless networking handbook and online wiki to build and maintain the wireless network in their villages. These operators have enough technical capacity to collaborate with other local organizations and individuals to collect fund as well as handover their skills to other young generation in order to keep running wireless network in their villages and provide the benefits to the community. Such benefits of technology is accessing by equal participation of gender, marginalized community and ethnic group. The model, the experiences and the techniques and methodologies developed by the project are replicating in other areas of the South Asia.

#### Mission Statement:
The project will focus mainly on building the capacity of local community people from 15 different villages to use and deploy the localized wireless networking handbook to build and maintain existing wireless network. The program will encourage equal participation of community and organizations accessing the technology and increase the quality of services (QoS) through the wireless network.

<table>
<thead>
<tr>
<th>Boundary Partners 1: Tele-center Operators</th>
<th>Outcome challenge 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISIF Funded grant program wants to see to enhance the technical capacity of tele-center operators to use Wireless networking hand book written in local language they speak. They need to build their capacity to use ICT in their local language and local content. They are able to build and maintain the wireless network in their village and if face any complex technical problem they can request help with the specialized technical national and international volunteers who has been supporting this network since last 10 years. Operators will provide similar training to other villagers who are interested to receive such skill and are capable of exchange their technical skills and knowledge and important tips from the localized wiki hosted in the network server. At least 24 operators will receive such training and get enough knowledge</td>
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</tr>
<tr>
<td>Boundary Partner 2: Local community Based Groups</td>
<td>Outcome challenge 2</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>ISIF Funded grant program wants to see to enhance the capacity of local community groups, their representatives and members understand the role and importance of wireless network and support to organize training as well as support to extend wireless network in their villages. Local community based group will establish collaboration among the local stakeholders and local government to organize the training and build wireless network in their villages. There are at least 15 villages community based groups will be involved in the program activities</td>
<td></td>
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</tbody>
</table>
# Design worksheet 2 - Progress Markers

ISIF Funded grant program wants to see to enhance the technical capacity of tele-center operators to use Wireless networking hand book written in local language they speak. They need to build their capacity to use ICT in their local language and local content. They are able to build and maintain the wireless network in their village and if face any complex technical problem they can request help with the specialized technical national and international volunteers who has been supporting this network since last 10 years. Operators will provide similar training to other villagers who are interested to receive such skill and are capable of exchange their technical skills and knowledge and important tips from the localized wiki hosted in the network server. At least 24 operators will receive such training and get enough knowledge.

<table>
<thead>
<tr>
<th>Expect to see – Tele-center Operators and Local community Based Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Participate in the regular discussion meetings in local level to identify opportunities for training.</td>
</tr>
<tr>
<td>2. Acquiring the new concept for participating in the training and development program</td>
</tr>
<tr>
<td>3. Contributing to collect local resources to run wireless training and build wireless network in their village to connect other villages as well as their schools and health post near their villages.</td>
</tr>
<tr>
<td>4. Establishing relation among other local organizations, groups and individual to continue such training in future.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Like to see – Tele-center Operators and Local community Based Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Involve in the process of building wireless networking infrastructure in their localities.</td>
</tr>
<tr>
<td>2. Encouraging others their relatives, friends, neighbors, and stakeholders to participate in the similar training program in future.</td>
</tr>
<tr>
<td>3. Develop a social network among the villagers and neighboring villages to build and maintain wireless network to keep sustain.</td>
</tr>
<tr>
<td>4. Coordinating and expanding the joint work to deployment of localized computing technology in every day activities of the local people.</td>
</tr>
<tr>
<td>5. Involving in the process of deploying the technology to manage own system. Such as management of local area network (LAN) and connect network to the people or organizations who are demanding the access of internet via Nepal wireless relay stations.</td>
</tr>
<tr>
<td>6. Identifying the opportunities for providing similar training to build the technical capacity of the local people.</td>
</tr>
<tr>
<td>7. Collecting the problems, troubleshooting tips and uploading in the localized wiki hosted</td>
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</table>
by project in the server connected with the wireless local network

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</table>
| 8 | Requesting new opportunities for increasing participation in the training program of localized computing technology in future.

**Love to see – Tele-center Operators and Local community Based Groups**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 1 | Playing a leading role in using localized hand book of wireless networking in village and encourage others to use it.
| 2 | Sharing lessons and experience through the wiki and encourage other to build and extend the wireless network in their villages.
| 3 | Influencing community level programme for formulating policy on prioritizing ICT as important component and making concentrate ICT development policy in the area.
<table>
<thead>
<tr>
<th>S.N</th>
<th>Practices</th>
<th>Key Actions</th>
</tr>
</thead>
</table>
| 1   | **Practice 1:** Prospecting for new ideas, *opportunities*, and resources | - Discussed with various national and international volunteers who has been supporting to build wireless network since last 10 years.  
- Organizing regular staffs and team members meeting to see new ideas for the training and mobilizing resources.  
- Study of related literature: Team members search as much sources of information on related issues.  
- Team members involve in discussion with various technical groups and workshop in side country as well as outside country to identify new relations and opportunities. |
| 2   | **Practice 2:** Seeking feedback from the key informants                  | - Team members actively involve in gathering the views, options and suggestion from the local level training program, governments organizations, and funding agencies to receive the key conceptual information and feedback by e-mails and meetings.  
- Conduct baseline survey from the 15 selected area of the project and frequently communication with it’s boundary partners to identify the existing situation, ongoing program impacts and attitude of the target users.  
- Team members actively involve in e-mailing, face to face discussion program and sometimes filling questionnaires to find out the people who are unsatisfied by the program and receive the key information from them on their dissatisfaction.  
- Team members involve in the meeting with governmental and other line agencies to get the feedback and key information of the program in the area. |
| 3   | **Practice 3:** Obtaining the support from next highest power of organization | - Team members present the update of the activity to the board members of the organization.  
- Simultaneously program members present and regular update the finding of the study and activities done in the project to the Team leader  
- Team members involve in presenting all the progress, challenges and lesson learn of the programs to the related government agencies and collect feedback and suggestion from them and shared them in internal forum. |
<p>| 4   | <strong>Practice 4:</strong> Assessing and re-designing products services, and procedures | - Team members involve for taking interim survey and feed back from boundary partners of the program. On necessity the training manual, training plan or methodology and modified accordingly. |</p>
<table>
<thead>
<tr>
<th>Practice</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Practice 5: Checking up on those already served to add value</td>
<td>Training staffs involve in the discussions to explore the duplication in training manual, training materials and training plan and avoid those duplication in future program.</td>
<td></td>
</tr>
<tr>
<td>6 Practice 6: Sharing your best wisdom with the world</td>
<td>Team members identify conferences and workshops on wireless network and localized computing technology and rural ICT and delivers papers and seminars on the experience and lesson learnt in the program; nationally and internationally</td>
<td></td>
</tr>
<tr>
<td>7 Practice 7: Experimenting to remain innovative</td>
<td>Team members involve in the discussion with existing boundary partners on exploring new boundary partners for new activities to take the program to height.</td>
<td></td>
</tr>
<tr>
<td>8 Practice 8: Engaging in organizational reflection</td>
<td>Team members are seriously curious to know the intervention coming in the program and continuously make an effort to learn from each intervention.</td>
<td></td>
</tr>
</tbody>
</table>
### Stage 2 - Outcome and Performance Monitoring

#### Monitoring Worksheet 5 - Outcome Journal

**Boundary Partner:** Tele-center Operators and Local community Based Groups

**Outcome Challenge:**
ISIF Funded grant program wants to see to enhance the technical capacity of tele-center operators to use Wireless networking hand book written in local language they speak. They need to build their capacity to use ICT in their local language and local content. They are able to build and maintain the wireless network in their village and if face any complex technical problem they can request help with the specialized technical national and international volunteers who has been supporting this network since last 10 years. Operators will provide similar training to other villagers who are interested to receive such skill and are capable of exchange their technical skills and knowledge and important tips from the localized wiki hosted in the network server. At least 24 operators will receive such training and get enough knowledge.

#### Expect to see – Tele-center Operators and Local community Based Groups

<table>
<thead>
<tr>
<th>Scale</th>
<th>Progress Markers</th>
<th>Source of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Participate in the regular discussion meetings in local level to identify opportunities for training.</td>
<td>Meeting Minute</td>
</tr>
<tr>
<td>Medium</td>
<td>Acquiring the new concept for participating in the training and development program</td>
<td>Survey and observation</td>
</tr>
<tr>
<td>High</td>
<td>Contributing to collect local resources to run wireless training and build wireless network in their village to connect other villages as well as their schools and health post near their villages.</td>
<td>Observation, Survey and record documents</td>
</tr>
<tr>
<td>Low</td>
<td>Establishing relation among other local organizations, groups and individual to continue such training in future.</td>
<td>Observation</td>
</tr>
</tbody>
</table>

#### Like to see – Tele-center Operators and Local community Based Groups

<p>| High   | Involve in the process of building wireless networking infrastructure in their localities.                                                                                                                      | Observation and survey                  |
| High   | Encouraging others their relatives, friends, neighbors, and stakeholders to participate in the similar training program in future.                                                                          | Survey                                  |
| Medium | Develop a social network among the villagers and neighboring villages to build and maintain wireless network to keep sustain.                                                                          | Survey                                  |</p>
<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Coordinating and expanding the joint work to deployment of localized computing technology in every day activities of the local people.</td>
<td>Observation and survey</td>
</tr>
<tr>
<td>Low</td>
<td>Involving in the process of deploying the technology to manage own system. Such as management of local area network (LAN) and connect network to the people or organizations who are demanding the access of internet via Nepal wireless relay stations.</td>
<td>Observation and Survey</td>
</tr>
<tr>
<td>Medium</td>
<td>Identifying the opportunities for providing similar training to build the technical capacity of the local people.</td>
<td>Observation and record from ENRD</td>
</tr>
<tr>
<td>High</td>
<td>Collecting the problems, troubleshooting tips and uploading in the localized wiki hosted by project in the server connected with the wireless local network.</td>
<td>Recorded documentation and observation</td>
</tr>
<tr>
<td>Medium</td>
<td>Requesting new opportunities for increasing participation in the training program of localized computing technology in future.</td>
<td>Observation</td>
</tr>
</tbody>
</table>

**Love to see – Tele-center Operators and Local community Based Groups**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium</td>
<td>Playing a leading role in using localized hand book of wireless networking in village and encourage others to use it.</td>
<td>Observation</td>
</tr>
<tr>
<td>High</td>
<td>Sharing lessons and experience through the wiki and encourage other to build and extend the wireless network in their villages.</td>
<td>Observation and survey</td>
</tr>
<tr>
<td>Low</td>
<td>Influencing community level programme for formulating policy on prioritizing ICT as important component and making concentrate ICT development policy in the area.</td>
<td>Observation and survey</td>
</tr>
</tbody>
</table>
### Monitoring Worksheet 6 – Strategy Journal

**Boundary Partner:** Tele-center Operators and Local community Based Groups

**Outcome Challenge:**
ISIF Funded grant program wants to see to enhance the technical capacity of tele-center operators to use Wireless networking hand book written in local language they speak. They need to build their capacity to use ICT in their local language and local content. They are able to build and maintain the wireless network in their village and if face any complex technical problem they can request help with the specialized technical national and international volunteers who has been supporting this network since last 10 years. Operators will provide similar training to other villagers who are interested to receive such skill and are capable of exchange their technical skills and knowledge and important tips from the localized wiki hosted in the network server. At least 24 operators will receive such training and get enough knowledge.

<table>
<thead>
<tr>
<th>Expect to see – Tele-center Operators and Local community Based Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategy to monitor</strong></td>
</tr>
<tr>
<td><strong>Strategy Type</strong></td>
</tr>
<tr>
<td><strong>Description of Activities Methodology</strong></td>
</tr>
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<td><strong>Effectiveness</strong></td>
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<tr>
<td><strong>Lessons and Required Follow-up or Changes</strong></td>
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<td></td>
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<td></td>
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<tr>
<td><strong>Advance skill:</strong></td>
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<tr>
<td><strong>Outputs</strong></td>
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</tbody>
</table>
### Monitoring Worksheet 7 - Performance Journal

#### Practice 1. Prospecting for New Ideas, Opportunities, and Resources

**Example or Indicators:** Utilized local resources to build home made antenna

**Sources of Evidence:** Wireless antenna and tower build by trainees.

**Lesson:** Trainees have known about utilizing local resources to build wireless network.

#### Practice 2. Seeking Feedback from Key Informants

**Example or Indicators:** Visit of the internal technical expert in the project areas.

**Source of Evidence:** Team members has received information from the technical expert

**Lesson:** Feedback has filled the gap in the project

#### Practice 3. Obtaining the Support of Next Highest Power

**Example or Indicators:** Coordination support from the district government body

**Source of Evidence:** Support from the Makwanpur and Mustang district government body

**Lesson:** Participation of Local government encourage the local people

#### Practice 4. Assessing and (Re)designing Products, Services, Systems, and Procedures

**Example or Indicators:** Trainees has get new knowledge to design network and radio configuration. Trainees has learned how to fix the solar system including the wireless relay tower.

**Source of Evidence:** Training manual has been redesign and including about power management

**Lesson:** Power generation (Solar and mini-hydro) training is also necessary for the tele-center operators.

#### Practice 5. Sharing Best Wisdom With the Others

**Example or Indicators:** Team member has provided similar type of training in India

**Source of Evidence:** Team member- Rajendra Prasad Poudel and Bikram Acharya has been to Chandari of India to provide wireless training October 2010

**Lesson:** Sharing knowledge has improve the confidence of the trainees.

#### Practice 6. Experimenting to Remain Innovative

**Example of Indicators:** Team members are now doing experiment for multicasting video software usable for tele-teaching and tele-medicine

**Source of Evidence:** Research is going on

**Lesson:**
Stage 3- Evaluation Planning

### Evaluation Worksheet 8 – Evaluation Planning

#### Practice 1. Prospecting for New Ideas, Opportunities, and Resources

<table>
<thead>
<tr>
<th>Evaluation Issue:</th>
<th>Access of ICT benefits for underserved rural community in high altitude</th>
</tr>
</thead>
</table>
| Who will use the evaluation report? | - Implementing organization  
- Funding agencies  
- Government agencies  
- Other national and international donor agencies. |

**Evaluation Questions**

1. What is the framework for efficiently and effectively extend the ICT services benefits in the underserved rural communities in mountain region of Nepal
2. How the local and national resources has been utilized to extend ICT services in the mountain region of Nepal.
3. How end users of rural community adopting ICT skills.
4. How national ICT policy has been contributing to extend ICT services in Nepal.

| Information and sources | - Past project document  
- Baseline survey report  
- Field visit  
- Performance Journal  
- Case study and research report |
|-------------------------|-----------------------------------------------------------------------|

| Methodology | - Focus group of the community in the project areas and government body  
- Document review  
- Field visit  
- Questionnaire and observation  
- |
|-------------|------------------------------------------------------------------------|

| Who will conduct the research | - Mr. Rajendra Prasad Poudel (Technical engineer and research and OM expert).  
- Ms. Biddya Bhattari (Sociologist and Research expert)  
- Ms. Ayako Ogawa (Research expert) |
|-----------------------------|--------------------------------------------------------------------------------|

| Date of completion | After the 6 months of the project completion. |
Conclusion

Outcome Mapping (OM) focus on one specific type of result: outcomes as behavioral change. Outcome are defined as changes in behaviour, relationships, activities, or actions of the people, group and organizations with whom a program works directly. (Sarah Earl et all). We are tying to link these outcome with our program activities in our outcome mapping framework. Since most of the activities involve multiple outcomes because there has been involving multiple numbers of boundary partners directly and indirectly. We are not going to claim the achievement of development impacts only form this program. But we want to see what other factor has been contributing to achieve the targeted goal and what are the best practices that has been followed by the community people and what sort of sales has been taken place among the boundary partners involve in the project.

The project has logically followed 3 stages. The first stage is Intentional Design, which helps to understand the project goal, it’s boundary partners, and the targeted changes happen in boundary partners. The second stage has. The second Stage is outcome and performance Monitoring, which provides a framework about monitoring of the program’s actions and the boundary partners’ progress toward the achievement of outcomes. It is based on systematized self-assessment by various data collection tools and documented organizational practices. The third stage gives evaluation planning. Since it takes long time to see the impact of program. After the completion of the project we take more extra 6 month time and start the evaluation.
Annex 2: Digital Empowerment Foundation. Training and mesh wireless network deployment at Chanderi (India)

Chandwiyas: Rural Empowerment through wireless connectivity

After the Indian Government has initiated the process of setting up approximately 240,000 Common Service Centers across rural and semi-urban areas within the country, then India has become a home to some of the largest telecentre initiatives in the world. This initiative is becoming an evidence to push India in an emerging national economy from the rural and urban sector. Digital Empowerment Foundation (DEF), a pioneer non-for-profit organization based in Delhi has been recorded an initiative to empower remote rural community by adopting broadband wireless technology and offering Information Communication Technology (ICT) training to the community leaders in their local language. DEF has joined it's hand with E-Networking Research and Development (E-NRD) chaired by Mahatmor Pun winner of 2007 Magguyray Award on community leadership to expand such training program in India.

At first time in October 12-16, 2010 there has been organized an ICT training to establish rural broadband wireless network in Chanderi of Lalitpur district in Madhya Pradesh of India by DEF. The training has been supported by the Internet Society (ISOC). Rajendra Prasad Poudel, who is the program Director of E-NRD and team member of Nepal wireless project and Bikram Acharya has been invited as trainer and resource person for the training. There were 12 participants representing from different region of India with different backgrounds. The training material is also developed in the local language by the trainer. According to Rajendra Prasad Poudel, “The training is focus for the people who have low level of literacy and with low knowledge on English language.”
Mr. Poudel is one of the experienced trainers for the ICT training in the rural community of Nepal. In addition to technical training, Poudel includes community mobilization content for the trainees. According to Rajendra Pasad Poudel, “The person who works in community telecenter should have enough technical knowledge. In addition it is highly recommended that they should know how to mobilize the community because, they have to directly deal with each community members. And the sustainability of the centers depends on their role. So these telecentre operators should be trained well, these are the pillar of the rural ICT project.” During this 5 days training trainees has received lots of practical and theoretical knowledge from basic concept of wireless networking including with cabling, site survey, building tower, configuration of different wireless radios devices, IP addressing , routing and DNS etc.

One of trainees Vijaya Roya from Rajasthan said “I could not understand English so always I was hesitating to participate in such training. I could not learn any things except sitting behind and have no any question to them. But this is the first time I got training in language which I speak. Our trainer has used such simple language which I can easily understand. Now I have confidence that I can build the wireless network in my Village. I am encouraged Now I have many questions in my mind and again I want to learn many things from
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Since the objective of the workshop is to provide training to the trainees and also build wireless network connecting 3 places of Chandani Nagar. During the training trainees have done filed survey by themselves and explored the location for building tower. Trainees has collected GPS data, calculated the distance between towers, estimated the tower height and configured the radio and placed them in proper place. Trainer Bharat Acharya explained “Since Radio Physics seems technically complex but we have done a lot effort to explain to our trainees in local language which they understand easily.” According to the Mr. Shahid who has been taking care about Chandani Project explained “This wireless network will provide access of Internet to the poor and marginalized community living around the Chandani nagar. Although there is coverage of the VSNL Internet but it is still expensive for the women and marginalized community. And also they do not have their personal computer. The other motive of the wireless network is to establish connection between many small entrepreneurs who are running by local people.”

Trainees has built and placed 3 wireless towers in RajaRani Mahal, BadaTikani and Pakhawna Temple respectively. The internet has been connected via VSNL ADSL router in the RajaRani Mahal. One internal wireless radio has been placed in the Raja Rani Mahal for distributing wireless internet around the Raja Rani Mahal square. Being RajaRani Mahal in the top of the hill an Omni Antenna has been placed to distribute wireless internet for the telecenter or individuals. Radio have been configured in 2400MHz frequency spectrum and providing maximum 56Kbps data bandwidth. To managed the authentication and accounting system Mikrotik router has been installed in RajaRani Mahal. Any person who like to access internet should contact
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System administrator of the Chandan Project. The administrator is/she will add Mac address of the specific PC in the Router only then the internet will be accessed in the PC. Also in the same tower there has been kept two wireless client bridge/access point to connect other two relay stations Pankhuwa Temple and Badashkani respectively. Badashkani is in the South side of the Cahandari Nagar and in 3.5 km distance having clear line of sight from Raja Rani Mahal. The objective of placing relay tower in Badashkani is to expand the coverage of the wireless network where signal from Omni Antenna of Raja Rani Mahal can not reach. Second objective of selecting this location is to connect other many isolated villages behind the hill of Badashkani. From the Badashkani to the eastern direction one can see clearly the Pankhuwa Temple relay station which is in 6.5 km distance. Also Pankhuwa Temple can bee clearly seen from the Raja Rani Mahal. So at this moment the internet has been shared from Raja Rani Mahal to these relay stations. Any telecenter who like to access internet via these two relay stations should be registered in the Microchip router placed in Rajarni Mahal. Since the dream of the Chandran wireless network is to expand it to around the villages to establish communication among the small entrepreneurs. Such communication facilities will enhance the skill of the rural people as well as support to expand their business.
Annex 2: Surge protection Report

Report On Surge Protection & Voltage Fluctuation

1. Introduction

Power is the greatest challenge for most installations in the developing world. Where there are electrical networks, they are often poorly controlled, fluctuate dramatically and are susceptible to lightning. Proper surge protection is critical to not only protect the wireless equipment, but all of the equipment connected to it. Power strips and power bars, by definition, don't have surge protection features, so "surge protector" is the proper term. A surge protector protects the computers and other electrical equipment’s from the surges, spikes, and other fluctuations in electrical current. The fluctuations in electrical current are emerging problem of today which is causing the rapid problem to the wireless equipment and other electrical equipment installed in villages. Without a surge protector, an electrical surge or spike could destroy the electrical equipment and all of its components within nanoseconds.

Although most of the electrical equipment such as computers, UPS etc., today have some sort of built-in surge guard, it generally isn’t sufficient for full protection, so it’s good to install the effective surge protector. In this report we have discussed the few terms which we have to consider before buying or choosing, installing, and using a surge protector. And also discussed about the some sort of solutions of preventing the wireless equipment and other electrical equipment from the voltage fluctuation.

Before purchasing the surge protector of any brand we need to consider each unit's features, performance, longevity, manufacturer's reputation, and, of course, price. The surge protectors come in two main types:

1. MOVs (metal-oxide variostors)

   MOVs have a series of tiny MOV disks that use semiconductors on each side to connect the hot wire to the grounding wire. When voltage increases, the MOVs lessen their resistance, and excess voltage passes through to the grounding wire. These are typically less expensive.
2. **Series mode**

Series-mode surge protectors absorb excess voltage and then gradually let the current pass through the hot wire after the surge ends. In general, series-mode surge protectors have less inherent risk. These are more expensive compared to MOVs.

2. **Before Purchasing the Surge Protector**

The following points should be considered while making a purchase of surge protector.

1. **Clamping voltage rating**

Clamping level or also known as a suppressed-voltage rating is the maximum voltage an surge protector will let the equipment reach before it goes to work and sends electricity to the grounding line. The lower the clamping level, the better it is. The good recommend rating for clamping level is less than or equal to 330V.

2. **Clamping response time**

When a surge protector detects a power surge, it will take some time to respond and halt the surge; this is called clamping response time. The faster the surge protector can react, the more likely it is to protect electrical equipment connected to it. In theory, series-mode surge protectors respond immediately, so this tip only applies to choosing a MOVs surge protector with the fastest response time. Look for a surge protector that responds in less than one nanosecond.

3. **Surge Current Rating**

The surge current rating provides a relative measure of the surge protector’s ability to withstand surge currents and is an indicator of the peak surge current that the device subassemblies and modules are designed to handle on a one-shot basis without failure. The higher rating provides assurance that the surge protector can withstand a number of smaller surges, each of which damages MOV grain boundaries by some amount, without experiencing complete failure of the surge protector. By this approach, the surge protector should have a longer life.
4. Joule rating

This is the amount of energy that the surge protector device can safely handle. A higher number indicates greater protection. Look for a protector that is at least rated at 200 to 400 joules. For better protection, look for a rating of 600 joules or more.

5. Guiding light

Good surge protectors typically include an indicator light or series of lights that shows the MOV is still working.

Besides above things some surge protectors may have coaxial cable surge protection, which will be more advantageous to us. Connect the incoming cable or broadband line to the input coaxial connector on the surge protector and then connect one end of a coaxial cable to the output coaxial connector on the surge protector and connect the other end to the input coaxial connector of the cable modem or other device which we want to protect.

Once we have purchased the surge protector for our device we need it to install properly to get the effective result. Setting up a surge protector is typically a fairly simple process although we need to consider following things while installing the surge protector devices.

- Plug the surge protector into a properly grounded outlet
- Place the surge protector where it's most convenient

I.e. basically we put surge protector on the floor, under the desk, and forget about it, like any other electronic device, a surge protector is sensitive to dirt, dust, water, and other elements that is why surge protector should be kept clean and dry.

Some of the MOVs surge protectors are:

- ProRTV (http://www.apcc.com)
- Model TLP602
Here we have some detailed specification of surge protector device normally found in the local market of Nepal.

<table>
<thead>
<tr>
<th>Brand Name</th>
<th>Response Time</th>
<th>KVA rating</th>
<th>Joules rating</th>
<th>Others</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legrand</td>
<td>1-3 ns</td>
<td>5</td>
<td>-</td>
<td>Fuse system</td>
<td>Rs.6000</td>
</tr>
<tr>
<td>TOR</td>
<td>-</td>
<td>-</td>
<td>177-312 J</td>
<td>Fuse system</td>
<td>Rs.1450</td>
</tr>
<tr>
<td>Reyun</td>
<td>&lt;25 ns</td>
<td>10</td>
<td>1.3 JV</td>
<td>Fuse system</td>
<td>Rs.1850</td>
</tr>
<tr>
<td>Hager</td>
<td>&lt;25 ns</td>
<td>8</td>
<td>-</td>
<td>No fuse system</td>
<td>Rs.3500</td>
</tr>
</tbody>
</table>

Beside these we have also searched for the various brand of surge protector in internet around the world, some of them are listed below with specification.

WATTRONICS

This company provides various surge protection solution such as for electrical device, data/cable modem etc. Some of its products with specifications are listed below:

1. **VoIP GUARD**

   The Wattronics VOIP guard is designed to handle speed in excess of 100 Mbps fully duplex. Surge protection , RJ45 protection ,Available in a 24 port and 8 wire configuration, Transient protection.

   **GENERAL SPECIFICATIONS:**

   **Normal Conditions:**
   - Voltage rating (Max.) : +/- 6.5Vp
   - Data Rate (Max.) - Duplexed : 100Mbps
   - Series Resistance (Max.) : <0.5
   - Earth leakage current : <0.5dB

   **Transient & Surge Conditions:**
   - Voltage Withstand @ 1.2/50uS (Max.): >5kV
   - Current Withstand @ 8/20uS (Max.) : >5kA
   - Protection Levels (TYP) - L->L @ 8/20uS (Max.) : 10V
Protection Levels (TYP) : Line to Earth : 10V  
Response Time : <5ns

2. **Surge King**

This is the 100% “switch-on” protection after a power failure, it prevent from different surge, spike, lightning and interference components. It has low voltage isolation (isolates at 180v), phase problem isolation, Line conditioning (noisy power supplies), High clamping voltage (above 400v), Low clamping voltage (above 275V), Lightning arresting. Over-load protection, Internal thermal protection. In this all the appliances are always remain earthed.

**GENERAL SPECIFICATIONS :**
- Shuttered 8-way multi-plug unit for safety and convenience
- Isolator (L&N)
- High voltage surge protection (L-N)
- Low voltage protection (L-N, L-E, N-E)

Reaction time < 25 Ns
- Line conditioning (L-N, L-E, N-E)
- Internal thermal cut-out 100°C
- Lowest clamping voltage 275v
- Absorbs up to 16500Amps on L & N
- Absorbs up to 13000 Amps on E
- Circuitry rated at a nominal max of 15Amps at 230VAC 50 Hz

3. **VOLT STABLE (single phase)**

This single phase units are not effected by input frequency variations and can be used in most situations where voltage stabilization is required. It includes a contact voltage regulator with small waveform distortion and High Efficiency, High Power Factor with Fully automated. Not effected by input frequency variations.
For the voltage fluctuation there are basically two way to protect the device, one is by using the Volt guard, it could be one as given above (VOLT STABLE) and other method is by using the switching circuit before the power supply to the electrical equipment.

1. Using fully automatic Volt guard
   For this we can buy the volt guard from the market of various rating according to our need from various suppliers.

2. Switching circuit
   This is the automatic circuit similar to the volt guard but performs differently than it, in this we use the switching system which will switch the whole system to the battery backup during the voltage fluctuation and re switched it to the normal line when the voltage is stable. For this we will prepare the circuit in our lab of Kathmandu University or we may find similar working circuit in the market. The basic working of the switching circuit is given below:

![Switching system diagram]

Fig: switching system