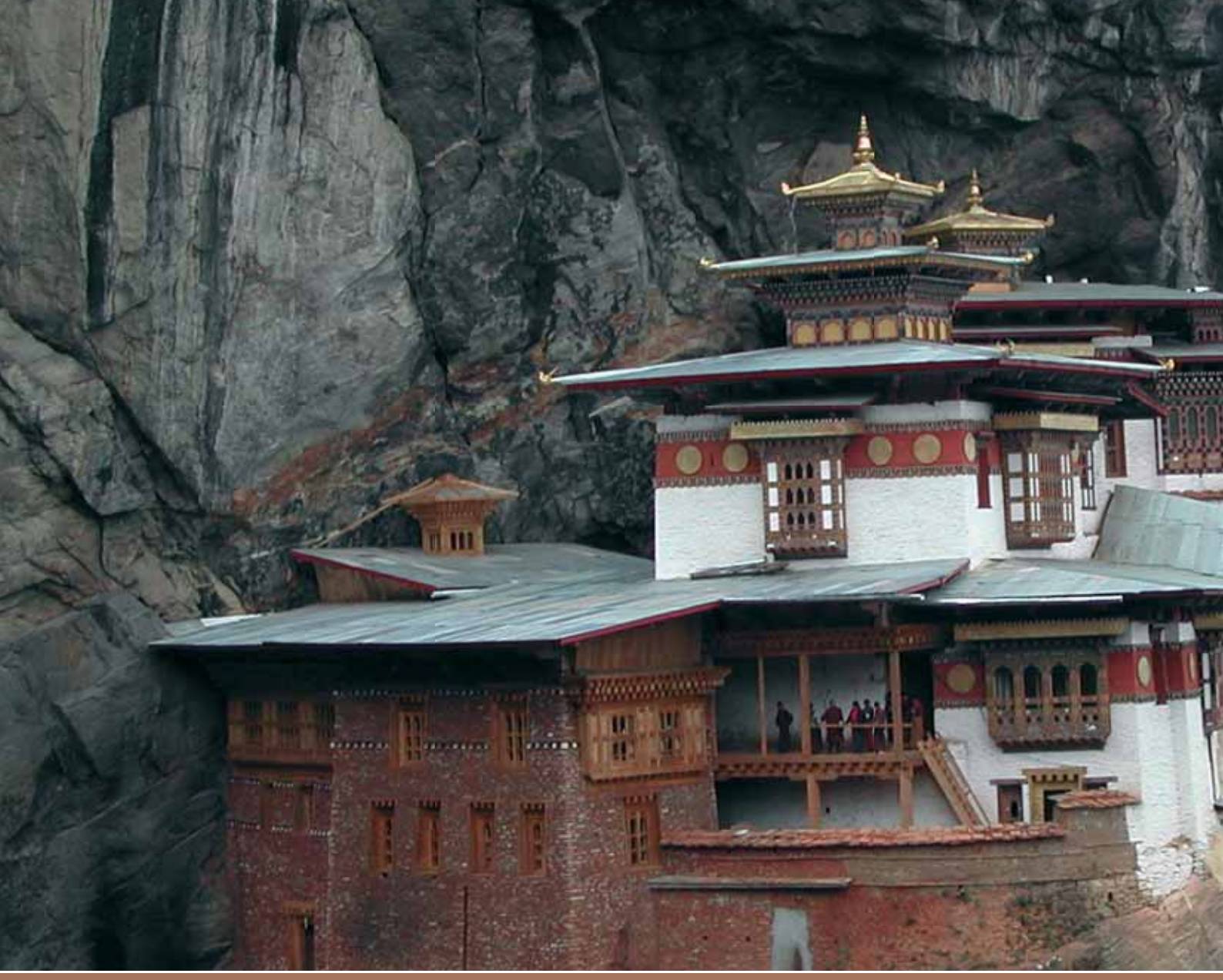

# Satellite Connectivity to Remote Areas and E-Services for Development: Initiatives through Post Office Telekiosks in Bhutan

A cooperation project between the Royal Government of Bhutan, the Government of India, the International Telecommunication Union and the Universal Postal Union

December 2009

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and the Universal Postal Union

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**International Telecommunication Union**
(Telecommunication Development Bureau)
**Universal Postal Union – International Bureau**
(Development Cooperation Directorate)

UPU UNIVERSAL POSTAL UNION

ITU International Telecommunication Union

## ACKNOWLEDGEMENTS

This report presents the results of the study conducted in Bhutan during June 2008 in order to assess the impact of the joint Government of India, Royal Government of Bhutan, ITU and UPU project, under the overall coordination of Vishnu-Mohan Calindi. The report was written by Pradosh Nath and Vishnu-Mohan Calindi.*

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# PREFACE

In 2003, the International Telecommunication Union (ITU), the Universal Postal Union (UPU) and the Government of India initiated a project in Bhutan bringing the benefits of digital technology to the populations of rural and remote areas of Bhutan using post offices as the mechanism of delivery. Post offices – probably more than any other institution – play a central role in people's lives. Everyone can be said to visit the post office at some time or the other. In rural areas, especially in developing countries, post offices often also serve as the *de facto* governmental presence. This is true even in the remote corners of Bhutan, and it was the reason behind the creation of a project to turn Bhutanese post offices into windows to the world.

Taking this proposal as the starting point, 38 post offices were identified to become ICT centres. Six of these were provided connectivity through a satellite network provided by India. The project has now been completed. What outcomes can be identified following the efforts of the last few years?

Now that this project has reached its conclusion, it offers concrete evidence that providing rural and remote areas with access to digital technology can have significant benefits. The VSAT system has proved to be the lifeline for the communities in remote locations, and has become an essential part of the national administration. These revamped post offices provided most people with their first experience of access to ICTs. In this case, it was an introduction to ICTs for both the populace at large and Bhutan Post. Perhaps most dramatically, this project has made it possible for the democratic election results from remote locations to be announced in real time, using the post office facilities, instead of waiting for anywhere from three to seven days, as was the case in the past. Furthermore, the project has revolutionized governance in Bhutan, changed the work culture of Bhutan Post as an organization, and encouraged innovation among the staff.

The benefits of this project are fundamental as well as transformative. The residents of the distant villages were cut off even from other parts of Bhutan. It would take five to seven days for mail to reach them. Today, these villages have access to telephones, Internet and e-Post. The people can receive and send messages from and/to any place in minutes. Their lives have changed significantly.

These accomplishments can be ascribed to the support and technology provided by the Government of India and the extraordinary efforts and dedication of the staff of Bhutan Telecom, Bhutan Post and the Telecommunications Consultants India Ltd. We are grateful to our partners for the cooperation extended – in particular, the Government of India for contributing technology expertise resources. Part of the ITU contribution to the project came from the remainder of funds provided by British Telecom, Deutsche Telekom, Ericsson, INTELSAT and Telstra for a different project. The latter contributors agreed to the use of the funds for this project, and we thank them for their generous gesture. This report has been prepared in accordance with the Memorandum of Understanding signed by the Government of India, the Royal Government of Bhutan, ITU and UPU on 11 December 2003. The MoU provides for evaluation of the benefits derived from the project and dissemination of the results. We thank Bhutan post and Bhutan Telecom for making all the information available for this study.

The successful implementation of the project has demonstrated what cooperation can achieve even in the most difficult of places. The project had the support of two Governments – the Royal Government of Bhutan and the Government of India, of two international organizations – ITU and UPU, and of two national agencies – Bhutan Telecom and Bhutan Post, and all partners cooperated effectively throughout, leading to the successful implementation of the project. This project and the cooperation displayed by all partners are exemplary and worth emulating elsewhere.

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# EXECUTIVE SUMMARY

1. It is generally accepted that access to information through ICT-based services, is an important component of social and economic development. The present evaluation report begins with an empirical study of the importance of ICTs in Bhutanese life. The statistical results of the macro-level exercise relating ICTs and economic changes in Bhutan have shown that ICTs contribute to the creation of economic diversity, and that increasing economic diversity results in enhanced usage of ICT-based services.

2. This ICT/economic change relationship provides the foundations and the justification of the ITU-UPU e-services project, establishing telekiosks using the extensive postal network of the Bhutan Post and expertise of Bhutan Telecom (two partners of the project), while the Government of India provided financial and technical assistance for establishing a VSAT network covering six remote locations.

3. Briefly put, the project has brought computerization to Bhutan Post. The impact has been twofold. The first one is internal to Bhutan Post in the form of changes in work culture, commitment, innovative initiatives, etc., and also in the form of demand for more computer-based services in the post offices. The other one is the telekiosk-based services being made available to the communities in the areas around the post offices.

4. The commitment and innovative spirit of Bhutan Post can be seen in the way the project staff installed the system in extremely remote locations that could be reached only by foot and after several days of walking in extremely difficult terrain, and also in the way that repairs and maintenance of the system were carried out with the most rudimentary of facilities. In many cases, postmasters keep the access to telekiosks open beyond normal office hours to cater to off-time demand. On their own initiative, the project staff developed required software for the Online Tracing System (OTS), accommodating the connectivity limitations.

5. The study has revealed that the facilities created by the project are actually being accessed not only by the communities where they are located but also by the villagers in surrounding areas that are even more remote. In many cases, users travel 10 to 15 km to access the services of the telekiosk. It has been seen that students, in general, are the primary users and beneficiaries of the telekiosk services. It is, therefore, not unreasonable to expect that the telekiosks will actually usher in a new generation that will catapult Bhutan into an information society. The value of this accessibility should be seen from the point of view of the relationship between ICT access and economic change in the Bhutanese context. Considering the above aspect, the impact the project made in the remote rural villages of Bhutan is more enduring than is reflected by the data on revenue earned by the post offices.

6. Establishing VSAT-based connectivity in six remote locations is the highlight of the ITU-UPU-India project. The VSAT-based connectivity even under the most hostile weather conditions has opened up the rest of the world to the remote villages of Bhutan. The telekiosk managers proudly recount that these VSAT stations were used to communicate the election results of these areas, which otherwise would have taken several days to be communicated to Thimphu, the capital of Bhutan.

7. The extent of use of the telekiosks by the communities can be assessed from the revenue earned by post offices from these services. As such, the bulk of the revenue is actually generated from voice communication and fax-based services. Use of the Internet is in its infancy. While revenue earned is reasonable for some of the post offices, for many others it has yet to reach a significant amount. Wherever there is growing demand for ICT-based services, emerging private enterprises take away

a share of the market. Post offices with higher organizational costs find it difficult to match the services provided by private enterprises. Two factors that limit use by communities are: a) the difficult terrain over which villages are spread make such facilities unreachable for many villages; b) the limited scale of economic activity and options for economic viability are constraints on increasing demand for ICT-based services in Bhutan.

8. As always happens in such cases, the project is now faced with quite a few roadblocks. The ICT services provided by telekiosks are bringing reasonably good business to those post offices that are located closer to urban areas or in the vincinity of educational institutions. However, in many cases, private enterprises have sprung up and they are providing similar services at a lesser price. Post offices, due to higher organizational costs, find it difficult to compete with private service providers. In addition, there is strong competition that the e-post service faces vis-à-vis mobile telephones. Wherever there is higher demand, there is also demand for faster connectivity. These post offices strongly feel the need for broadband connectivity.

9. Many roadblocks are external to the project, and in many cases they are not foreseeable. Such situations require rethinking and revamping cost, price and modes of services. However, there are issues that are internal to the system and the project. In the case of this project, the single most important issue is maintenance: repairing and replacement of the equipment. This problem has to be addressed keeping in mind the fact that once computerization has been carried out, any breakdown lasting a few days will cause the collapse of the system. At present, the problem is addressed on an ad hoc basis. Mobilization of resources should be planned for this purpose.

10. The major challenge of the project is to ensure the long-term sustainability and viability of the telekiosks. There is no short-cut method of either cutting costs or generating revenue to strike a balance between cost and revenue of the kiosks. This is even more the case for VSAT connectivity, which is the responsibility of Bhutan Telecom, where project cost is far higher than for other kiosks. It is strongly felt that both Bhutan Post and Bhutan Telecom have to pursue their technical commitments to manage the difficulties brought about by longer gestation periods for achieving sustainability. The Royal Government of Bhutan has expressed its long-term commitment to the project. Both Bhutan Post and Bhutan Telecom have universal service obligations. At the time of the project's initiation, Bhutan Telecom was the only telecom operator in the country. The situation has now changed, with a second mobile operator having been licensed. It is thus a matter of considerable urgency that appropriate policy measures are instituted to ensure, in the long term, the provision of services in remote areas, given that such services consume considerable resources of the operator. This could take the form of subsidy, for example.

11. The project has achieved the goal of reaching the unreached. In this case, it was essentially through creating an ICT infrastructure in the post offices of Bhutan. The initiation into a new era of computerization has thrown up new challenges for Bhutan Post. The future challenge remains of carrying ICTs to far-flung communities. Carrying ICTs deep into the remote areas will require a longer gestation period for breaking even, but will reduce the gestation period for economic change, and in turn will create more demand for and revenue from ICT services.

12. The core of any developmental project like the present one is the expected gains or achievements. Yet in most cases, such projects bequeath many unaccounted or intangible gains, the long-term effect of which might far outweigh the projected gains. This happens because such projects actually work as a catalyst and create cascading effects on many social, cultural and economic practices. The Bhutan telekiosk project one such case.

# CHAPTER 1 INTRODUCING THE PROJECT

The International Telecommunication Union (ITU), the Universal Postal Union (UPU) and the Government of India have collaborated on a project in Bhutan that brings the benefits of digital technology to the population in rural and remote areas, using post offices as the vehicle. A powerful rationale for the project is that the post office, more than any other institution, has a presence in people's lives even in the remote corners of Bhutan. Bhutan, with its difficult terrain and inadequate communication system, offers the right case for creating the appropriate ICT infrastructure for universal access. The project sets the sight to a future of nationwide digital infrastructure from which various digital services would flow and would create a modern e-society.

It will be appropriate to recapitulate here the observations made by Prof. Brij Kothari in his feasibility report for the project. He wrote: "E-mail first, higher order access later. If there is one element of the digital revolution that has made the greatest value addition to the lives of the digital haves, it is arguably e-mail, as distinct from the Internet. E-mail fulfils a basic human need, i.e. to communicate, which the Internet, minus e-mail if it can be imagined, does not. This is not to suggest that the wealth of information on the Internet does not contribute to people's quality of life. But take away e-mail from the digital revolution or price it prohibitively high for most of us digital haves to be able to afford, and suddenly the digital divide becomes terribly palpable. In contrast, leave e-mail untouched in our lives but take away the Internet, the new digital divide may still seem tolerable. Thus, a simple way to think of bridging the digital divide in developing societies is to approach e-mail as separate from the Internet. A first goal may be to provide cheap, reliable and affordable e-mail access to every citizen, without the need for individuals to be literate, computer literate, or knowledgeable in any particular language. If non-literate, below average income people can have others write letters for them in their own language/script that they can later drop off at a post-office or in a letter-box for delivery at an affordable price, they should be able to do the same electronically for a fraction of the cost of an ordinary letter and at a delivery speed that is several times faster and more reliable. These are precisely the benefits enjoyed by the digital haves can be extended to every citizen. Higher order digital access can then build upon this basic digital access. Yet, in our bid to provide higher order access, which is always a greater challenge from an equity standpoint, insurmountable hurdles are introduced for most citizens." With this observation, Prof. Kothari suggests that, "the concept of e-post is developed as a means of creating a basic digital infrastructure that can potentially touch every person. From a project perspective, implementation issues and costs involved are also discussed. Overall, we feel that e-post could be a model that can bridge the digital divide in developing countries, even if it cannot eliminate it entirely."[1]

The programme has been conceived as establishing telekiosks within the routine operations of the post offices, so that postal employees could become an integral part of the initiatives. As for the implementation plan, the already existing postal network of Bhutan Post was taken as the launching pad and main executing agency. Since the backbone of the new technology is the telecommunication system, Bhutan Telecom became an implementation partner. Together, Bhutan Post and Bhutan Telecom identified 38 post offices to be targeted. In the first year, telekiosks were to be established in 17 post offices that had a reasonable postal infrastructure as well as stable telecommunication services, and in six post offices at remote locations that had no telecom connectivity. Out of the remaining 21 post offices, six were located in very remote areas. It used to take about three to seven days for the mail to reach these post offices. It was thought that it would be great boon for the customers served by these post offices if the latter could provide e-post. However, these locations had neither telecommunication connectivity nor electricity. It was then agreed that it would be possible to provide connectivity if VSAT links, powered by solar energy, were established and if India provided access to its communication satellite. The Government of India was thus invited and readily agreed

1 Brij Kothari, Indian Institute of Management, Ahmedabad, "Equitable Digital Access in Bhutan", submitted to ITU, April 2002.

to join the project to provide telecom connectivity to these remote places, which are accessible only a few months in a year.

In addition to providing computers and Internet connectivity, the project envisaged launching e-post services as the vehicle to carry ICT to remote places. The concept of e-post was to receive e-mails at the post offices and deliver a printout to the addressee. Once the post offices are connected, the programme is expected to substantially speed up the delivery of mail. A project document was signed in 2002 by Bhutan, ITU and UPU. A Memorandum of Understanding (MoU) was signed by India, Bhutan, ITU and UPU for the provision of connectivity to six remote locations. Details of the contributions from the different partners are given in Annex 1.

## Project implementation

A project document was signed in 2002 that envisaged the establishment of telekiosks at post offices in Bhutan with the aim of providing e-mail and e-post services to the communities that have limited access to information and communications facilities. Bhutan Post identified a total of 38 post offices spread throughout the kingdom, six of which were located in remote areas. The six remote locations were to be connected via VSAT satellite communications. The following were partners in the implementation of the project:

1. International Telecommunication Union (ITU);
2. Universal Postal Union (UPU);
3. Bhutan Postal Corporation Ltd (BPCL), known as Bhutan Post; and
4. Bhutan Telecom Ltd (BTL).

The international partners, ITU and UPU, provided funding for the initial phase of the project and also assisted with technical support. ITU and UPU contributed US 35 000 and US 30 000, respectively, to the initial phase of the project. These sums were subsequently increased to USD 150 000 by ITU and USD 50 000 by UPU.

The national partners, Bhutan Postal Corporation Ltd (BPCL) and Bhutan Telecom Ltd (BTL), the executing agencies of the project, contributed USD 30 600 and USD 10 200 to the initial phase. BPCL was responsible for establishing basic e-post services, the marketing plan and system maintenance, whereas BTL was in charge of communication access, basic computer training to BP staff and establishing the six remote VSAT terminals for e-post services along with their operation and maintenance.

The implementation of the project was to take place in three phases. Locations were chosen based on the infrastructure available and the revenue generation potential. Seventeen post offices were to be connected in the first year, followed by 13 in the second year and eight in the third year. The programme consisted of equipping the selected post offices with required hardware and software. The startup hardware package included a computer, scanner and printer and the provision of Internet connectivity. This was to be coupled with training of post office staff (hardware and software). Bhutan Post would develop the e-post software.

The maps in Annex 2 show the details of the implementation of telekiosks. Map 1 shows the post offices equipped with computers in Phases 1 and 2. Five post offices have been equipped with computers over the last years, under the Community Information Centre Programme launched by Microsoft Corporation. These post offices were not originally part of the telekiosk project. Map 2 shows the location of six post offices connected through VSAT. Map 3 shows the location of ten post offices where computerization is under way.

Bhutan Post carried out the training programme for post office staff, which is conducted twice a year at the Thimphu General Post Office (GPO) and includes modules on the use of software and in hardware maintenance.

By December 2003, the full hardware package had been delivered and installed in 17 selected post offices. Training sessions of Bhutan Post staff had been arranged: one in India (at Saharanpur) and another at

Thimphu, the capital city of Bhutan, followed by on-site and on-job training at the 17 post offices where systems were installed. Training was carried out mainly by the Bhutan Post personnel at the Thimphu central office, as and when required by the staff at the post offices. By January 2004, all the 17 post offices were equipped with Internet connectivity through DrukNet, the Internet service provider arm of Bhutan Telecom. In addition to the commitments agreed in the project document, six servers were concurrently installed at the General Post Office in Thimphu for inter-post office connectivity. By 2006, the project covered a further 21 locations.

**The VSAT Project**: Installing telekiosks in six extremely remote locations of Bhutan was the most challenging part of the project. Annex 3 provides a detailed account of the task that has been accomplished with commitment and precision.

**An MoU was signed by Bhutan, India, ITU and UPU on 11 December 2003, on the sidelines of the World Summit on the Information Society (WSIS) held in Geneva**


H.E. Ambassador H. S. Puri, Permanent Representative of India to the UN, Geneva; Dr Hamadoun I. Touré, then Director of BDT/ITU; Mr Thomas Leavy, Director General, UPU; Mr Dasho Tashi Phuntsog, Secretary, Ministry of Information and Communication, Bhutan; and Mr Vinay Deshpande of Encore Software

A Memorandum of Understanding was signed in December 2003 between the Government of India, the Royal Government of Bhutan, the International Telecommunication Union and the Universal Postal Union to provide connectivity via VSAT links to six remote locations identified in the project to enable the establishment of telekiosks. The Government of India agreed to finance the supply and installation of a hub station in Thimphu and six VSAT terminals including solar panels with a capacity of producing 600 watts and battery standby of eight days, and training and maintenance. India's contribution amounted to INR 20 million (approximately USD 500 000) as a grant. The Government of India also agreed to provide space segment on INSAT free of cost for the duration of the project, which is two years.

The following places were identified to be provided with VSAT communication links:

| | | |
|---|---|---|
| 1. | Laya | a three-day walk from the nearest road access |
| 2. | Lunana | a seven-day walk from the nearest road access |
| 3. | Merak | a two-day walk from the nearest road access |
| 4. | Minjiwoong (Serthi) | a two-day walk from the nearest road access |
| 5. | Shingkhar Lauri | a four-day walk from the nearest road access |
| 6. | Sombeykha | a four-day walk from the nearest road access |

The contract for the implementation of VSAT links was awarded to Telecommunications Consultant India Ltd (TCIL). BTL was given the responsibility over the local transportation of equipment/materials to site, civil works, providing earthing materials, labour for installation works and installation of equipment (with TCIL engineers). The first installation took place at Merak in September 2005. The equipment/materials were transported using mules and human labour. It took more than a week to get all the materials to the project's sites. The installation and commissioning was completed on 11 October 2005, when one of the first remote locations got connected to the public telecommunication network via VSAT. Successful voice and Internet connectivity tests were also carried out by the installation team. The VSAT terminal is equipped with one voice and one data channel. A three-line PABX is connected to the voice channel, which is distributed among the local users.

Realizing the difficulty of transporting the equipment by head load within the deadline, BTL hired a helicopter to transport the equipment/materials to the other five remaining sites. All the materials had been transported to their respective sites by the first week of November 2005. Installation was carried out jointly by BTL and TCIL staff.

**Bhutan Post team on their way to Shingkhar Lauri**

*Source:* Bhutan Post.

The installation and commissioning of Laya was completed on 11 November 2005, Sombeykha on 2 December 2005, Minjiwoong on 26 December 2005 and Shingkhar Lauri on 3 January 2006. All terminal stations are equipped with one voice and one data channel. The voice channel is shared by three users, distributed through a PABX system. The installation of Lunana, one of the most difficult sites, could not be taken up due to extreme weather conditions and difficult access and would not be completed before July 2006.

The total contribution of BTL for this project is approximately USD 56 500, including local transportation, civil works, earthing and manpower for the installation work, besides the training provided to BPCL staff.

**Training:** A total of eight technical staff of BTL were trained on the operation and maintenance of VSAT terminals at the Advanced Level Telecommunication Training Centre (ALTTC), Ghaziabad, India, in December 2005. The training was financed by ITU.

**Project beneficiary:** The direct beneficiaries of this project are the village communities, the schools, the Basic Health Units (BHU) and the Renewal Natural Resource Centres of the Ministry of Agriculture. Villagers are now able to talk to their families and friends settled elsewhere in Bhutan, which otherwise would not have been possible. Government departments and offices now have direct contact with their respective units for consultation, and vice-versa. Dissemination of information is much quicker, compared to

the past when people had to walk for days in order to send even bits of information to government offices or relatives. Letters could take weeks to reach their destination. With the introduction of telephone and e-post services, this will change.

**Bhutan Post team installing the computers at Laya VSAT station**


*Source:* Bhutan Post.

**Operation and maintenance:** At each site location, BTL recruited one staff member who was subsequently trained on the operation of a PABX system and the routine maintenance of VSAT terminals. The monthly average revenue of these five terminal stations is approximately 12 000 Ngultrum (Nu)[2], which is not sufficient to pay the salary of the staff. The Merak station is different from the other stations, with an average revenue of BTN 50 000. The revenue from other services is subsidizing the operation of the VSAT stations. However, social benefits derived from this project are much greater than the economic benefits.

**Shingkhar Lauri VSAT station**


*Source:* Bhutan Telecom.

2 Ngultrum (or Nu) is the Bhutanese currency. One Ngultrum equals 1 Indian Rupee. This document uses BTN to represent Bhutanese ngultrum.

**Solar panels in Laya and Serthig**

*Source:* Bhutan Telecom.

## CHAPTER 2 DOES CONNECTIVITY MATTER?

Briefly, the project described in the previous chapter is aimed at reaching remote rural communities of Bhutan, where remoteness in some cases means walking across difficult Himalayan terrain for seven days in order to reach the target community. VSAT was the only technological option for connectivity, and hardware had in some cases to be air dropped. Has this initiative changed the social and economic lives of the Bhutanese? In other words, what has changed in Bhutan in five years? That is, from 2003 when the telekiosk project arrived in Bhutan to 2008 when the project reached its final stages. What does it mean when we say that a developmental project is at the concluding stage? The first question concerned the task of evaluating the outcome of the project, and the other surfaced after the evaluation. Since all developmental projects are meant to initiate and catalyse a dynamic process, they cannot be an end in themselves. The end has to be a series of further initiatives that will ensure the consolidation, the sustenance and the advancement of the gains achieved. This report, therefore, extends somewhat to address also the second question on the task ahead for the realization and consolidation of the telekiosk initiatives in Bhutan.

During our stay in Bhutan to conclude the project evaluation, a story was published in the *Bhutan Observer* (16 May 2008), a new weekly news magazine from Thimphu[3] about Aum Kali, a 76-year-old lady with as many wrinkles on her face as her years, who alone brought up her five children after the death of her husband. She is from Puduna village, in the Sama gewog of Haa dzongkhag. She has been selling milk products at the Dorokha market in Samtse, a 12-day walk from her village, for many summers and winters. She lives with one of her daughters (a widow) and four grandchildren, three of whom are studying in a school in Haa, and the one who has completed schooling takes care of her cattle. One of her daughters is employed in a private company in Thimphu. The story tells a lot about the changing Bhutan. The younger generation is becoming more and more literate, they look for jobs in the city, and young educated villagers are more than willing to try a career different from their traditional livelihood, and ready to discover the world outside their village. It is not unusual to meet an Aum Kali in any of the remote post offices of Bhutan, people who walk quite a few hours to reach the post office and wait for somebody to help them get connected to their son or daughter working in places far off from the safe surroundings of their village. Connectivity is their livelihood line as well.

Numbers do not tell lies, but sometimes do miss the truth. A five per cent rise in connectivity is statistical information. There is no lie in it. What it does not tell is the difference it makes in the lives of rural societies. When Laya is Internet connected and wakes up in a snow-sunk morning to discover that there is actually bright warm sunshine in Mexico, the single connectivity in Laya does not tell anything about the world of difference it makes to the people of Laya, the sleepy hamlet of Gasa dzonkhag in Bhutan.

Does connectivity really matter to the people of Laya? What we have learnt is that it does matter if Laya is changing; and we have also learnt that not only it is changing but it is changing pretty fast, the economic and social profiles of Laya as well as of Bhutan. Bhutan has compulsory free education, the mythological apple that creates desires for more. So, as connectivity matters to Aum Kali, so it does for the younger generations, who are literate and do not think that being literate is an end in itself. The changing economic and social profiles create a two-way traffic. As people from remote villages go out to explore new avenues, villages also open the doors for outsiders. Change creates a huge need for connectivity infrastructure. Aum Kalis do not need the Internet, they just want to hear the voice of their dearest ones and exchange news about their respective well being. For the younger, educated generations only the Internet is not enough, they want faster connectivity and many more services based on ICTs.

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3 In 2004, *Kuensel*, published weekly, was the only news magazine in Bhutan. There are two more now, *Bhutan Post* and *Bhutan Observer*.

We have also tried a statistical exercise to add substance to the above, which may sound rhetorical and which prompted us to undertake a study of the relationship between ICT penetration and economic changes in Bhutan. The details of the statistical exercise are presented in Chapter 7. In a nutshell, the result suggests that the better economic performance of a Dzonkhag can indeed be explained by access to ICT infrastructure, along with human resources and other physical infrastructure. It also suggests that the state of the economy, the status of education and health and the extent of government activities generate increased demand for ICTs.

The finding has great significance for the proposed evaluation of the project. The study does not generate the kind of data that would enable us to identify the deeper catalytic role that the project has played. What we at best know from the survey is the profile of a cross-section of users and a certain idea about the purpose of use of ICTs. Given the background provided by the regression analysis, we shall be able to say that the extended use of ICTs in remote and rural areas of Bhutan is likely to contribute to the economic diversity of this largely sleepy country, and that the increasing economic diversity in turn will further extend the use of ICTs. Together, these dynamics are likely to create an all-pervasive cascading effect to direct Bhutan towards a modern information society.

**Box 1: The context of connectivity**

The following two findings form the basis of this evaluation study. They are based on the macro-level study of the factors that govern the use of ICTs and also how ICTs contribute to economic development.

- increasing diversity of economic activities, along with government initiatives towards education and health services and public administration, increases the use of ICT services;
- ICT infrastructure, along with human resources and development of physical infrastructure, creates the conditions for increasing economic diversity.

Connectivity involves cost. One cause of the digital divide is the price that is to be paid for connectivity. Faster and more value-added services come with higher price tags. Those who have money can, therefore, access ICT-based services more intensively. Most developing countries face the dilemma of having to choose between the cost of connectivity and the immense need of connectivity. Aum Kalis would be in financial stress if they were to use connectivity frequently. What they can afford at best is talking to their dearest ones once in a month or so. What are the ways to manage the dilemma? The evaluation does not answer the question, but debates the same in the specific context of Bhutan.

The ITU/UPU project in Bhutan, which received technical and financial assistance from the Government of India, had taken a giant step in installing VSAT connectivity at six remote locations. It entailed costs. It also comes with a promise of catalysing structural change in the Bhutanese economy. The sustainability of the connectivity services means, in simple terms, telekiosks earning enough money to continue providing existing services at their current level, whereas structural changes require a longer duration in order to produce a tangible effect. The evaluation tends to favour long-term gains for the present monetary cost.

Excerpt from a report in English posted on the website of the Bhutanese official newspaper *Kuensel* website on 22 March 2006

"So far we were cut off from other parts of the country. We had to walk for days to the dzongkhag [district] headquarters for official work. Now, with telephone connections and Internet services, we are saved from all these trouble. We feel connected."

The gup [headman] of Sombeykha was speaking to a group of dignitaries and other government officials about the recently installed satellite telephone service at the official launching ceremony of the e-post and very small aperture terminal (VSAT) project by Bhutan Telecom and Bhutan Post on 20 March.

Five remote villages – Laya, Merak, Sombeykha, Shingkhar Lauri and Minjiwoong in Serthi geog [village group] – have been connected with VSAT technology and Internet services. The Indian government provided six VSAT terminals, worth 20m Ngultrum [approximately USD 450 000 dollars], with the free use of their satellite space segment for two years.

While equipment has already reached Lunana, it could not be installed because of harsh weather. Telecom officials said that possible snowfall on their way held them back. "If we go there and it starts snowing we would be stuck for about six months," said Bhutan Telecom's managing director, Thinley Dorji. "The installation of the services in Lunana has been postponed until the end of April."

Thinley Dorji said that, in Merak, Bhutan Telecom had to hire 112 people and 26 horses to carry the equipment over steep terrain for two days from Phongmey. Eventually, Telecom officials decided to hire a chopper for about a week. …"Had it not been for this project, it would have taken us years to reach these remote areas," Thinley Dorji added.

Bhutan Post also officially launched its e-post services in these remote areas. This new service will help people of these remote communities send and receive pictures and letters in both English and Dzongkha languages through the Internet. The letters sent or received can be printed and delivered to the people much faster than the normal postal system.

In his inaugural address the Minister of Information and Communication, Lyonpo Leki Dorji, said that ordinary people should not be made to feel that information and communication technologies (ICT) are something extraordinary and that they were out of place, in this world of "plug and play".

Clever implementation of the appropriate technologies, he added, could help people improve their socio-economic standards and the quality of their lives.

The Indian Ambassador, Sudhir Vyas, said that VSAT technology would provide access to communication and IT services in six identified rural areas and assist in narrowing the digital divide. He said that the Indian Government contributed 20m Ngultrum worth of equipment for the project, as part of its cooperation over the ninth five-year plan.

*Source: Kuensel* website, Thimphu, in English, 22 March 2006.

**Young people from Shingkhar Lauri being trained by Bhutan Post staff**

*Source:* Bhutan Post.

**Solar panels and VSAT antenna in Sombeykha**

*Source:* Bhutan Post.

# CHAPTER 3 ASSESSMENT OF THE OUTCOMES

The study has made an attempt to throw light on important changes that have been triggered by the project. There are two types of changes that have been anticipated and captured by the study. The project allowed for the computerization of the Bhutan Post and triggered a few internal changes within the organization that have the potential to yield far-reaching benefits. We shall discuss the extent and nature of the direct impact of the computerization of the Bhutan Post. Another impact is indirect and secondary, its cascading effect being realized through extension of access to information to common people. Our questionnaire has tried to capture the profiles of the users of the facilities created through the project. Given that in Bhutanese economy access to ICT services creates diversification (as discussed in Chapter 7), our study indicates that wider access would change the economic and social behaviour of the Bhutanese towards more modern economic activities.

## Data/information types and sources

This report stemmed from two visits to Bhutan, one in April 2004 at the initial stages of the project, and another in June 2008, when activities were running at full steam. With the insights of the 2004 visit as background, we envisaged to assess two different sets of project outcomes. An important component being computerization of the post. One expected outcome would be the direct consequence of computerization, which is likely to bring in a whole new work culture through a paradigmatic shift in the man-machine interface. Such interfaces bring in new routines, new problems and new relations. We tried to capture this aspect through a series of visits to post offices for direct interaction with the staff and also to directly observe and understand the new routines. These visits were complemented and verified by rigorous discussions with the executives at Bhutan Post and Bhutan Telecom. The other outcome was the extended access to common people in and around the computerized post offices. This was assessed based on the information collected through a structured questionnaire. Briefly, the following procedures were adopted for the collection of various types of data/information.

1. Visits to a few post offices for on-site assessment of the status and progress of the project;
2. Workshop at Thimphu with a number of postmasters from remote areas;
3. A joint meeting with Bhutan Post, Bhutan Telecom, ITU and UPU representatives to assess managerial and regulatory issues in connection with the project.
4. A questionnaire-based survey was carried out to assess various aspects of project management and outcomes. The questionnaire has three components: a) Management of the telekiosk at the post offices (including the revenue generated from the services) and perceptions of the postmasters with regard to the project, b) Extent of use of services and revenue earned, and c) Profiles of some representative users. The VSAT locations were treated separately because the functioning of the system was a critical aspect. Again, being very remote and sparsely populated, these locations required special attention in the study.

The initial plan was to get responses from at least 20 users (male and female), and also from different occupational backgrounds. Neither the number nor the distribution of respondents in terms of gender and occupation could be ensured because of the sporadic nature of the visits. The survey, therefore, was restricted to as many users could be approached within a day or two as possible. As a result, a uniform number and pattern of respondents could not be ensured. In some cases, the number of respondents was more than twenty, but in many cases it was difficult to reach even five respondents. Again, most of the respondents were male, with few female respondents. They are presented separately because they are different from each other in terms of remoteness, in economic condition and in ICT density.

While a questionnaire is usually a very useful method to gather structured information, many finer aspects of management and performance and changes can be understood only through rigorous and focussed

discussions with project personnel. Thus, meetings with postmasters from distant post offices and discussions with executives of Bhutan Post and Bhutan Telecom complemented the information gathered through the questionnaire. These discussions helped us understand the commitment and work culture of project personnel, and also the innovations that were necessary for the execution of the project.

**First telephone call being made by the then Minister of Information and Communication, Lynpo Leki Dorji, in 2005 at the Laya VSAT station**

*Source:* Bhutan Telecom.

**Poster showing tariffs for using the Internet Café at the Wangdue Post office**


*Source:* ITU.

# CHAPTER 4 COMPUTERIZATION OF BHUTAN POST: ENDURING CHANGES

In this Chapter we present a schematic view of our findings. This is presented in two different sections: a) Status of the services offered and accessed; and b) Changing work culture, which is seen as change in the commitment of employees and also as innovative initiatives.

## a) Status of the services offered and accessed

1. Bhutan Post has installed and adopted the software "Meghdoot" used by the Indian postal services for the computerization of counter-based services in all its post offices. While this can be hailed as a major achievement, it is generally accepted that stand-alone computerization should eventually be upgraded or replaced with the appropriate software to provide effective connectivity among post offices. The tracking and tracing of international EMS and parcels is now available through the use of IPS Light and the online tracking system of domestic express, registered and parcel mail is to be soon introduced. International remittances of money are available through collaboration with a private player. The implementation of IFS Light is being tested. Bhutan Post is also considering the feasibility of introducing postal banking services.
2. The computerization of post offices has created quite a few new opportunities. These include digital photos, required for various licences and permits, several forms of accessing various services and permits from different government departments, certificates and mark sheets for school results, etc. It is quite evident from the visits to post offices that students are the most important beneficiaries of the computerization programme.
3. Post offices provide a number of services such as access to e-post, Internet, fax, telephone, scanning, digital photography and photocopying. Fax services are mostly used for money transfer. The availability of photo services in post offices is very important because they are not offered in most of the smaller towns in Bhutan. Demand for Internet services is at its nascent stage. The main users are students and the personnel from academic institutions. On average, Internet use is restricted to about 5 hours a week, and rarely used in the remote areas. E-post services were initiated with adequate publicity through radio and other print media. The initial success was gradually dampened with the inroads of mobile telephones. Villagers have shown preference for direct voice communication as opposed to waiting for e-post.
4. Until 2004, Bhutan Post had a very rudimentary physical and human resource-based ICT infrastructure. Hence, the unreached were not only the inhabitants from rural and remote areas, but Bhutan Post itself. In 2008, a discernible change is that postmasters, who were not comfortable with the new equipment, and were sceptical about the usefulness of this unnecessary burden, have become computer literate, so much so that they not only demand more services to be computerized, they fear how helpless they would become in case of any breakdown.
5. Postmasters complain about the slowness of dial-up Internet connections. Four years ago, the only service they were appreciative of was using fax to send money orders. Now they realize that because of the slow connectivity, much of the revenue from fax money orders actually goes to telephone bills. They realize that a dedicated infrastructure would help increase their revenue.
6. Bhutan Post established a separate IT unit at its headquarters in Thimphu. The unit has taken proactive initiatives to develop the appropriate software for OTS, or online tracking system. The software is ready to be installed, and trial runs are currently being conducted in a few post offices.

## b) Work culture

The most enduring impact of the project with Bhutan Post was possibly felt in the work culture of the organization. The project has inculcated a sense of commitment in the staff at Bhutan Post and also at the post offices. It has also infused the culture of innovation, while dealing with various problems that have been encountered in the implementation process and also ensuring smooth services to the users. Following are a few visible examples.

### Commitment

1. Bhutan Post has created a separate IT unit to deal with the computerization of the post office services. The unit is also responsible for the execution, monitoring and troubleshooting of the project. The unit has only two regular staff, with the help of a visiting staff member from Japan. They attend to the hardware and software-related complaints from post offices and are also responsible for imparting training to post office personnel. This they do on-site, travelling from one post office to another, covering difficult terrain, many a time walking days before arriving at their destination, often carrying the equipment on their backs.
2. In the absence of expertise that can be outsourced, the IT unit staff have learnt maintenance and repairing jobs by trial and error, with rudimentary initial knowledge. Equipment that cannot be repaired on-site is brought to the Bhutan Post office at Thimphu for repair. Equipment that is beyond repairing is not thrown away: efforts are made to re-use many of the components for other systems under maintenance.
3. At local post offices, facilities are often open till late hours, and on weekends, to attend customers who want to access e-mail or other Internet services.
4. It is probably this commitment that encouraged Microsoft to choose a few Bhutanese post offices (as shown in Map 1) to take part in their Community Information Centre Programme.

### Innovation

1. The culture of innovation is reflected in the initiatives to make the system functional in the most unfavourable conditions. A most glaring example is the fact that VSAT connections are functional in five out of six locations, and being used for telephone and, in some cases, for Internet access. These remote setups stood the test of efficacy during the recent first general election in Bhutan, when the local results were communicated to the rest of the country through the setup. Because of the adverse climatic conditions, system breakdowns are much more frequent, and help from headquarters is always a matter of at least a few days and sometimes few weeks. The staff in these stations, however, manage to run the system by makeshift and ad hoc means until help arrives.
2. The programme to establish connectivity among post offices through OTS software required an innovative mentality. The software was customized with the help of a local firm. The installation of the software brought in a new set of problems. Dial-up connectivity is not only slow, it becomes non-functional while transmitting large volumes of data. At the same time, the traffic is not large enough to sustain broadband connection. The innovative solution for the problem has been achieved by developing a protocol using UCP, UUCP in UNIX that will transmit data in packets.

**Box 2: The project as catalyst for fundamental changes**

The computerization of the post offices under Bhutan Post has brought in changes that are in many cases intangible, but have a most enduring effect on the organization itself. The project has infused a great sense of commitment in the personnel of Bhutan Post. The glaring example is the installation of VSAT stations in remote areas, where equipment had to be carried on the back of yaks throughout six- to seven-day walks in order to reach the stations. The same commitment is also seen in the initiatives for equipment repair and maintenance in all 38 post offices spread over difficult mountainous terrain and with rudimentary infrastructure.

The effort deployed to develop software for the online tracking system and also to overcome the problem of slow dial-up connectivity is indicative of the innovative zeal infused by the project.

**Installation team on its way to Laya**

*Source:* Bhutan Telecom.

**Hub antenna at Bhutan Telecom office in Thimphu**

*Source:* ITU.

**Hub equipment, Thimphu**


*Source:* ITU.

# CHAPTER 5 THE VSAT VENTURE IN BHUTAN

This is a giant step in the telekiosk project, unlike anything that has been tried before. The venture brings six remote and high-altitude locations of Bhutan within the telecommunication reach of the rest of the country and the world. The technical details of the project and the network design are shown in Annex 4. The VSAT connectivity to six remote and high-altitude locations is the most challenging part of the e-post project. It is a daunting task that the project has performed by mobilizing the financial resources and technological input required for the operation of the solar power equipment, procuring and transporting hardware to places that are normally unreachable, and to involve agencies from different countries to contribute to the execution of the project. The enormity of the task of setting up VSAT connectivity in six locations can be guessed from the following facts:

- The expression "remote location" acquires a whole new, deeper meaning in the Bhutanese context. Six of the remote locations are in the northern and north-western part of Bhutan. All of them are at an altitude ranging from 3000 to 4500 metres. The population of the villages, dependent on subsistence farming and animal husbandry, ranges from 1000 to 3000. These villages used to be served by "postal runners" – a one-way trip taking anywhere between three to seven days on foot.
- The implementation of the project in these areas presents a major logistical challenge. It takes a seven-day walk to reach Lunana, part of the glacial backcountry of Bhutan. This is by far the most difficult site to reach. The route crosses eight major passes – three above 5300 metres. There are two possible routes taking similar time, but both involve crossing passes over 5000 metres.
- Sombeykha, in the western region of Bhutan, is a four- to five-day walk from the nearest road point. Shingkhar Lauri is about 50 km from the nearest road point and it takes two to three days of walking through a very harsh mountainous terrain. Laya is located in the extreme north of Bhutan, at about 4000 metres of altitude, and it takes about three to four days of trekking from the nearest road point, named Tashithang.
- All the other locations equally involve walking for several days over harsh mountainous terrain. The routes also criss-cross fast-flowing streams where leeches and swift currents present a constant challenge. These locations also pose complex logistical problems in transporting equipment – for example, it has to be sized and should not weigh more than 40 kg so that yaks can carry the load. To transport the equipment to Merak, BT had to hire 112 people and 26 horses to carry the equipment over steep terrain for two days from Phongmey, the nearest road point. Eventually, BT officials decided to hire a helicopter for about a week to transport the equipment.
- VSAT equipment had been installed at all the locations with the exception of Lunana by September 2005. While equipment had already reached Lunana, it could not be installed because of harsh weather till June 2006. Unfortunately, the signal was lost a few days after installation and could not be regained.[4] The satellite equipment was retrieved, but the solar panels and batteries were left behind for use by the local community. The project was formally inaugurated on 22 March 2006. Bhutan Post also officially launched its e-post services in these remote areas.

[4] An e-mail from Thinley Dorji, Managing Director of Bhutan Telecom, to Vishnu Calindi of ITU captured the issue: "We just got back a few days ago. It was quite an expedition, walking for six days one way and then staying in Lunana for about seven days. We established communications for about a day and half but after that could not get signal. As we had no equipment to measure many of the system parameters, we retuned to Thimphu to see what went wrong. After proper evaluation we will once again send a team to Lunana to establish communications." From thinley@telecom.net.bt, 6 June 2006.

**Inauguration of the project, Thimpu, 20 March 2006**

*Source:* ITU.

**Bhutan Telecom mounted an exhibition explaining how the project was implemented**


*Source:* ITU.

- Five out of the six VSAT locations are functioning with obvious and expected hiccups because of hostile climatic conditions, difficult terrain (making timely interventions difficult), and also the difficulty in procuring spares in real time. With all these constraints, it is a phenomenal achievement that the five locations are functioning, with only one location reporting 55 days of outage in a year. The one location where the initiative failed was Lunana, the remotest of the sites, where the station had to be ultimately abandoned because of the unfavourable climatic conditions.
- 2008 was the year of the first democratic election in Bhutan. Election results from these remote areas were announced at Thimphu, in real time, as soon as the counting was over using VSAT connectivity. This is the high point of achievement of VSAT stations, as one of the executives of Bhutan Telecom expressed it with great pride.

## The performance of VSAT locations

### Operational issues

The performance of VSAT stations has been examined with regard to technological feasibility as well as extent of use of the facility. Table 5.1 in Annex 5 gives details of the technical performance of the stations. Given the remoteness of the locations, unfriendly weather conditions, and difficulties in arranging logistics for the transport of instruments, quite a few hiccups and delays were to be expected. The commitment of the personnel from Bhutan Post and Bhutan Telecom, however, belied the apprehensions. The installation was smoother than expected and the functioning of the systems was reasonably trouble-free. Out of the five stations, Minjiwoong and Shingkhar Lauri reported a breakdown-free functioning of the instruments, whereas Laya reported two to three breakdowns a year. Merak recorded breakdowns for longer periods, mainly because of delays in reaching the station with spare parts. Sombeykha has a perennial problem with 14/12 GHz-band that gets affected by bad weather. Solar panels are generally working well, but bad weather conditions may occasionally reduce the optimal functioning of the panels. Bad weather may affect the recharging of batteries, thereby reducing battery life, as was the case in Merak. Laya station had to ask for frequent help from Thimphu, whereas other stations reported a smooth functioning. All stations feel that repairing and maintenance may become a major problem, particularly because of their hard-to-reach location.

**Box 3: Proud moments of VSAT stations**

**VSAT stations used for the nation**

The stations took pride in being able to communicate the results of the first democratically held general elections of Bhutan in real time. Had these communication facilities not been installed in the VSAT stations, the election results from these areas would have taken days to reach Thimphu, the capital city of Bhutan. Both Bhutan Telecom and Bhutan Post proudly highlighted this achievement as a firm step towards building a modern society, with a modern political system.

### User villages and villagers

The technical problems faced during the installation and running of the system seem well worthwhile when we look at the profiles of the users who, in many cases, travel for days to use the facilities in these kiosks. Table 5.2 in Annex 5 presents brief and broad profiles of the villages that accessed the services of these stations. The villages connected by VSAT stations are remote and poor in terms of economic condition and literacy status. Laya station caters for two user villages in a radius of more than 15 km away from the station. Literacy rates in the user villages are 6 per cent to 10 per cent. The station had a total voice traffic of 18 720 minutes in the period 2007-2008, or about 51 minutes a day. Internet use is insignificant. The station at Minjiwoong recorded 120 hours of Internet use and 16 140 minutes of voice traffic in the period 2007-2008. There are 10 villages within 7 to more than 15 km using the facilities. Stations at Sombeykha and Merak also do not record much use of the Internet. Two villages use the facilities at Merak; they are about two days on foot from the stations, and villagers are mainly engaged in Yak herding. The station at Shingkhar Lauri recorded an Internet use of about 180 hours in the period 2007-2008. Eight villages around the station accessed the facilities. Most of the villagers are engaged in traditional agricultural practices.

### Revenue from the VSAT kiosks

Table 1 shows the revenue generated from services provided by the VSAT stations. Telephone services are the most popular use of the telekiosk. Internet use is still in its infancy and sporadic. Hence, the data on revenue generation is not likely to show any pattern. Fax service is also quite popular, as it is in all other post offices, mainly for money transfer, a procedure speeded by fax communication. Revenue data for 2006 and 2007 show higher earnings from voice communication. In fact, access to voice communication has taken away the need for e-post service. Digital camera-based services are not offered by any of the VSAT stations. Table 4 ranks the services for VSAT stations. Ranks are defined by the postmasters in terms of the extent of use of the facilities (1 for most used facility, etc.). The telekiosk at Merak does not offer fax services. After telephone, photocopy/scanner is the most accessed service. In post offices where there is no photocopy facility, scanners are used for copying documents.

**Table 1: Revenue generated from various services (values in thousand BTN*)**

| Post offices | Telephone | | Internet | | Fax | | Photocopy/ scanner | | Digital camera | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| Laya | 14.3 | 14.9 | | | 7.2 | 8.2 | | | | |
| Lunana | Project abandoned because of unfavourable weather conditions | | | | | | | | | |
| Merak | 50.0 | 52.5 | | | | | | | | |
| Minjiwoong | 10.7 | 16.5 | 2.7 | 1.8 | 3.0 | 4.0 | 2.5 | 3.0 | | |
| Shingkhar Lauri | 12.8 | 14.8 | 4.05 | 2.7 | 2.5 | 2.0 | 1.0 | 1.5 | | |
| Sombeykha | Not provided | | | | | | | | | |

(BTN 1= INR 1; INR 43= USD 1)

* Ngultrum (or BTN) is the Bhutanese currency.

***Note:*** Internet charges: First 15 minutes; 30 BTN; up to 30 minutes; 50 BTN; up to 1 hour; 90 BTN, beyond one hour. 1 BTN. per minute.

**Table 2: Ranking of services**

| Stations | Telephone | Internet | Fax | Photocopy/scanner | Digital camera |
|---|---|---|---|---|---|
| Laya | 1 | | 2 | | |
| Lunana | The system could not function because of hostile weather conditions and had to be dismantled. | | | | |
| Merak | 1 | | | 2 | |
| Minjiwoong | 1 | 4 | 2 | 3 | |
| Shingkhar Lauri | 1 | 4 | 2 | 3 | |
| Sombeykha | Information not provided | | | | |

### Perception of the officials in VSAT stations

Each station has only one employee for managing routine services as well as to attend to technical problems. They have been trained in basic computing, the use of accessories and in VSAT operation/maintenance. E-post service has been introduced in Minjiwoong and Singkhar Lauri, with moderate success. Most operators singled out delivery of mail and technical problems like connectivity and accessibility as a major hindrance in the extensive use of e-post. Power breakdowns, and equipment-related problems also hamper the efficient functioning of services. It is generally felt that the technical knowledge of the staff is insufficient. All operators felt that awareness-building among the villagers is an essential step for rendering the services more popular. They think that more time should be spent on demonstrating the usefulness of the services.

### Perception of the users

The main users of the services, as expected, are students and professionals. The number of female users, currently a minority, is increasing. The services are mainly used for social interaction, career-related information and also many a time on health- and hygiene-related matters. Users, as it was reflected in the user survey, feel that the main value of telekiosk services is the access to information related to career development and health programmes, and cheaper connectivity with relatives.

### Problems and technical concerns

The VSAT system links some of the world's most remote communities and has been implemented by India in what are arguably the most challenging of conditions. It was formally inaugurated on 23 March 2006. The system has proved to be a lifeline for the communities it serves and has become an essential part of the national administration. A striking example has been the transmission of the election results in real time from the locations to Thimphu. Earlier, it could have taken many days. The network, as it is now, is a nucleus that can be expanded to cover as many as 100 locations.

There have been some setbacks, however. The installation of the system at Lunana, the most remote of the locations, proved to be extremely challenging. It was delayed for nearly a year because of weather conditions and, once installed, connectivity to the satellite was lost and could not be regained. Bhutan Telecom decided to abandon the location – VSAT antennae, indoor and outdoor units have been brought back to Thimphu, but the solar panels and batteries have been handed over to the local community for their usage.

It is important to bear in mind that VSAT network is an advanced technological system and would require a certain degree of skill and expertise. The system also functions in what is arguably the most hostile environment – altitude, snow, blizzards, lack of sunshine, etc. The details on outages thus need to be seen in perspective. A system breakdown in Merak during the winter would mean that there would be no service for as long as three to four months, before a technician can visit the place and restore the service. Delays are inevitable, given that the passes close due to snow.

A major issue with policy and regulatory implications to emerge from the project is the role of the incumbent operator and the financing of universal service obligations. When the project was planned and implemented, Bhutan Telecom was the only telecom operator. The situation has changed since, the market has been liberalized and a second national mobile operator has been licensed and started providing services.

The average revenue generated from each of these five location ranges between BTN 5000-8000 (USD 110-180) a month. According to Bhutan Telecom, the revenues are not even sufficient to meet the operational costs.

The MoU signed by Bhutan, India, ITU and UPU provides free access to the INSAT transponder for the duration of the project. Bhutan Telecom requested that this be counted from 23 March 2006 (formal

inauguration of the project, the earlier usage treated as testing), and further requested extension of access free of charge until March 2010.[5]

Given the low revenue and high operational costs, the network is at present a major drain on the resources of Bhutan Telecom. This issue acquires greater urgency given the liberalization of telecommunications in Bhutan and the emergence of a second national mobile operator. Bhutan Telecom requested the Regulatory Authority to provide subsidies.[6]

A regulatory and policy issue relating to the development of telecommunications in rural, remote and underserved areas has been firmly placed on the agenda in Bhutan. The obligations of telecom operators and the mechanism for supporting universal access, such as, creation and operation of universal service funds, are to be addressed in order to ensure effective operation of rural communication services.

Some of the major technical issues faced by the network relates to the fact that, currently, the system functions with dedicated circuits. This is wasteful and places an unnecessary burden on Bhutan Telecom. A system already economically unviable is thus rendered out of reach. There is great merit in adding DAMA lite to the system, thus reducing the recurring charges. Given that the free availability of circuits courtesy of the Government of India will stop sooner or later, the burden will fall directly on Bhutan Telecom. This upgrade to DAMA lite thus acquires urgency in order to reduce operational costs. A technical proposal is currently under preparation, which is likely to be accepted by the Ministry of Information and Communication for inclusion by the RGoB in the tenth five-year plan. The request will then be forwarded to the Government of India.

Bhutan Telecom reported a very high incidence of failure of voice cards and added that spares initially provided for the system were not adequate. The issue of maintaining a cost-effective inventory for replacement of faulty systems cannot be overemphasized.[7] Expert inputs for diagnosing the faults and providing advice on proper procedures for operations and maintenance are a matter of urgency.[8]

### Training

Bhutan Telecom technicians were provided a one-week training session in VSAT systems at the Advanced Level Telecommunications Training Institute, Ghaziabad, India. Bhutan Telecom feel that the one-week training course given in 2005 needs to be supplemented and would particularly like for qualified Bhutan Telecom personnel to be attached as trainees in operational situations involving the INSAT system. The fact that Bhutan Telecom is experiencing a shortage of skilled personnel owing to qualified personnel moving to the new telecom operator, as well as newly established BOP operation centres, has an effect on the operations of the VSAT network.

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5 The representative of India at the coordination meeting (Thimphu, 23 June 2008) suggested that India would consider the request. The matter is to be taken up by the Bhutan Ministry of Information and Communications/ Ministry of Foreign Affairs with the Government of India.

6 The question of financial sustainability was not taken for granted in the formulation of the project. Far from it, it was noted that the economies of these villages are based on subsistence agriculture and yak herding – one or two locations are not even monetized. The issue of operator responsibility and burdens need to be addressed as part and parcel of the universal service policies. The Royal Government of Bhutan (RGoB) is currently working on the universal service fund issue.

7 The coordination meeting of 23 June 2008 informed participants that Bhutan Telecom experienced some system problems owing to lack of stabilization. The system is shut in the evening and has to be reset in the mornings. A few weeks prior to the meeting, the baseband unit combiner and low-noise amplifier failed at the hub station in Thimphu, with the result that data services were stopped. The restoration of data services requires the purchase of a 10-watt amplifier, which costs USD 25 000.

8 At the 23 June 2008 Coordination meeting, Bhutan Telecom stressed the need to have proper support from the INSAT Network Operations Centre (NOC) for network monitoring and status analysis, especially during system failures.

**Box 4: An unedited e-mail received from one of the VSAT stations**

| FROM | | | TO | |
|---|---|---|---|---|
| Name | Sombeykha community | 12008-39  11001 | Name | Director |
| Address | Sangbeykha | | Address | BDT ITU |
| | Haa | | | Camp Thimphu |
| | | | | |
| Telephone | 02670200 | | Telephone | 023222281 |
| E-mail | sombekhamail@bhutanpost.com bt. | | E-mail | thimphumail@of bhutanpost.com.bt |
| | | | Country | |
| Mailing Date | 20-03-2006 07:10:33 | | Receipt Date | 20-03-2006 07:12:47 |
| Destination | Domestic | | Contents | Letter |
| Postage | Nu0- | | Option | **Printout, Official** |

Your Excellencies, and all the Distinguished Guests there in Thimphu!

On behalf of the people of Sombeykha, and sectoral staffs of this place, I would like to share our warmest greetings on this auspicious occasion.

Sombeykha has been very much isolated once, but now it is no more isolated with the implementation of e-post and VSAT services, which provide voice as well as data communication. So, on behalf of the people of Sombeykha, I would like to express our sincere gratitude to the Royal Government of Bhutan (RGOB), the Government of India (GOI), the International Telecommunication Union (ITU), the Universal Postal Union (UPU), the Bhutan Telecom and the Bhutan Post for the successful implementation of such services here in Sombeykha.

I can see the changes already in front of me, and I can feel the differences of yesterday and today. So, it is indeed a blessing for all of us here in Sombeykha and we are very much grateful for this opportunity to convey our sincere thanks to all of you involved in bringing these wonderful changes in the lives of humble people who are residing in the most remote area. We look forward for the assistance and support in near future from your good end for achieving the Gross National Happiness.

Thank you very much and Trashi Delek.
Head teacher
Sombeykha Primary School

**Box 5: Report on the VSAT station at Merak published in *Kuensel*, the popular English-language newspaper in Bhutan**

Kuensel dated OCTOBER 26, 2005

DZONGKHAG 5

VSAT AT MERAK

# Reaching the unreached

**Merak calling: about 30 people use the telephone everyday**

BY SAMTEN WANGCHUK IN MERAK

LOBSANG DEMA, 46, of remote Merak gewog in northern Trashigang, vaguely recalls making a telephone call several years ago.

To do that she had to walk all the way down to the nearest telephone facility in Rangjung, a day's hike from Sakten.

On October 10, she walked about five minutes from her home to the previous gup's office and called her brother and sister who work in Thimphu.

"Talking over the phone is as good as meeting them in person," said Lobsang Dema. "I have not met my brother and sister in three years."

At 3,400 metres above sea level Merak is one of the remotest gewogs in the country and home to the brokpas, a nomadic community that rear livestock. It is not connected by road.

Earlier this month it got connected through the telephone making it perhaps one of the most significant development to have taken place in Merak in recent years.

The Bhutan Telecom installed three other solar powered telephones at the school, the Basic Health Unit and at the gup's office.

According to the caretaker of the new service, Phurpa Tshering, a 20 year-old class 10 dropout, more than 30 people use the telephone everyday.

When there are callers on the other end, Phurpa sets a time for them to call back and then rushes to the village, about five minutes away, to pass the information.

If the call is for somebody in Gengu, another small community in Merak, which is about 15 minutes walk, Phurpa sends the message through a person headed there.

According to Phurpa the people of Merak call as far as Mysore, Bangalore and Chennai in south India, Delhi in the north and the bordering Indian state of Arunachal Pradesh to talk to their children, friends and close relatives, besides making calls to almost all parts of the country.

For every call within the country, Phurpa charges Nu. 10 a minute and Nu. 20 a minute for calls outside the country. At the end of each day he makes a collection of about Nu. 500 to Nu. 1,000.

But the people of Merak don't mind paying considering the amount of time taken hiking to Rangjung to make an emergency call in the past.

"Besides helping me to keep in touch with my two brothers who are monks in Mysore, I can now make deals with businessmen in Arunachal Pradesh," said 25-year-old Dawa. "I can ask them to keep the goods I need ready and they can in turn tell me about the kinds and the quantity of various livestock products they need from here."

Three weeks ago the people of Merak communicated with their loved ones only when they came to Rangjung and Trashigang for some work.

"In summer the rain makes the trail slippery and in winters it is buried in knee deep snow," said Norbu Wangdi, 24, adding that finding a vehicle on reaching Phongmey was yet another problem.

He said that it was very difficult when serious patients carried all the way from Sakten needed to be admitted immediately to the Trashigang hospital.

"Now we can call the hospital from here itself and fix a date and time for the ambulance to pick our patients," said the Merak gup, Sangay Khandu.

He added that development activities in the gewog should also progress more smoothly with the communication link. "For timely completion of development works we have to constantly keep in touch with the dzongkhag officials. Now it is possible," said gup Sangay Khandu.

Merak has 300 households with a population of about 2,010 people.

# CHAPTER 6 TELEKIOSKS IN NON-VSAT LOCATIONS

Non-VSAT locations in Bhutan are not situated on the plains. In general, villages in Bhutan are remote and road networks are rudimentary. There are villages with not more than five households. As we shall see, even in non-VSAT project locations villagers have to walk miles to reach a post office. The villagers, therefore, access ICT services only when it is of dire necessity to do so, and moreover when they can combine various other activities to make the long journey to reach the nearest post office. As in the case of the VSAT locations, in the case of non-VSAT locations we have also tried to capture the profiles of the users and their perceptions of the services.

## Performance of the kiosks

### Operational issues

We received completed questionnaires from 16 post offices. All these post offices are equipped with computers with Internet connectivity, scanner and fax machine. Some of the post offices have photocopy machines. Under a separate programme called Community Information Centre (CIC), a few post offices were provided with a digital camera to augment the computer-based services. Digital cameras are extensively used in these post offices for photographs required for various applications, licences, certificates, etc. Table 3 shows the ranking of various services in post offices according to the extent of use of the facilities. Table 4 gives a summary report of the rankings of services. Telephone and telefax services were ranked "1" by seven post offices. For the Paro post office, the Internet is the most used service. Paro, being an airport city, has a large number of visitors who are the main customers of the Internet service. Two post offices have ranked photocopying as the most accessed service.

**Table 3: Ranking of services provided by various post offices**

| Post offices | Telephone | Internet | Fax | Photocopy/scanner | Digital camera |
|---|---|---|---|---|---|
| Bumthang | 1 | 3 | 4 | 2 | |
| Dagana | 3 | 4 | 1 | 2 | |
| Deothang | 2 | | 1 | | |
| Haa | 1 | 2 | | | |
| Kanglung | 4 | 3 | 1 | 2 | |
| Lhuentse | 1 | | 2 | 3 | |
| Mongar | 2 | | 1 | | |
| Paro | 2 | 1 | | | |
| Phuntsholing | 1 | 4 | 3 | 2 | |
| Punakha | 1 | 3 | 2 | 4 | |
| Rangjung | | 4 | 1 | 3 | 2 |
| Samste | 1 | 4 | 2 | 3 | |
| Tsirang | 4 | 3 | | 1 | 2 |
| Wamrong | 2 | 4 | 1 | 3 | |
| Wangdue | 1 | 3 | 2 | | |
| Zemgang | 2 | 4 | 1 | 3 | |

*Note:* Digital cameras were received as part of the Community Information Centre project (Microsoft).

**Table 4: Ranking of services – summary table**

| Services | Ranked 1 | Ranked 2 | Ranked 3 | Ranked 4 |
|---|---|---|---|---|
| Telephone | 7 | 6 | | 3 |
| Internet | 1 | 1 | 5 | 5 |
| Fax | 7 | 4 | 1 | 1 |
| Photocopy/scanner | 2 | 4 | 4 | 1 |

The above ranking is in terms of the revenue earned by the post offices from these services. This also shows the most frequently accessed services. Blank spaces mean that the particular service is not provided by the post office. Interpretation of the table is quite tricky. As can be seen from the Table 3 above, out of 16 post offices, for seven telephone service is most important. In Phuntsholing (trading centre), Punakha (tourist spot) and Bumthang (tourist hub), demand for telephone services is large because of a substantial number of visitors. On the other hand, in the cases of Haa, Samste and Lhuentse, demand exists because the post office is the most convenient access point for telephone connectivity. With the exception of Paro, the airport town with comparatively high tele-density, in most other post offices, telephone services get a lower rank of importance due to the low demand for voice communications. In such cases, demand for fax, mostly for fast money transfer, is greater than that for the telephone. The fax service is actually the most used service across all the post offices. The demand for fax services rises substantially with the beginning of seasonal admission in schools across the country. Similarly, photocopy services also experience brisk demand in all the post offices, mainly from students (again seasonal) and also for various legal and official purposes.

The computerization of post offices has created demand for new services. One very popular service is colour photography using digital cameras. Much construction work is being undertaken in all parts of Bhutan. In fact, the construction sector has emerged as the second most important employer after agriculture. All construction labourers have to carry a photo identity card, and this has resulted in a huge demand for colour digital photographs. The contractors of these construction works also generate a good demand for photographs, photocopies of the documents necessary for tender application, access to the Internet for copying the various application forms, licences, approvals, notifications, etc., and also for online submission of various applications and documents.

The provision of digital cameras was not part of the telekiosk project. The Microsoft Corporation had initiated a Community Information Centre (CIC) Project in Bhutan in 2006. A digital camera was part of the hardware kit that was given to various centres as part of the programme. A few post offices that were computerized under the telekiosk project were also beneficiaries of the CIC programme, and could use their existing capability to cater to the demand for digital-camera-based services.

### Revenue from the kiosks

Earnings from different services have to be read carefully. In many post offices, PCO services faced competition from private enterprises, and therefore posted a fall in revenue (in 2007) from the earlier year (2006). Fax-based services show a steady revenue-generating activity. Use of the Internet is not a revenue-generating service but is showing a steady increase. E-post services lost ground to mobile communications. Direct voice communication has been seen as a preferred mode compared to e-post services mainly because of privacy and the advantage of instant communication.

**Table 5: Revenue from telekiosk services (values in thousand BTN*)**

| Post offices | Telephone | | Internet | | Fax | | Photocopy/ scanner | | Digital camera | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 |
| Bumthang | | | | | | | | | | |
| Dagana | 21.2 | 9.6 | | | 9.64 | 9.41 | 6.12 | 6.72 | | |
| Deothang | 18.8 | 18.0 | | | 45.0 | 40.0 | | | | |
| Haa | | | | | | 3.62 | | | | |
| Kanglung | Details not provided | | | | | | | | | |
| Lhuentse | 19.6 | 10.9 | | | 13.5 | 13.4 | | | | |
| Mongar | 7.20 | 5.00 | | | 6.00 | 28.6 | | | | |
| Paro | Not provided | | | | | | | | | |
| Phuntsholing | 48.6 | 29.2 | | | 25.9 | 25.8 | | | | |
| Punakha | 64.3 | 58.4 | 13.6 | 16.5 | 24.0 | 34.0 | | | | |
| Rangjung | | | 0.1 | 1.30 | 9.60 | 11.2 | 0.12 | 4.60 | 0.64 | 4.80 |
| Samste | Not provided | | | | | | | | | |
| Tsirang | 18.6 | 8.43 | | 0.26 | 17.5 | 14.0 | 8.20 | 18.5 | | 11.0 |
| Wamrong | | | | | 2.19 | 2.85 | | | | |
| Wangdue | | 15.5 | 1.37 | 10.6 | 37.1 | 37.6 | | 0.10 | | |
| Zemgang | | 12.5 | | 0.77 | | 12.3 | | | | |

* Ngultram (or BTN) is the Bhutanese currency. BTN 1 = INR 1; INR 43 = USD 1

*Note:* Internet charges: First 15 minutes: 30 BTN; up to 30 minutes; 50 BTN; up to 1 hour: 90 BTN, beyond one hour: 1 BTN per minute.

### User villages and villagers

Table VI.1 in Annex VI gives a brief profile of the villages that used the services provided by the telekiosks. As mentioned earlier, out of 32 non-VSAT locations of the kiosks, the project team received completed questionnaires from 16 post offices. The questionnaire-based survey tried to establish the usefulness of the telekiosks to the villagers in and around the post offices. From the post offices we identified the farthest villages that accessed the services. It was quite a revelation that in many cases users were from villages as far as 50 km away. It is quite common that many users walk hours to reach the post office in order to use the telephone or fax, and in some cases even the Internet. It is obvious that these are cases of occasional users of the services; nevertheless, it shows the role telekiosks can play in the lives of people from remote and rural areas.

### Perception of post office officials

Table VI.2 in Annex VI presents a brief account of the views of the personnel from the post offices regarding functions, problems and scope of the telekiosk. With the exception of Phuntsholing, which is a regional head post office and caters to a vibrant trading centre, all other post offices are manned by two to four persons, depending on the volume of the work. All the post office personnel had received training in basic computing, accessories, and some basic knowledge on maintenance imparted by Bhutan Post. E-post was tried by all the post offices with various degrees of acceptability. Although detailed accounts have not been maintained, post offices have tried to provide a rough estimate of the peak volume of e-post. The post office at Bumthang achieved almost 25% of the total mail volume as e-post. In none of the post offices, however, could the

service continue beyond the initial few months. There were problems from both the service providers' side and the users' side. As reflected in Table VI.2 in Annex VI, most of the post offices found delivery of e-post as a major problem, in addition to the technical bottlenecks like connectivity and readability, as well as in many cases having to write the mail for the users. At the same time, users have shown a clear preference for voice communication for reasons of privacy and the advantage of instant communication. The introduction of mobile telephony has made voice communication easier. For the literate section of the users, the Internet appeared as the much preferred mode to e-post. Most of the postmasters indicated power breakdown, shortage of manpower, connectivity and equipment malfunctions as the major problems impeding the smooth functioning of the kiosks. They were in agreement that replacement, maintenance and repair of the equipment are going to emerge as major problems if steps are not taken immediately.

### Perception of the users

Our plan was to get feedback from at least 20 users (comprised of men, women, boys and girls, and also from various occupations) from each post office. This could not be achieved for various reasons. Many post offices will not have 20 users in some weeks, and it was not possible to visit user villages, most of which are located far away from the post offices, as shown in Table V.2 in Annex V. Table VI.3 in Annex VI is based on whatever feedback was available from a few selected users (in some cases, the number was more than 20, in some other cases it was not more than four or five). As shown in Table VI.3 in Annex VI, main users are students (both boys and girls) and professionals, whereas farmer users are also not uncommon. Social interaction, education, business and health-related matters are the main purpose of using the telekiosk services. Most of the users think that the kiosks provide better connectivity with relatives, access to business and career-related information.

**User at Wangdue Post Office**


*Source:* ITU.

# CHAPTER 7 ICTS AND THE ECONOMY OF BHUTAN

In VSAT locations as well as non-VSAT locations, the main users of the telekiosk services are students and professionals. In many cases, even though they may not constitute the majority, there are a substantial number of women users of the services. There are users who walk miles to access the services. Other than social interactions, services are used also for education, medical, professional and business purposes as well. What does it mean for the economy as a whole? What do they do with the information they access? The answer is there in our understanding of the role of information in the dynamics of any representative economy. Information is ubiquitous in economic activities. Its role is for coordination of complex economic actors and also for decision-making that involves a large number of variables. The more complex the economic activities, as is the case of developed economies, greater the need for complex coordination and decision-making and the need for information. Access to information provides access to opportunities, which in turn creates the need for new coordination and decisions to synchronize the economic agents. In other words, a subsistence economy with the simplest possible production and exchange activities would have little need for information. The need for information in an economy therefore takes an evolutionary path along the trajectory of economic development. As the economy progresses, so does the need and demand for information.

The most important aspect of this relationship between economic progress and information is that they are intertwined. Need for information is generated by the progress of the economic activities, and the economy progresses by creating easier access to information. Back to the Bhutanese context, the need for creating wider access to information is to be seen in the context of increasing globalization that offers wide varieties of economic opportunities. The wider access to information is the enabling instrument to equip the people of Bhutan to capitalize on these opportunities. In Bhutan, government plays a proactive role for social and economic development by initiating various developmental programmes. It is imperative that the access to information keeps pace with these initiatives for realizing the developmental goals.

The exercise presented below tries to highlight this aspect of the Bhutanese economy. It tries to seek answers to the question raised above regarding the potential impact of wider access to ICTs. In other words, we shall get an indirect answer to the question of why people walk miles to access ICT services. The exercise is about the ICT penetration and its relationship with various developmental indicators.

Table 6 below shows the extent of ICT penetration in Bhutan. The data is presented Dzongkhag-wise. Dzongkhag are the administrative units of Bhutan and are roughly equivalent to districts.

Overall telephone penetration is 12.20 per cent of total households in urban areas and 4.90 per cent among rural households. It is to be noted that Bumthang shows a very high percentage of telephone penetration in rural areas, and in the cases of Haa, Paro and Punakha, telephone penetration in rural areas is much higher than that in urban areas. Bumthang is a major tourist attraction, and the facilities for tourists are spread far beyond the notified urban areas. The same is the case for Paro (also the airport town) and Punakha. Haa has a major military establishment and therefore better telecommunications spread over the rural areas. If we leave out some of the outliers, major areas of tourist attraction and trading centres, like Bumthang, Chukha, Sarpang and the capital city Thimphu, the average comes down to about 5.1 per cent in the urban areas and 3 per cent in rural areas. As expected, both computer and the Internet have a very low penetration rate. If we leave out outliers, computer penetration becomes about 1 per cent and Internet penetration becomes about 0.03 per cent of the total urban household.

The question that we are interested in at this stage is about the economic factors that can explain the variations in ICT penetration in each Dzongkhag. Although the understanding of how access to ICTs contributes to development is still at a nascent stage, we postulate that the impact is actually derived from the role of information in the economic and social lives of a modern, complex, industrial civilization. It is generally accepted that the rich countries with vibrant economic activities can derive benefit from access to

ICTs more effectively than their poorer counterparts. In other words, it means that ICTs do contribute to economic progress, but the economy has to have the means of making use of it. A more fundamental and root cause of digital divide, however, is the structural aspect, and the solution is in the social and economic transformation of the country in question. Any economy that is mainly inward bound, engaged in traditional and simple economic and social practices based on age-old wisdom, and is not inclined to change, does not face the problem of connectivity or need for information. An expanding and diversified economy, on the contrary, poses the problem of decision-making for the economic and social actors and thereby creates need and demand for ICT-based services. The flip side of this hypothesis is that access to ICTs, along with the development of physical and human resources, helps the acceleration of diversified economic and social activities. It is not easy, however, to find substantiation for this intuitive understanding with hard data for the simple reason of the intertwining causality of the relationship; in simple terms it means that economic prosperity accelerates the use of ICTs, whereas use of ICTs actually contributes to economic prosperity.

**Table 6: ICT density as percentage of households**

| Dzongkhag (administrative districts) | No. of households | Telephone | | Computer | | Internet | |
|---|---|---|---|---|---|---|---|
| | | Urban | Rural | Urban | Rural | Urban | Rural |
| Bumthang | 2 870 | 14.63 | 11.05 | 1.25 | 0.80 | 0.50 | 0.80 |
| Chhukha | 14 482 | 19.35 | 4.58 | 3.26 | 0.27 | 1.52 | 0.14 |
| Dagana | 3 485 | 3.62 | 1.46 | 0.32 | 0.03 | 0.10 | 0.00 |
| Gasa | 727 | 6.88 | 2.34 | 0.14 | 0.00 | 0.00 | 0.00 |
| Haa | 2 290 | 8.86 | 12.62 | 0.56 | 0.43 | 0.35 | 0.21 |
| Lhuentse | 3 001 | 2.17 | 1.96 | 0.27 | 0.00 | 0.03 | 0.00 |
| Monggar | 7 348 | 6.15 | 1.40 | 0.64 | 0.09 | 0.23 | 0.00 |
| Paro | 7 118 | 3.10 | 22.78 | 1.37 | 0.89 | 0.25 | 0.95 |
| Pemagatshel | 2 937 | 5.10 | 3.65 | 0.20 | 0.27 | 0.10 | 0.03 |
| Punakha | 3 387 | 4.30 | 10.58 | 0.47 | 0.44 | 0.17 | 0.21 |
| Samdrupjongkhar | 8 363 | 6.79 | 0.83 | 0.75 | 0.08 | 0.42 | 0.01 |
| Samste | 11 634 | 4.29 | 0.64 | 0.63 | 0.13 | 0.21 | 0.01 |
| Sarpang | 8 211 | 10.61 | 4.93 | 0.90 | 0.06 | 0.39 | 0.01 |
| Thimphu | 19 689 | 36.49 | 4.56 | 9.14 | 0.38 | 4.72 | 0.13 |
| Trashigang | 10 813 | 4.98 | 3.25 | 0.58 | 0.26 | 0.26 | 0.04 |
| Trashiyangtse | 3 764 | 2.82 | 2.07 | 0.56 | 0.10 | 0.31 | 0.04 |
| Trongsa | 2 739 | 7.48 | 5.12 | 0.55 | 0.07 | 0.40 | 0.04 |
| Tsirang | 3 651 | 4.10 | 3.65 | 0.19 | 0.08 | 0.19 | 0.03 |
| Wangdue | 6 227 | 6.58 | 3.95 | 0.56 | 0.32 | 0.32 | 0.13 |
| Zemgang | 3 379 | 6.63 | 3.23 | 0.59 | 0.09 | 0.33 | 0.00 |
| *Total* | | *12.20* | 4.90 | *2.30* | *0.03* | *1.10* | *0.10* |

*Source:* Population and Housing Census of Bhutan, 2005.

From the intuitive argument presented above we may suggest that variables that reflect economic activities and economic progress are likely to explain the variations in ICT penetration in the various Dzongkhags. We have accepted that the extent of activities related to education, health and the presence of government

administration are indicators of the status of education, health and government initiatives that have significant contributions to economic development. We have created three variables – EDU, HEALTH, and ADMN – using the ratios of the numbers of people employed and total number of households in each Dzongkhag. We also wanted to account for the economic diversity of the Dzongkhags as a contributor to ICT penetration. The variable economic diversity, or ECD, has been constructed using sector-wise employment data. The Population and Housing Census of Bhutan 2005 gives employment data for agriculture, mining/quarry, manufacturing, electric/gas/water, construction, retail/wholesale trade, hotel/restaurant, transport/communication, finance/insurance, and others. The category "others", although not specified, includes mainly those who do not have any regular employment and who work as casual workers. The ratios between the employment under these categories and the total workforce give the relative shares or relative importance of a sector in the economic lives of a Dzongkhag. If the share of agriculture is 90 per cent, then the sectors employing the remaining 10 per cent is actually insignificant in the economics of the Dzongkhag. In such cases, the standard deviation of the sectoral share of employment will be very high. We can, therefore, say that standard deviations thus calculated will reflect the ECD or economic diversity of a Dzongkhag. The physical infrastructure, like roads, electricity, etc., of a Dzongkhag is also likely to contribute significantly to ICT penetration. We noticed, however, very high correlations between ECD and infrastructure-related variables, and hence excluded the latter ones to avoid the problem of auto-correlation in our proposed linear regression analysis. As dependent variables, in the proposed regression equation, we have used only telephone penetration and had to leave out computers and the Internet because of statistically insignificant penetration of both computer and Internet use.

The proposed linear regression function is:

$$ICT = f(ECD, EDU, HEALTH, ADMN) \quad (1)$$

Description of variables:

ICT = Telephone per household.
ECD = Economic diversity as measured by the standard deviation of the sectoral shares of labour. The larger the value of ECD, the lesser the extent of economic diversity. So ECD is expected to be inversely related to ICT.
EDU = Ratio of number of employees in education-related activities and total households.
HEALTH = Ratio of number of employees in health-related activities and total households.
ADMN = Ratio of number of employees in govt. administration and total households.

We also expect that ECD, or economic diversity, of a region is significantly influenced by the extent of ICT penetration or availability of ICT infrastructure along with other factors like human resources and physical infrastructure. If human resources is captured by the literacy rate in a region, and physical infrastructure by availability of roads and electricity, then we can propose another regression function as:

$$ECD = f(ICT, LIT, ROAD, ELECT) \quad (2)$$

Description of variables:

ECD = Economic diversity as measured by the standard deviation of the sectoral shares of labour. The larger the value of ECD, lesser the extent of economic diversity. So ECD is expected to be inversely related to ICT.
ICT = Telephone per household.
LIT = Ratio of number of literate population and total population.
ROAD = Percentage of households living more than 6 km away from the main road. The higher the percentage, the lower the value of road infrastructure. It is expected to be inversely related to ECD.
ELECT = Percentage of households having regular access to electricity.

**Table 7: Results of the regression analyses**

| Regression | Adjusted $R^2$ (f value; sig) | Standardized coefficients (t values; sig) |
|---|---|---|
| Dependent variable – ICT | 0.70<br>(12.146; 0.000)<br><br>Residual; 410.47 | Constant – 31.60 (4.50; 0.000)<br>ECD – 0.57 (–3.53; 0.003)<br>EDU – 0.19 (0.63; 0.537)<br>HEALTH – 0.02 (0.41; 0.968)<br>ADMN – 0.23 (0.60; 0.560) |
| Dependent variable – ECD | 0.63<br>(9.103; 0.001)<br>Residual; 72.064 | Constant – 22.77 (1.844; 0.085)<br>LIT – 0.082 (–0.197; 0.846)<br>ROAD – 0.327 (–1.627; 0.125)<br>ELECT – 0.113 (–0.495; 0.628)<br>ICT – 0.754 (–2.014; 0.062) |

The data used for the above regression is for 20 Dzongkhags. For any empirical analysis, the data set is not, therefore, adequately large. We did not, therefore, expect a very good linear fit, and good values for associated statistics and significance. As evident from Table 7, $R^2$s are reasonably large for both, with a high level of significance, and values of Beta (standardized coefficients) have signs as expected in the intuitive understanding. The statistical exercise presented above rigorously proves the following two major relations:

- Increasing diversity of economic activities along with government initiatives towards education and health services and public administration together push up the use of ICT services;
- ICT infrastructure along with human resources and development of physical infrastructure create the conditions for increasing economic diversity.

The results show that in Bhutan throughout the Dzongkhags differences in economic performances are both the cause and effect of the extent of ICT penetration.

**A telephone user at Merak**

*Source:* Bhutan Telecom.

# CHAPTER 8 SUSTAINABILITY

We have argued that connectivity matters in a fast changing Bhutan society. We have also mentioned that connectivity comes at a cost. Although it is recognized that new technologies have brought down the cost of connectivity, the realization of cost is still volume driven. In less developed economies like Bhutan, the adequate volume is yet to be materialized. The remoteness of various locations, as in the case of VSAT connectivity in Bhutan, enormously raises the cost of connectivity. If remoteness is not only geographical or topographical, and it is also in terms of social and economic parameters reflected by insignificant economic diversity, infrastructure development, and economic opportunities, sustainability of connectivity would be elusive.

If we rule out the option of no connectivity, the strategy is to mobilize resources, both from internal as well as external sources, for funding the deficits. Our survey results show that in most of the telekiosks, including the remote VSAT stations, revenue is increasing. It is not increasing at a pace that would quickly wipe out the deficits. Also, voice communication and fax services being the main usage, there is not much diversification in the usage of the services. Our study on the economic dynamics of ICT use in Bhutan shows that extensive use is actually dependent on the extent of diversification of the economic activities, the extent of education and the state of physical infrastructure. The result is quite indicative of the fact that extensive use of ICT-based services of the telekiosks will come along the way of creation of economic opportunities in Bhutan.

The Bhutanese economy shows many changes in the desirable directions. If employment pattern is any indication, it shows that, after agriculture, the construction sector is the most important employer. This indicates that physical infrastructure is on the path of development. Literacy has always been a positive aspect of the Bhutanese developmental scenario. It has to be complemented with more opportunities for higher skill-oriented educational opportunities as well as opportunities for skill-based economic activities. As we know, extensive use of ICTs constitutes both cause and effect of the process of economic development. From the sustainability point of view, the required resources from internal sources can be mobilized only through the diversified economic activities of the country. As the economy grows, mobilization of resources becomes easier, and the need for support from external resources decreases. In fact, as the economy grows, demand for ICT services also grows and gradually reaches the volume required to break even.

None of these, however, happen quickly, and never overnight. The big question, therefore, is how to sustain the telekiosks till the demand for services reaches the required volume? The question is more important for telekiosks in the VSAT locations, where even the maintenance of the stations incurs very high costs compared to those having normal connectivity. Our understanding of the users, usage and the dynamics of the Bhutanese economy suggests the following:

1. At present kiosks, are managed by post offices. Installations of the facilities are funded mainly from external resources. The beneficiaries are not aware of the cost-revenue aspect of the problem.
2. We expect that economic growth will create opportunities and employment for villagers. This is where resources will be generated through economic growth. We also expect that the process will generate more demand for ICT-based services in villages.
3. Involvement of the community/villagers in the management of the telekiosks, therefore, appears to be the desirable direction of changes in the management of the kiosks. This will relieve the post offices from the day-to-day management of the kiosks, and relieve the post offices from the problem of shortage of manpower, a problem highlighted by all the post offices that participated in the survey.
4. This will require shifting the location of the kiosks to a place to be allocated by the beneficiary community. This will save valuable space occupied by the equipment meant for the kiosks. Because

of the space problem, most of the post offices experience great difficulty in providing personal access to the computer to the prospective users of the services such as Internet access. Post offices also find it difficult to provide services beyond the normal post office hours. This problem also can be resolved if the kiosks are managed by the beneficiary communities.

5. The beneficiary community will employ its own individual to manage the day-to-day function of the kiosk. The employee, selected by the community, will have adequate knowledge and also will be trained by the post office personnel for operations of the various ICT-based services.

6. The employee thus selected and trained will impart training to the villagers on various computer-related usages on the basis of fees decided by the community.

7. Revenue earned from the access services and also from the training of the villagers will go to the community, who will pay the employee a negotiated amount on a monthly basis.

8. We visualize multiple benefits from the proposed change in management. Villager-users will be made aware of the cost-revenue issues of running the kiosk. It will also help in spreading awareness of the computer and ICTs deep down into the community. Over and above these factors, the expected economic growth will be immediately reflected in the demand for services, earnings from the kiosks, prices of the services, etc., based on which the community will take decisions on the nature, type, and prices of the services.

9. We visualize the role of the post office mainly as overseeing the installation of the kiosks in villages, training of the personnel, maintenance of the equipment, and also advising on the nature and types of new services, equipment, costs, etc.

10. The process of shifting the kiosks to the communities has to be gradual. It has to begin with the kiosk belonging to villages with a reasonable size of users, persons with adequate ability to bear the responsibility of managing the kiosk and also a community that is willing to take that responsibility. As such, the VSAT-connected kiosks are going to be at the end of the process of shifting of management of the kiosks. This is not only because they are economically behind many others, but also because the user villages are dispersed and sparsely populated.

11. The resources that are needed for the survival of the kiosks during the intermediary gestation period have to be arranged by mobilizing resources from external sources. It has to be carefully monitored that dependence on these resources gradually declines to ensure self-sustainability of the kiosks managed by the beneficiary communities.

The essence of the above suggestion is involvement of the community in managing the ICT infrastructure that is going to bring in multifaceted benefits to them; and, in the process, to make them aware of the problem of the cost-revenue balance, that is, the problem of the sustainability of the telekiosks and its solution.

# CHAPTER 9 SUMMARY AND CONCLUSION

Briefly described, the project has brought computerization to Bhutan Post. The impact is twofold. The first impact is internal to Bhutan Post in the form of changes in work culture, commitment, innovative initiatives, etc., and also in the form of demand for more computer-based services in the post offices. The other one is the telekiosk-based services being provided to the communities in and around the post offices. The extent of use by the communities can be assessed from the revenue earned by post offices from these services. As we have seen, most of the revenue is actually generated from voice communication and fax-based services. Use of the Internet is in its infancy. While revenue earned is reasonable for some of the post offices, for many others it is yet to reach a significant amount. Wherever there is growing demand for ICT-based services, emerging private enterprises take away a share of the market. Post offices with higher organizational costs find it difficult to match the services provided by the private enterprises. Two factors that limit the use by communities are: a) difficult terrain over which villages are spread make such facilities unreachable for many villages, b) the economic activities in Bhutan are not vibrant enough to generate increasing demand for ICT-based services. The study has brought out the fact that the facilities created by the project are actually being accessed also by the villagers from very remote places. The value of this accessibility should be understood from the relations between ICT access and economic changes in the Bhutanese context. The statistical results of the macro-level exercise relating ICTs and economic changes in Bhutan have shown that ICTs contribute to the creation of economic diversity, and also that increasing economic diversity enhances the use of ICT-based services. Seen from this perspective, the inroads the project is making in the remote rural villages of Bhutan are more enduring than is reflected by the data on revenue earned by the post offices.

### Road blocks

As always happens in such cases, the project faces quite a few roadblocks. The ICT services provided by telekiosks are bringing reasonably good business to those post offices that are located closer to urban areas or in the vicinity of educational institutions. However, in many cases, private enterprises have sprung up and they are providing similar services at a lesser price. Post offices, due to higher organizational costs, find it difficult to compete with private service providers. Wherever there is higher demand, there is also demand for faster connectivity. These post offices strongly feel the need for broadband connectivity. We have already mentioned the competition that the e-post service faces vis-à-vis mobile telephones.

### Issues

Many roadblocks are external to the project, and in many cases they are not foreseeable. Such situations require rethinking and revamping cost, price and modes of services. However, there are issues that are internal to the system and the project. In the case of this project, the single most important issue is maintenance: repairing and replacement of the equipment. This problem has to be addressed keeping in mind the fact that once computerization has been carried out, any breakdown lasting a few days will cause the collapse of the system. At present, the problem is addressed on an ad hoc basis. Mobilization of resources should be planned for this purpose.

### Challenges

The major challenge of the project is to ensure the sustainability of the telekiosks. There is no short-cut method of either cutting costs or generating revenue to strike a balance between cost and revenue of the kiosks. This is even more so for VSAT connectivity, where project cost is far higher than for other kiosks. As we have stated at the outset, the project has achieved the goal of reaching the unreached. In this case it was, essentially, through creating an ICT infrastructure in the post offices of Bhutan. The initiation into a new era of computerization has thrown up new challenges for Bhutan Post. The future challenge remains of carrying ICTs to far-flung communities. Our considered view is that, riding on the experiences of the project,

and also from the experiences of similar projects in Viet Nam, the telekiosk project can now be shifted to local communities. What we are proposing is a business model with public citizen partnership. The day-to-day management of the kiosk can be left with a representative of the local community after initial training of reasonably educated community members. In the case of Viet Nam, each local community employs its own personnel for managing the kiosk. S(he) is also paid by the local community as a percentage of the total revenue earned. Maintenance, repairs and training are taken care of by the post office. A similar model can be considered for taking ICTs to the community level in Bhutan. The mainstay of this proposal is not earning more revenue, but to make ICTs accessible and familiar to local communities, and to make them partners in the benefits as well as the costs of the services. This also lessens the burden of the post offices in operating the telekiosk. The core of this proposal is the findings of the statistical exercise, presented above, that tells us that ICTs contribute to economic change. Carrying ICTs deep into the remote areas will require a longer gestation period for breaking even, but will reduce the gestation period for economic change, and in turn will create more demand for and revenue from ICT services.

### Epilogue

The core of any developmental project like the one discussed above is the expected gains or achievements. Yet in most cases, such projects bequeath many unaccounted or intangible gains, the long-term effect of which might outweigh the projected gains. This happens because such projects actually work as a catalyst and create cascading effects on many social, cultural and economic practices. The Bhutan telekiosk project is a glaring example of such a case.

Another question is when does a project end? Is it after the projected time period is over, and achievements are accounted for? From the Bhutan experience we learn that it ends only with a new beginning, with new ideas, new problems, and new achievable plans. Carrying ICTs from post offices to communities is probably that new beginning of the Bhutan project.

**IT Maintenance Centre at Bhutan Post. Equipment from different parts of the country is brought here for repairs. The facility needs urgent upgrading**

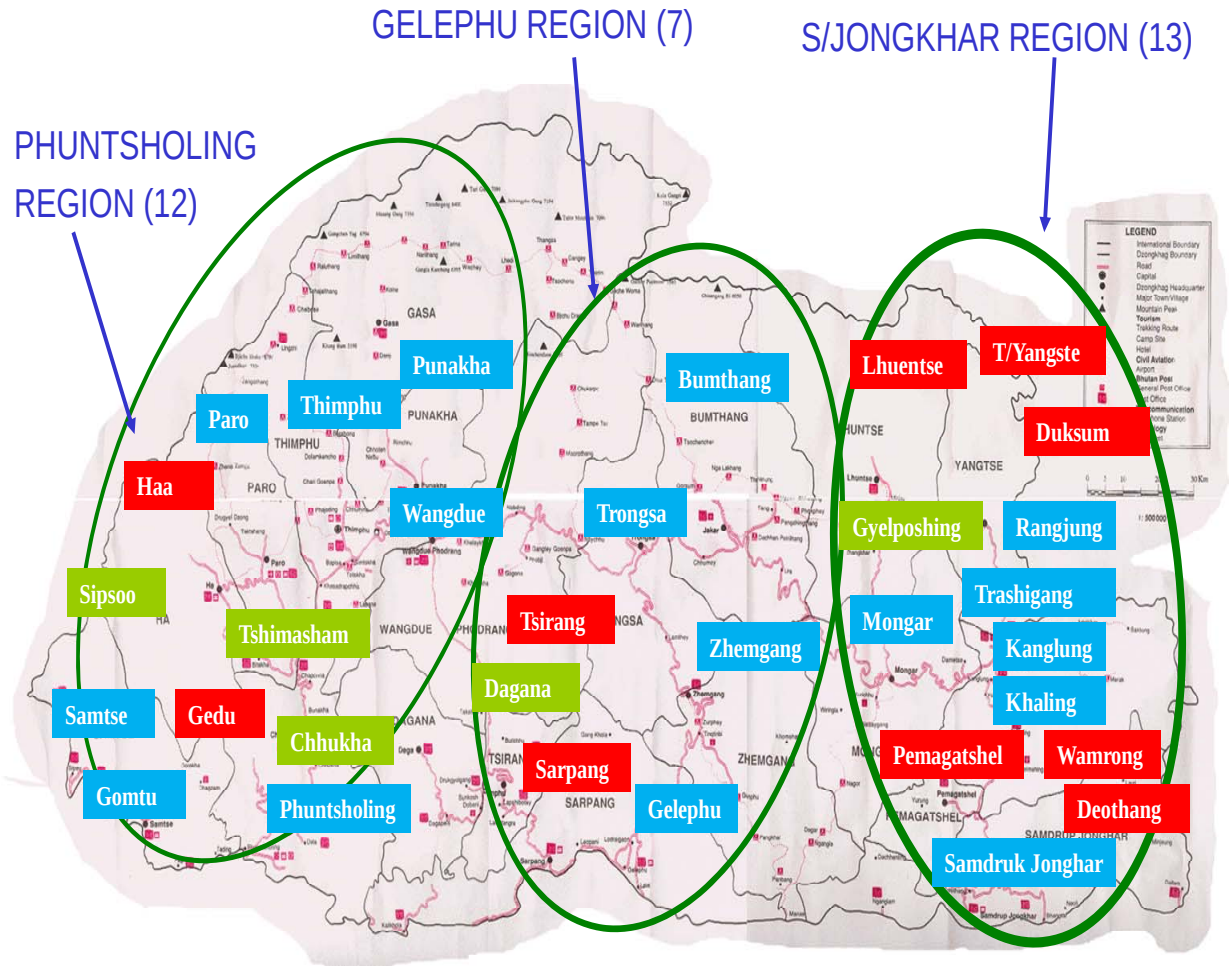

*Source:* ITU.

# ANNEX I CONTRIBUTIONS FROM PARTNERS

| Partner | Contribution | Value (USD) | Duration | Remarks |
|---|---|---|---|---|
| ITU | Feasibility study, project document, computer equipment for post offices, LAN at GPO, wireless equipment, and training | 160 000 (including 40 700 contributed by British Telecom, Deutsche Telecom, INTELSAT and Telstra) | 4 years | |
| UPU | IT equipment and training | 50 000 | 4 years | |
| Bhutan Post | Equipment, personnel, buildings | 275 000 | 3 years | |
| Bhutan Telecom | Training BP personnel, VSAT network | 200 000 | 3 years | |
| India | – Six VSAT terminals (antenna diameter: 1.2 metres) for provision of voice and low/medium speed data services + hub in Thimphu);<br>– Power sources: solar energy, with about eight days autonomy;<br>– Access/transponder capacity on INSAT system (free for the duration of the project, and later within equivalent INTELSAT DAMA tariffs); and<br>– Training and maintenance. | 500 000 | 2 years<br>2004-05 | MoU signed by Bhutan, India, ITU and UPU in 2003. Project inaugurated on 20 March 2006. |

## ANNEX II MAPS

**Map 1: Computerized post offices, 2008**

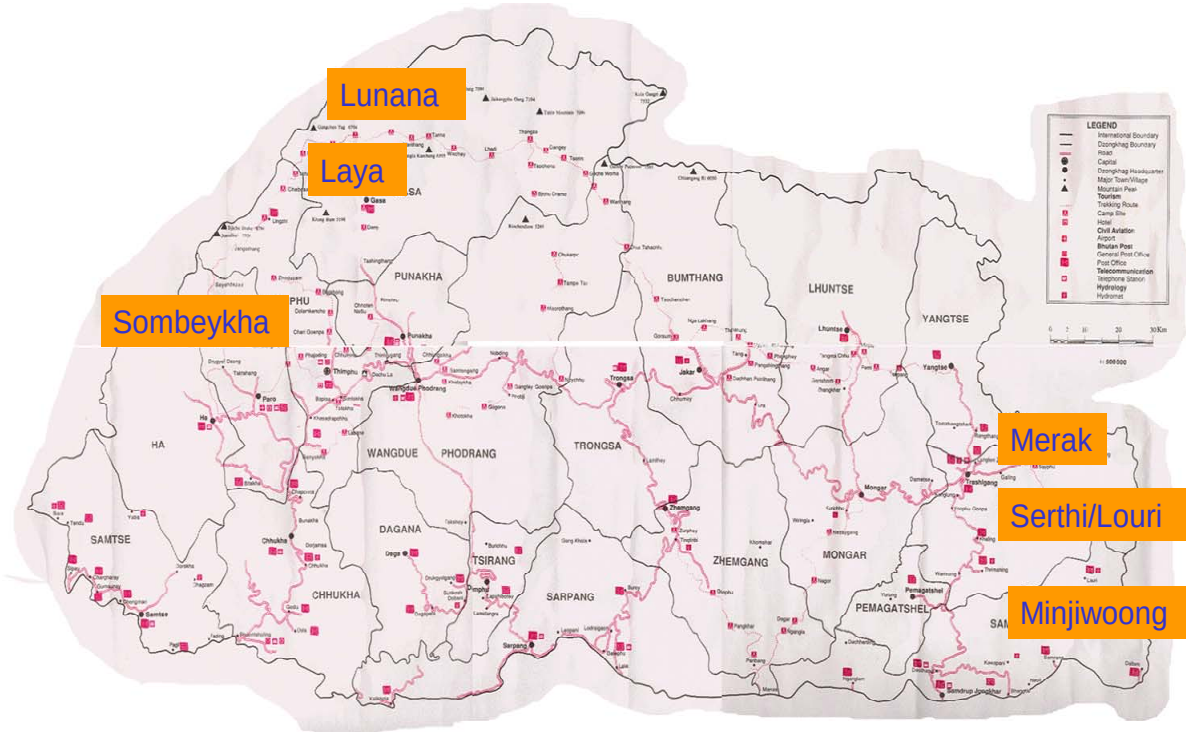



17 post offices in the first phase

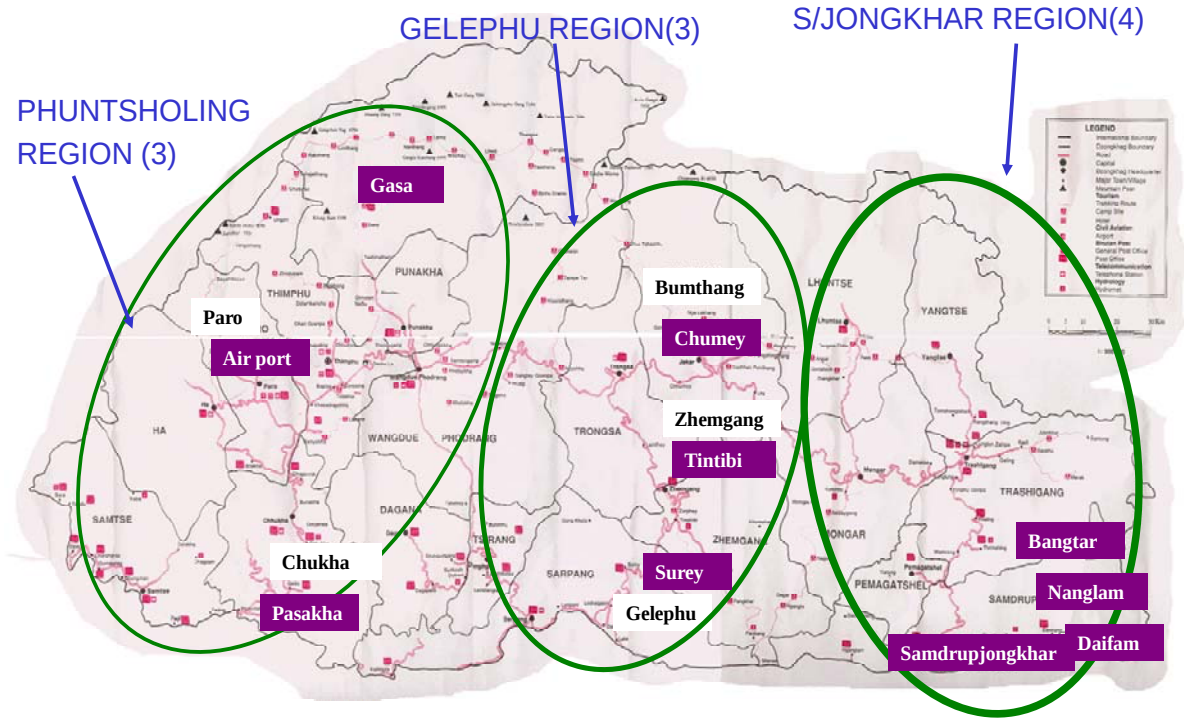
10 post offices in the second phase

5 post offices computerized under the CIC programme

## Map 2: VSAT locations, 2008




## Map 3: Post offices to be computerized



ANNEX III

# AN ACCOUNT OF THE ESTABLISHMENT OF VSAT-BASED TELEKIOSKS

## Telecommunications Consultants India Limited

The Government of India's Ministry of Communications and Information Technology, the Royal Government of Bhutan's Ministry of Information and Communications, the International Telecommunication Union and the Universal Postal Union have entered into an MoU to provide connectivity to remote areas for the establishment of telekiosks at post offices in six villages in Bhutan, with the hub station at Thimphu. As established in the MoU, Telecommunications Consultants India Limited (TCIL) were entrusted with the execution of the project.

Six villages were identified to receive the telekiosks, namely:

1. Laya
2. Lunana
3. Merak
4. Minjiwoong
5. Shingkhar Lauri
6. Sombeykha

ITU requested TCIL to conduct a survey of these six villages to ensure project feasibility. In December 2003, Bhutan Telecom officials joined the TCIL team to conduct a survey of two villages, Merak and Sombeykha, for VSAT installation, and Thimphu, for hub station installation. A techno-commercial proposal was submitted in January 2004. At that time, the sites of Laya and Lunana, located in northern Bhutan, were not accessible due to heavy snowfall and therefore could not be surveyed.

In April and May 2004, TCIL and Bhutan Telecom officials carried out the survey of three other villages. It was then decided at a meeting with the Managing Director of Bhutan Telecom to exclude Lunana, still not accessible, from the survey.

The survey was aimed to determine:

a) The most appropriate sites for the location of VSAT stations with LOS to the INSAT-3 A satellite.
b) Suitability of existing infrastructure of facilities needed for the equipment and solar panels.

The following are the requirements envisaged by Bhutan Telecom at each VSAT location:

1. Three voice circuits
2. One data circuit

Bhutan Telecom intends to have the hub located at the existing satellite earth station at Thimphu that will act as a gateway. They are planning to extend these facilities to at least ten more locations in the near future (second phase) and the proposed hub should have the capacity to meet these requirements. Bhutan Telecom has agreed to arrange for vehicles with driver and fuel, tents and sleeping bags, for conducting the survey. They have deputed an official of Bhutan Telecom to guide the team.

### General observations

1. The sites Laya and Shingkhar Lauri are at a distance of 110 km and 50 km, respectively, from the nearest road point. The other three villages are around 20-25 km from the nearest road point. Mode of transportation is by foot and material transportation by mule.
2. None of the sites receive a commercial power supply and solar power supply is therefore essential for the functioning of the proposed equipment. All the sites have HF/VHF communication systems operating on a solar power supply system whose capacity is far below the requirements. Hence, separate solar power systems have been planned.

3. All the sites have sufficient space for the installation of antennas and solar panels and for keeping Indoor Unit (IDU) and other equipment.
4. All the sites have clear visibility in a south-westerly direction in order to be able to operate with the INSAT series of satellites.
5. Laya, Lunana and Merak experience moderate to heavy snowfall during winter months. Snowfall is not significant at the other sites.

## Site survey details

### Station 1: Thimphu

Thimphu has a satellite earth station functioning in the premises of the Bhutan Telecom Office, where the exchange and ISP are located. The station works with Intelsat-62 Deg (IS-904) and operates links with six countries. The station has a 13-metre C-Band antenna.

The longitude, latitude and other details have been noted. The station possesses 45 KVA UPS and the station engineer has indicated that there is spare capacity available that can cater to the needs of the proposed hub station. The equipment room has sufficient space to house the proposed equipment.

The exchange and the ISP are located on the same campus at a distance of about 150 to 200 metres away and it is very much easier to extend the connectivity to PSTN and ISP.

### Station 2: Merak

The village of Merak comes under the Trashigang District administration and is located in the north-eastern region of Bhutan. It is located at an altitude of 11 582 ft. It takes about nine hours on foot (trekking) to reach Merak from the nearest road administration, i.e. gewog. A team of officials from TCIL and Bhutan Telecom set out from Thimphu and reached Merak and returned as per the following itinerary:

Day 1: Thimphu to Jhakar

Day 2: Jhakar to Trashigang

Day 3: Trashgang to Ridhi to Merak on foot. Stay at Merak.

Day 4: Merak to Trashigang

Day 5: Trashigang to Jhakar

Day 6: Jhakar to Thimphu.

The distance from the nearest road point (gewog) to Merak is approximately 25 km over very harsh mountainous terrain. The population of the village is about 700. The village has a wireless system working with Trashigang. The system works with a solar power system as there is no power supply.

The site posseses enough vacant space for the proposed VSAT antenna and solar power panel installation. The visibility of the antenna for working with an INSAT satellite is clear. The soil is rocky. The IDU and the PC (for the proposed telekiosk) can be installed in the same room where the wireless set is functioning at present. The approximate distance from the proposed antenna location to the equipment room is 25 metres. It is considered preferable to keep the Outdoor Unit (ODU) along with the antenna.

There is a primary school situated at a distance of 150 metres from the proposed location. If Bhutan Telecom desires to have a telephone provided in the school, this can be arranged by extending a drop wire from the IDU.

**Merak VSAT station**

*Source:* Bhutan Telecom.

**Station 3: Sombeykha**

The village of Sombeykha comes under the Haa District administration and is located in the western region of Bhutan. It is located at an altitude of 6140 ft. It takes about four to five days on foot (trekking) to reach Sombeykha from the nearest road point for Haa which is about 5 km by foot/vehicle from Bhutan Telecom set up at Haa. A team of officials from TCIL and Bhutan Telecom set out from Thimphu and reached Sombeykha and returned as per the following itinerary:

Day 1: Thimpu to Haa

Day 2: Day spent at Haa

Day 3: Haa to Dorikha

Day 4: Dorikha to Pajab

Day 5: Pajab to Shebji

Day 6: Shebji to Sombeykha

Day 7: Sombeykha to Shebji

Day 8: Shebji to Pajab

Day 9: Pajab to Dorikha

Day 10: Dorikha to Haa

Day 11: Haa to Thimphu

The distance from the nearest road point at Haa to Sombeykha is approximately 90 km over very harsh mountainous terrain. The population of the village is about 1000. The village has a wireless system working with Thimphu. The system works with a solar power system, as there is no power supply. We met Mr Karma Chendup who is the Health Assistant (HA) at Sombeykha and who looks after the livestock extension centre and the wireless system.

The site possesses enough vacant space for the proposed VSAT antenna and solar power panel installation. The visibility of the antenna for working with an INSAT satellite is clear. The soil is rocky.

The IDU and the PC (for the proposed telekiosk) can be installed in the same room where the wireless set is functioning at present, or in another new building just 20 ft above (at 6160 ft of altitude) at longitude 089 06.338 E and latitude 27 09.995 N. This may be decided by Bhutan Telecom in consultation with the

village administration, which is the sole owner of the buildings. Both buildings have rooms big enough to house all the equipment. The approximate distance from the proposed rooms to the proposed antenna location is 30 metres. It is considered preferable to keep the ODU along with the antenna.

The team was informed that the village receives moderate to heavy rain from April to October. The summer is usually from July to September during which time the village receives only blurred sunlight due to the foggy conditions in that region. From November to March during the winter the site experiences moderate to good sunlight.

The telephone set may be installed in the equipment room. The transportation of antenna, solar power panel system, Radio Frequency Terminal (RFT) and other material from the road point to the Sombeykha site has to be planned as the terrain is very harsh and it takes four to five days to reach the site.

### Station 4: Laya

The village of Laya comes under Gasa District administration and is located in the extreme north of Bhutan. It is located at an altitude of 3941 metres. It takes about three to four days on foot (trekking) to reach Laya from the nearest road point named Tashithang. A team of officials from TCIL and Bhutan Telecom set out from Thimphu and reached Laya and returned as per the following itinerary:

| | | *Dates* | |
|---|---|---|---|
| Day 1: | Thimphu to Tashithang | 14-04-04 | |
| Day 2: | Tashithang to Gasa | 15-04-04 | |
| Day 3: | Gasa to Koena | 16-04-04 | |
| Day 4: | Koena to Laya | 17-04-04 | |
| Day 5: | Laya to Koena | 18-04-04 | |
| Day 6: | Koena to Gasa | 19-04-04 | |
| Day 7: | Gasa to Tashithang | 20-04-04 | |
| Day 8: | Tashithang to Wangdue | 21-04-04 | (to proceed to other sites) |

The distance from the nearest road point at Tashithang to Laya is approximately 110 km over very harsh mountainous terrain. The population of the village is about 900. The village has a wireless system working with Thimphu. The system works with a solar power system, as there is no power supply. We met the health assistant at Laya who looks after the livestock extension centre and the wireless system.

The site possesses enough vacant space for the proposed VSAT antenna and solar power panel installation. The visibility of the antenna for working with an INSAT satellite is clear. The soil is sandy.

The IDU and the PC (for the proposed telekiosk) can be installed in the same room where the wireless set is functioning at present. The approximate distance from the proposed room to the proposed antenna location is about 20 metres. It is considered preferable to keep the ODU along with the antenna.

The team was informed that the village receives average to good rain from June to August. Except during the rainy months, the area receives good sunlight. From September to April there is snowfall, which is heavy in January and February when approximately 4 ft of snow falls. During March-April, heavy winds are also frequent.

The telephone set may be installed in the equipment room. The transportation of antenna, solar power panel system, RFT and other material from the road point to Laya has to be planned as the terrain is very harsh and it takes three to four days to reach the site.

### Station 5: Minjiwoong (Serthik Block)

The village of Minjiwoong comes under the Samdrup Jongkhar District and Serthik Block administration. It is located in the extreme south east of Bhutan. It is at an altitude of 740 metres. It takes about five to six hours on foot (trekking) to reach the Minjiwoong site from the nearest road point named Daifam. From the Samdrup Jongkhar border with India to Daifam, about 250 km of road runs through Assam, India. At present, due to the ULFA and Bodo disturbances in the area, Bhutan government vehicles are allowed to travel with the Indian Army convoy, which leaves the Samdrup Jongkhar border on Thursdays only and returns from Daifam on Fridays. A team of officials from TCIL and Bhutan Telecom reached Daifam on the afternoon of 29 April 2004 and proceeded to Minjiwoong the next day as per the following itinerary:

| | | *Date* |
|---|---|---|
| Day 1: | Daifam to Phogcheri<br>Phogcheri to Minjiwoong | 30-04-04 |

The distance from the nearest road point at Daifam to Minjiwoong is approximately 20 km over mountainous terrain. The population of the village is about 3000. The village has a wireless system working with Thimphu. The system works with solar power, as there is no power supply. We met the staff in charge of the RNR (Renewable Natural Resources) centre that looks after the livestock extension centre and the wireless system.

The site possesses enough vacant space for the proposed VSAT antenna and solar power panel installation. The visibility of the antenna for working with an INSAT satellite is clear. The soil is sandy.

The IDU and the PC (for the proposed telekiosk) can be installed in the proposed room, which has enough space (12 × 6 ft). The approximate distance from the proposed room to the proposed antenna location is about 20 metres. It is considered preferable to keep the ODU along with the antenna.

The team was informed that the village receives average to good rain from June to August. Except for during the rainy months, the area receives good sunlight. There is no snowfall during winter. During March-April, strong winds are experienced.

The telephone set may be installed in the equipment room. The transportation of antenna, solar power panel system, RFT and other material from the road point to Minjiwoong has to be planned, as the terrain is hilly and it takes six to seven hours to reach the site.

**Jamyang Phuntsho at the Minjiwoong VSAT station**

*Source:* Bhutan Telecom.

### Station 6: Shingkhar Lauri

The village of Shingkhar Lauri is in the Samdrup Jongkhar District and is located in the extreme south east of Bhutan. It is located at an altitude of 1361 metres. It takes about two to three days on foot (trekking) to reach Shingkhar Lauri from the nearest road point at Daifam. Since we had already crossed in one day the distance to the site of Minjiwoong, Shingkhar Lauri could be reached from there in one to two days' time. A team of officials from TCIL and Bhutan Telecom set out from Minjiwoong and reached Shingkhar Lauri (and returned) as per the following itinerary.

| | | *Dates* |
|---|---|---|
| Day 1: | Minjiwoong to Lungko<br>Lungko to Shingkhar Lauri | 1-05-2004 |
| Day 2: | Shingkhar Lauri to Lungko<br>Lungko to Minjiwoong | 2-05-2004 |
| Day 3: | Minjiwoong to Phogcheri<br>Phoogcheri to Diafam | 3-05-2004 |

The distance from the nearest road point at Daifam to Shingkhar Lauri is approximately 50 km over very harsh mountainous terrain. The population of the village is about 3000. The village has a wireless system working with Thimphu. The system works with a solar power system, as there is no power supply. We met the person in charge of the Reneweable Natural Resources Centre who is looking after the livestock Extension Centre and the wireless system.

The site possesses enough vacant space for the proposed VSAT antenna and solar power panel installation. The visibility of the antenna for working with an INSAT satellite is clear. The soil is sandy.

The IDU and the PC (for the proposed telekiosk) can be installed in the proposed empty room, which has enough space (12 × 6 ft). The approximate distance from the proposed room to the proposed antenna location is about 20 metres. It is considered preferable to keep the ODU along with the antenna.

The team was informed that the village receives average to good rain from June to August. Except for during the rainy months, the area receives good sunlight. There is no snowfall. During March-April, heavy winds are experienced.

The telephone set may be installed in the equipment room. The school and basic health unit (BHU) are also situated close to the proposed room. The transportation of the antenna, solar power panel system, RFT and other material from the road point to Shingkhar Lauri has to be planned as the terrain is very harsh and it takes two to three days to reach the site.

### Station 7: Lunana

The Lunana site is located at an altitude of 4500 metres and has a population of approximately 1000. The accessibility is over harsh mountainous terrain and it takes more than seven days to reach the site from the nearest road point. The team learnt that a primary school, basic health unit and renewable natural resources centre were functioning at Lunana.

Lunana receives heavy snowfall for at least eight months in a year. The local school and the Natural Resource Centre are open for only four months in a year. It is proposed that helicopters may have to be utilized for transportation of men and equipment during installation work.

During the meeting held on 8 April 2004 at Thimphu, it was decided that the Lunana site would not be surveyed due to the inaccessible conditions prevailing there.

**Lunana VSAT station**

**On the way to Lunana**

*Source:* Bhutan Telecom.

**Special observations:**

a) **Logistics:** The team observed that there was no access or approach road to these villages. All these villages are situated atop mountains and one has to walk continuously over harsh mountain terrain for two to seven days to reach the destination. It is therefore recommended that the responsibility of transporting equipment to these destinations be given to Bhutan Telecom, which has good logistic support.

b) **Installation:** As regards installation, it is felt that two teams of engineers from Bhutan Telecom can be trained in VSAT installation and equipment configuration so that these teams can install the VSATs in remote locations. The TCIL team can do the installation and commissioning of the hub facility in Thimphu and extend support for the commissioning of VSAT terminals.

c) **Equipment:** It should be noted that the minimum temperature in these villages during the peak winter may drop to –10 degrees Celsius. Only equipment that will function at these low temperatures without any deterioration should be proposed.

d) **Solar power system:** Generally, solar power systems are designed for three to four days' autonomy, depending on the regions and availability of sunlight. The availability of sunlight at both the Merak and Sombeykha locations is moderate in the summer season and minimal during the rainy and winter seasons. The conditions are similar or even more critical at Laya and Lunana. Keeping this in mind, the solar power system designed and recommended can provide 8 days of autonomy on the basis of a six-hour work day. This is to ensure good network availability in all seasons.

**Data Link**

Bhutan Telecom has requested a data link of 64 kbit/s for each remote station, in addition to three voice circuits. Considering the traffic generated from one e-post terminal and minimum Internet application, this data rate is on the high side. Initially, a low-speed data link would meet their needs.

## ANNEX IV TECHNICAL DETAILS OF THE VSAT PROJECT

### Telecommunications Consultants India Limited

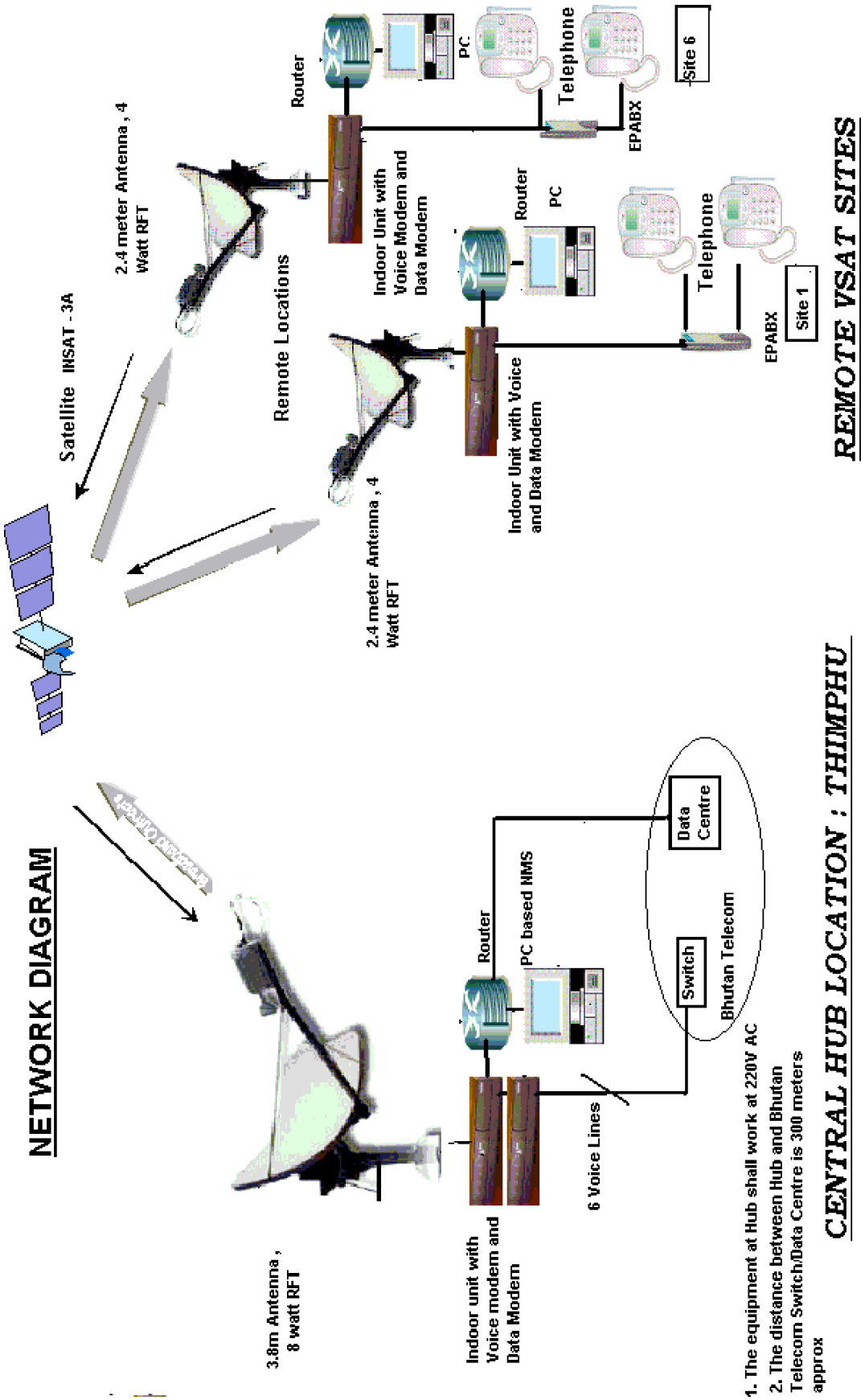
The hub shall be installed on the Bhutan Telecom premises in Thimphu, and the six VSATs shall be installed at the following sites:

1. Laya
2. Lunana
3. Merak
4. Minjiwoong
5. Shingkhar Lauri
6. Sombeykha

The network shall work via an INSAT 3A satellite in the 14/12 GHz-band. The network shall be utilized for transmission of voice (8 kbit/s) and data (24 kbit/s) between Thimphu and various VSAT locations.

The network shall operate in permanently assigned multiple access (PAMA) mode for the present. However, the proposed equipment shall be capable of demand assigned multiple access (DAMA) working. A network diagram is given in Figure IV.1.

Figure IV.1: VSAT network



## EQUIPMENT DETAILS (HUB):

*HUB Earth station at Thimphu*

The hub will act as a central point for the entire traffic flow. The hub Earth station shall be comprised of a 3.8 metre antenna, 8 watt RFT, seven voice and seven data modems. Six voice and data modems shall provide connectivity at the hub for each of the VSAT locations, while one voice and data modem is spare. The six voice lines shall be extended to the PSTN switch at Thimphu and the data shall be routed to the data centre through a router type 2651XM. The bill for material and the broad specifications are attached.

All the equipment at the hub shall operate via 220 volts AC.

**The equipment to be installed at the hub is as follows:**

**a) VSAT antenna: 3.8 m (14/12 GHz-band)**

| Specifications of 3.8 m antenna (14/12 GHz-band) | |
|---|---|
| **1. Electrical specifications** | |
| Operating frequency | 10.95 GHz to 12.75 GHz Rx |
| | 13.75 GHz to 14.5 GHz Tx |
| Antenna gain (mid band) | 51.7 dB/Rx, 53.2 dB Tx |
| VSWR | 1.3:1 |
| Antenna noise temperature | 10 EL – 29 K |
| | 20 EL – 21 K |
| | 30 EL – 20 K |
| | 40 EL – 19 K |
| **2. Mechanical specifications** | |
| Reflector diameter and feed type | 3.8 m, offset feed/prime focus |
| Reflector material | Glass fibre reinforced polyester |
| Centre hub, mount and mast | Steel galvanized |
| Antenna optics | 4 quadrants on 8 trusses or multi-petal antenna |
| Azimuth adjustment | 360° continuous, +/–35° fine adjustments |
| Elevation adjustment range | 12° to 90° (0° to 15° inverted) |
| **3. Enviromental** | |
| Wind loading | 80 km per hour, Operational |
| | 200 km per hour, Survival |
| Operating temperature | –40 ˚C to 60 ˚C |
| Solar radiation | 360 BTU/hr/ft |
| Atmospheric conditions | Salt, pollution from coastal and industrial areas |

### b) RFT: 8 watt (14/12 GHz-band)

| Specifications of RFT-8W (14/12 GHz-band) | |
|---|---|
| Frequency band (GHz) | 8 W |
| **Transmit** | |
| Output P1 dB compression | 39 dBm |
| Maximum AC power consumption | 150 VA |
| Input frequency | 70 ±18 MHz |
| Output frequency | 14/12 GHz-band |
| | 1.0 MHz |
| IF input power range | –25 to –5 dBm |
| **Phase noise** | |
| 100 Hz offset | –60 dBc/Hz |
| 1 kHz offset | –70 dBc/Hz |
| 10 kHz offset | –80 dBc/Hz |
| 100 kHz offset | –90 dBc/Hz |
| Frequency step size | 1.0 MHz |
| Reference signal stability | $10^{-7}$/year, $10^{-9}$/day |
| IF input interface | 50 N-type female |
| RF output interface | WR75/G |
| **Receive** | |
| **Phase Locked Low Noise Block (PL LNB)** | |
| RF input frequency | 14/12 GHz-band |
| L-band output frequency | 950 to 1700 MHz |
| Noise figure/temperature at 25 °C | 1.0 dB / 75 K |
| Gain | 60 dB (typ) |
| RF input interface | WR75/G |
| **Indoor unit** | |
| L-band input frequency | 950 to 1700 MHz |
| IF output frequency | 70 ±18 MHz |
| Gain stability (–40 to 60 °C) | ±3.0 dB max |
| Intermodulation product | –35 dBc |
| Spurious (36 MHz BW) | –55 dBc max |
| **Phase noise** | |
| @100 Hz offset | –60 dBc/Hz |
| @1 kHz offset | –70 dBc/Hz |
| @10 kHz offset | –80 dBc/Hz |
| @100 kHz offset | –90 dBc/Hz |
| L-band input interface | 50 N-type female |
| IF output interface | 50 N-type female |
| **Power supply** | |
| Input voltage (factory preset) | 220 V AC |
| DC output voltage to LNB | +13 V DC at RF IN connector |
| **Monitor and control** | |
| Interface | RS 232/485 |
| Form ’C’ relay contacts | Optional |

| Environmental | |
|---|---|
| Operating temperature | –40 °C to +55 °C |
| Relative humidity | up to 95% |

**c) Voice modem:** 7 (seven)

**Data modem:** 7 (seven)

The data modem will be interfaced to the router.

The voice modem will be interfaced to the EPABX.

**Technical specifications of SCPC DAMA / PAMA baseband:**

a) SCPC DAMA/PAMA satellite modem shall be able to work in manual/local mode for setting up SCPC PAMA links without the control of DAMA NMS.

b) SCPC DAMA/PAMA data modem shall be able to support data rates up to 128 kbit/s.

c) SCPC DAMA/PAMA voice modem shall have FXS/FXO, E&M interface (2 or 4 wires).

d) The voice modem shall be able to support voice and fax as per the requirement.

e) The voice modem shall be capable of handset-initiated DAMA call setup.

***Modem characteristics:***

- 1/2 or 3/4 forward error correction
- Viterbi decoding
- QPSK modulation/demodulation
- Internal BER measurement
- Frequency range 52 MHz to 88 MHz synthesized in 10 kHz steps
- Transmit level –10 dBm to –30 dBm in steps of 0.5 dB
- Receive level –45 dBm to –70 dBm
- Impedance 75 ohms
- Eb/No of 7.0 dB to give BER of less than $1x10^{-7}$ at 1/2 rate
- Acquisition time typically less than 10 seconds
- Carrier spacing less than 1.4 times the bandwidth
- Modem shall be capable of supporting Async. data up to 19.2 kbit/s and Sync. data up to 128 kbit/s on a single modem

*Environmental specifications:*

- Operating temperature 5 to 45 °C
- Humidity 20 to 90% RH
- Shock vibrations to withstand transportation and handling by air/sea/road
- Electro-magnetic As required for microwave compatibility electronic equipment mechanisms working in the vicinity of each other

**d) UPS-5KVA with one-hour backup**

Electronic and computer-based equipment needs a high quality uninterrupted power supply.

**Specifications of UPS system:**

- Input voltage: 160-270 V rms single phase
- Output voltage: 220V +/–2%
- Output voltage Distortion (RMS total harmonic distortion): Less than 5% max.

- Frequency: 50 Hz +/– 5%
- Waveform: Sinewave

**e) PC-based NMS**

The NMS shall contain the workstation and monitoring software. The NMS software residing in the workstation shall act as an administrator for configuring (adding or deleting) the remotes in the network. Traffic statistics, fault management and configuration management shall be provided by NMS software. The NMS shall be based on standard protocol SNMP, an industry standard for communication. The capabilities of NMS offered are:

- Up/Down status reporting of the link
- Generating pop-up alerts indicating the up/down status of the links
- Bandwidth utilization reports

**f) Router: Cisco Router 2651XM shall be provided**

The data from data modems shall be routed to the PC-based NMS and to the data centre via the router.

The product description is as follows:

| Product | Description |
|---|---|
| CISCO2651XM | High Performance Dual 10/100 Modular Rout with Cisco IOS IP |
| CAB-ACE | Power Cord Europe |
| S26C-12213T | Cisco 2600 Ser IOS IP |
| MEM2600XM-32U48FS | 32 to 48 MB Flash factory upgrade for the Cisco 2600XM |
| NM-4A/S | 4-Port Async/Sync Serial Network Module |
| WIC-2T | 2-Port Serial WAN Interface Card |
| CAB-V35MT | V.35 Cable, DTE, male, 10 ft |
| CAB-SS-V35MT | V.35 Cable, DTE male to Smart Serial, 10 ft |
| MEM2600XM-128U256D | 128 to 256MB DRAM factory upgrade for the Cisco 2600XM |

**g) Nineteen-inch rack**

All the indoor equipment shall be housed in a 19-inch rack. A standard 19-inch rack of suitable height shall be supplied.

## Equipment details (Remote)

**The equipment to be installed at remote sites is as follows:**

The remote end VSAT configuration shall consist of voice and data modems connecting to the central hub in PAMA mode. The equipment shall run on solar power. All the equipment except the router and EPABX at a remote site shall operate via –48 volts DC.

The VSAT shall comprise a 2.4 metre 14/12 GHz-band antenna, a 4-watt RFT and associated voice and data modems. The voice modem shall be connected to an EPABX, which will provide connectivity for three telephones. The data modem shall be used for transmission of data from a computer via a router 1721 as previously shown in Figure 1.

The detailed specifications and the bill of quantities (BOQ) are as follows:

### a) VSAT antenna: 2.4 m (14/12 GHz-band)

| Specifications of 2.4 m antenna (14/12 GHz-band) | |
|---|---|
| **1. Electrical specifications** | |
| Operating frequency | 10.95 GHz to 12.75 GHz Rx |
| | 13.75 GHz to 14.5 GHz Tx |
| Antenna gain (mid band) | 47.6 dB/Rx, 49.2 dB Tx |
| VSWR | 1.3:1 |
| Antenna noise temperature | 10 EL – 42 K |
| | 20 EL – 32 K |
| | 30 EL – 28 K |
| | 40 EL – 27 K |
| **2. Mechanical specifications** | |
| Reflector diameter and feed type | Offset feed/prime focus |
| Reflector material | Glass fibre reinforced polyester |
| Centre hub, mount and mast | Galvanized steel |
| Antenna optics | 4 quadrants on 8 trusses or multi-petal |
| Azimuth adjustment | 360° continuous, fine adjustments +/–30° |
| Elevation adjustment | Fine, 5° to 90° continuous fine adjustment |
| **3. Environmental** | |
| Wind loading | 80 km per hour, Operational |
| | 200 km per hour, Survival |
| Operating temperature | –40 ˚C to 60 ˚C |
| Solar radiation | 360 BTU/Hr/ft |
| Atmospheric conditions | Salt, pollution of coastal and industrial areas |
| Rain | 100 mm/hour |
| Snow protection | A suitable cover shall be supplied for a 2.4-metre antenna to prevent the accumulation of snow |

### b) 14/12 GHz-band RFT: 4 watt

| Specifications of RFT-4W | |
|---|---|
| **Transmit** | |
| Output P1 dB compression | 36 dBm |
| Maximum AC power consumption | 150 VA |
| Input frequency | 70 ±18 MHz |
| Output frequency | 14/12 GHz-band |
| Step size | 1.0 MHz |
| IF input power range | –25 to –5 dBm |
| **Phase noise** | |
| 100 Hz offset | –60 dBc/Hz |
| 1 kHz offset | –70 dBc/Hz |
| 10 kHz offset | –80 dBc/Hz |
| 100 kHz offset | –90 dBc/Hz |
| Frequency step size | 1.0 MHz |
| Reference signal stability | $10^{-7}$/year, $10^{-9}$/day |
| IF input interface | 50 N-type female |
| RF output interface | WR75/G |
| **Receive** | |
| **Phase Locked Low Noise Block (PL LNB)** | |
| RF input frequency | 14/12 GHz-band |
| L-Band output frequency | 950 to 1700 MHz |
| Noise figure/temperature at 25 °C | 1.0 dB/75 K |
| Gain | 60 dB typ |
| RF input interface | WR75/G |
| **Indoor unit** | |
| L-band input frequency | 950 to 1700 MHz |
| IF output frequency | 70 ± 18 MHz |
| Gain stability (–40 to 60 °C) | ±3.0 dB max |
| Intermodulation product | –35 dBc |
| Spurious (36 MHz BW) | –55 dBc max |
| **Phase noise** | |
| 100 Hz offset | –60 dBc/Hz |
| 1 kHZ offset | –70 dBc/Hz |
| 10 kHZ offset | –80 dBc/Hz |
| 100 kHZ offset | –90 dBc/Hz |
| L-band input interface | 50 N-type female |
| IF output interface | 50 N-type female |
| **Power supply** | |
| Input voltage (factory preset) | –48 VDC |
| DC output voltage to LNB | +13 VDC at RF IN connector |

| | |
|---|---|
| **Monitor and control** | |
| Interface | RS 232/485 |
| Form 'C' relay contacts | Optional |
| **Environmental** | |
| Operating temperature | –40 °C to + 55 °C |
| Relative humidity | Up to 95% |

c) **Voice modem:** 1 (one)
**Data modem:** 1 (one)

**Technical specifications of SCPC DAMA / PAMA baseband:**

a) SCPC DAMA/PAMA satellite modem shall be able to work in manual/local mode for setting up SCPC PAMA links without the control of DAMA NMS.

b) SCPC DAMA/PAMA data modem shall be able to support data rates up to 128 kbit/s.

c) SCPC DAMA/PAMA voice modem shall have FXS/FXO, E&M interface (2 or 4 wires).

d) The voice modem shall be able to support voice and fax as per the requirement.

e) The voice modem shall be capable of handset-initiated DAMA call setup.

*Modem characteristics:*

- 1/2 or 3/4 forward error correction
- Viterbi decoding
- QPSK modulation/demodulation
- Internal BER measurement
- Frequency range 52 Mhz to 88 Mhz synthesized in 10 kHz steps
- Transmit level –10 dBm to –30 dBm in steps of 0.5 dB
- Receive level –45 dBm to –70 dBm
- Impedance 75 ohms
- Eb/No of 7.0 dB to give BER of less than $1x10^{-7}$ at 1/2 rate
- Acquisition time typically less than 10 seconds
- Carrier spacing less than 1.4 times the bandwidth
- Modem should be capable of supporting Async. data up to 19.2 kbit/s and Sync. data up to 128 kbit/s on a single modem

*Environmental specifications:*

- Operating temperature — 5 to 45 °C
- Humidity — 20 to 90% RH
- Shock vibrations — To withstand transportation and handling by air, sea and road
- Electro-magnetic — As required for microwave compatibility
  Electronic equipment mechanisms working in the vicinity of each other

### d) Router: Cisco Router 1721

Specifications of Cisco 1721 Router:

| Sr no. | Product | Description |
|---|---|---|
| 1 | CISCO1721 | 10/100BaseT Modular Router w/2 WAN slots, 32M Flash/64M DRAM |
| 2 | WIC-1T | 1-Port Serial WAN Interface Card |
| 3 | MEM1700-64U128D | Cisco 1700 64MB to 128MB DRAM factory upgrade |
| 4 | S17C-12213T | Cisco 1700 IOS IP |
| 5 | CAB-ACE | Power Cord Europe |
| 6 | CAB-V35MT | V.35 Cable, DTE, male, 10 ft |

### e) Nineteen-inch rack

All the indoor equipment shall be housed in a 19-inch rack A standard 19-inch rack of suitable height shall be supplied.

### f) The solar power system to be deployed at the remote sites

The system shall consist of a solar power panel, batteries and solar charge controller. It shall work for six hours a day and shall have eight days autonomy. Sealed valve regulated lead acid (VRLA) maintenance-free deep-cycle batteries shall be provided:

| Load | Solar power panel capacity | Battery capacity at C/10 rate | Solar charge controller |
|---|---|---|---|
| 600 watts | 1800 Wp | 850 Ah | 48 V, 40 A |

An inverter shall be supplied to interface equipment working on AC, such as routers and EPABX.

**g) The EPABX system,** to be deployed to cater to the requirements of Bhutan

Telecom to provide three extensions at a remote site, shall provide the following features:

- All the EPABX system shall operate via 220V AC.
- The EPABX shall support 2W/4W E&M, FXO/FXS on the trunk port.
- The EPABX shall have 2 CO lines and 4 extensions.

### h) Spares

Necessary spares (including 4-watt RFT, 4-slot chassis, power supply for 8 watts, power supply for 4 watts and for the chassis, router-1721, cards for central router, data modem and voice modem) shall be provided.

### i) Bandwidth requirements

A bandwidth of 600 kHz shall be available on INSAT 3A satellite in the 14/12 GHz-band.

### j) Training

Training shall be given on site and shall cover the contents required for installation, operation and maintenance of various subsystems – for example, the hub and VSAT equipment as well as other infrastructure equipment.

### k) Warranty support

One-year warranty support will be provided from the date of the commissioning of the system.

# ANNEX V TECHNICAL PERFORMANCE, PROFILES OF THE USERS, POSTMASTERS' PERCEPTIONS AND USE PATTERN

**Table V.1: Technical performance of the VSAT stations**

| Stations | VSAT reliability | Efficiency of solar panels | Battery back-up | Outdoor equipment and weather conditions | Incidence of seeking help from BTL (Thimphu) | Issues related to maintenance | Major problems sfaced |
|---|---|---|---|---|---|---|---|
| Laya | Connectivity breakdown for two or three times during last year | Average | Sufficient | System required to be reset every day in the morning at Thimphu hub | Twelve times over last year | Geographically located in a very remote place; takes three days to reach technical help in case of breakdown | Power breakdown |
| Minjiwoong | No connectivity breakdown | Reliable | Sufficient | No problem | Did not require help over last year | Geographically located in a very remote place; takes two days to reach technical help in case of breakdown | No major problem faced so far |
| Sombeykha | VSAT connectivity is using 14/12 GHz-band which is affected by adverse weather conditions | No problem faced so far, but might be affected by the unpredictable local weather | Sufficient and effective | Is affected by foggy, rainy and cloudy weather | Only once when the feed horn was broken | Geographically located in a very remote place; takes two/three days to reach technical help in case of breakdown | No major problem faced so far |
| Merak | Connectivity breakdown twice. Once for 50 days and another for 5 days | Due to frequent bad weather, solar panel cannot be used efficiently | Battery cannot get fully charged, and efficiency is reduced | Voice card had to be replaced; there was a problem with data card replacement because of unavailability of spare | Twice in 2008 | Availability of spares and transportation of equipment because of difficult terrain | Lap-top was virus-infected and a team from Thimphu had to visit to attend to the problem |
| Shingkhar Lauri | Functioning properly | Reliable | Sufficient | System needed to be reset every day in the morning at Thimphu hub | Not required so far | Geographically located in a very remote area; takes two/three days to reach technical help in case of breakdown | No major problem so far |
| Lunana | The system could not function because of hostile weather conditions and had to be dismantled. | | | | | | |

**Table V.2: Profile of the user villages of the VSAT stations**

| Stations | Voice traffic (minutes) | Internet usage (hours) | Profile of the user villages |
|---|---|---|---|
| Laya | 18 720 | | Most of the users are from Laya town.<br>Number of villages that accessed the services: 4<br>Number of villages located: *within 5 km* *more than 15 km*<br>From the kiosk: 2 2<br>From other facilities: 2 2<br>Literacy rate: 6% to 10%<br>Traditional agriculture is the main economic activity. |
| Minjiwoong | 16 140 | 120 | About 10 villages use the services.<br>Number of villages located: *within 7-12 km* *more than 15 km*<br>From the kiosk: 6 4<br>From other facilities: 6 4<br>Literacy rate: 3% to 20%<br>Traditional agriculture is the main economic activity. |
| Sombeykha | 13 657 | | Details not received. |
| Merak | 542 | | Most users are from Merak town. Two villages that have accessed the facility are about two-days' walk from the kiosk and have a few occasional users. For the villagers, other facilities like the school, health centre and main road network are about 4 days' walking distance.<br>Yak herding is the main occupation, and the general economic condition is poor. Literacy about 6%. |
| Shingkhar Lauri | 13 620 | 180 | 8 villages use the services.<br>Number of villages located: *within 5 km* *more than 10 km*<br>From the kiosk: 3 5<br>From other facilities: 3 5<br>Literacy rate: 3% to 20%<br>Traditional agriculture is the main economic activity. |
| Lunana | The system could not be installed due to adverse climatic conditions. | | |

**Table V.3: Postmasters' perceptions about the functioning of the stations**

| Post offices | No. of employees | Training | E-post as % of total post | Problems with e-post | Major problems faced | Steps required |
|---|---|---|---|---|---|---|
| Laya | 1 employee. Operation of the VSAT station is managed by BTL personnel | On VSAT and e-post delivery | – | Technical | Technical knowledge, and also power breakdown | Building awareness of the users; technical knowledge of the staff |
| Minjiwoong | 1 employee. | Computer and accessory related training by Bhutan Post | 12% | Technical and equipment-related problem | Technical knowledge of the staff | Awareness of the villagers; technical knowledge of the staff |
| Sombeykha | Details not provided | | | | | |
| Merak | Operation of the VSAT station is managed by BTL personnel | On VSAT and e-post delivery | – | Technical, delivery problem | Machine malfunction, power breakdown | Technical knowledge of the staff; maintenance of the equipment |
| Shingkhar Lauri | 1 employee. Operation of the VSAT station is managed by BTL personnel | Comupter and accessory related training by Bhutan Post | 10% | Technical and equipment-related problem | Technical knowledge of the staff | Awareness of the villagers; technical knowledge of the staff |
| Lunana | Project abandoned | | | | | |

**Table V.4: Users and use pattern of the services**

| Stations | Main users | Main purpose of the use | Value of the services |
|---|---|---|---|
| Laya | Students and professionals; also accessed by women | Social interaction, health and hygiene, and career related | • Cheaper connectivity with relatives<br>• Access to health facilities<br>• Education and career related<br>• Access to developmental programmes |
| Minjiwoong | Students and professionals | Social interaction and profession, as well as health and hygiene related | • Cheaper connectivity with relatives<br>• Access to health facilities<br>• Education and career related<br>• Access to developmental programmes |
| Sombeykha | Did not provide | | |
| Merak | Men, women, students and professionals | Social interaction, study and education related, business related | • Cheaper connectivity with relatives<br>• Education and career related<br>• Access to developmental programmes |
| Shingkhar Lauri | Students and professionals | Social interaction, health and hygiene, profession and career related | • Cheaper connectivity with relatives<br>• Access to health facilities<br>• Education and career related<br>• Access to developmental programmes |
| Lunana | The system could not function because of hostile weather conditions and had to be dismantled. | | |

# ANNEX VI USER PROFILES, POST OFFICE PERCEPTIONS AND USER PERCEPTIONS

**Table VI.1: User profiles**

| Post offices | Profile of the user villages |
|---|---|
| Bumthang | In addition to the Bumthang town, four villages use the services. One of the villages is 50 km away from the kiosk. The other three are from 20 to 25 km away. Mainly agriculture based, the economic conditions of the villages are average. |
| Phuntsholing | Phuntsholing is a major trading town of Bhutan. The regular users of the facilities are from the town as well as the business visitors from villages around. |
| Dagana | Three villages access the services. Two villages are about a one-day walk from the post office and another is 6 hrs travel from the post office. One of the villages is poor compared to the other two, which are average in economic conditions. All villages are fully dependent on agriculture. |
| Haa | Haa is located at a high altitude on difficult terrain. It is also sparsely populated. Haa town is the main user of the facility. There are occasional users from a village 8 km away from the post office. |
| Lhuentse | Two villages access the services: Kustoe (3 days' walk) and Jorrey (2 days' walk). There are both regular and occasional users. |
| Mongar | Three villages have accessed the services of the kiosk. One of the villages, about 3 km away from the post office, is quite prosperous and, in addition to traditional agriculture, it has horticulture export as a source of income. The financial transactions of the village bring good revenue for the post office through fax money order services. The other two villages are 8 km and one day's walk away, and have occasional users. |
| Paro | Paro is an airport town as well as an important tourist attraction. It has a few educational institutions. The ICT services, therefore, have a good market. The post office faces competition from private operators. Many residents have their own ICT facilities. |
| Punakha | Regular users from a village about 4 km away. There are four villages from 6 to 20 km away, with a few occasional users. There are two private operators near the post office, providing stiff competition. They are open for a longer duration. To compete, the post office also has to operate beyond office hours, and opens on Saturday, which is normally an off-day. |
| Samste | Two user villages, about 2 days' walking distance from the post office, have a few occasional users. The other 4 villages in a radius of one and half km have regular users. |
| Tsirang | Details not received. |
| Wangdue | About six villages around the post office use the services. There are user villages located more than 20 km away. There are about 10-15 regular users of the PCO and Internet. Students and professionals are the main users of the Internet service.<br>Economic conditions of the villages are average, mainly agriculture. There are a few service holders and a few working abroad from these villages. |
| Zemgang | Three villages are main users. One of the villages is quite prosperous, having activities of 50% agriculture, 25% service and 25% crafts. The rest are average, mostly agriculture. Villages have around 80% literacy. All of them have a school and health centre and other facilities within 3 km. |
| Wamrong | Two of the user villages, providing occasional users, are 2 days' walk from the post office. A nearer one, one and half day's walk away, has many occasional users. |
| Deothang | Four villages have accessed the services. The farthest one is about one day's walk away from the post office. The other three are 1 to 5 hours walk from the post office and have regular users. Villages are poor and mainly dependent on traditional agriculture. |
| Rangjung | Rangjung town provides the maximum demand for the services. There are four villages that have used the services. One village with many occasional users is 18 km away from the post office. The other three villages are between 6 to 10 km from the post office. |
| Kanglung | Details not received. |

**Table VI.2: Postmasters' views about the functioning of the kiosk**

| Post offices | No. of employees | No. trained | E-post as % of total post | Problems with e-post – from post office side | Problems with e-post – from users' side | Major problems faced | Steps required |
|---|---|---|---|---|---|---|---|
| Bumthang | 3 | 3 | 25% | Manpower | Preference for voice communication | Power breakdown; manpower | Technical knowledge; maintenance and repairs |
| Phuntsholing | 42 | Many | 2% | Manpower | – | Connectivity, technical knowledge | Technical knowledge; awareness; Maintenance and repairs |
| Dagana | 2 | Not provided | | | | | |
| Haa | 2 | 2 | 10% | Delivery and also shortage of manpower | – | Manpower shortage; connectivity | Awareness |
| Lhuentse | 2 | 2 | – | Delivery and also shortage of manpower | – | Machine malfunction; technical knowledge; manpower | Technical knowledge awareness |
| Mongar | 3 | 3 | – | Technical and delivery | – | Connectivity | – |
| Paro | 4 | 4 | – | – | Internet is more popular | Connectivity | Technical knowledge; repairs and maintenance |
| Punakha | 3 | 3 | 10-15% | Technical and delivery | – | Connectivity; technical knowledge | Awareness; technical knowledge of the staff |
| Samste | 3 | 3 | – | Technical | Preference for voice communication | – | Building awareness |
| Tsirang | 2 | 2 | – | – | – | Equipment malfunction; power breakdown | Awareness; technical knowledge of the staff |
| Wangdue | 4 | 4 | 10% | Delivery and also shortage of manpower | Preference for voice communication | Connectivity | Repairs and maintenance |
| Zemgang | 3 | 3 | – | Delivery | Privacy | Connectivity; malfunction of the machines | Awareness; technical knowledge |
| Wamrong | 2 | 2 | – | Technical and delivery | – | Machine malfunction; technical knowledge | Technical knowledge; repairs and maintenance |

| Post offices | No. of employees | No. trained | E-post as % of total post | Problems with e-post – from post office side | Problems with e-post – from users' side | Major problems faced | Steps required |
|---|---|---|---|---|---|---|---|
| Deothang | 2 | 2 | 5% | Delivery and also shortage of manpower | Preference for voice communication | No major problems | Awareness; technical knowledge; maintenance and repairs |
| Rangjung | 2 | 2 | | Lack of experience | | Technical knowledge | Technical knowledge; repairs and maintenance |
| Kanglung | 2 | 2 | | Technical knowledge and manpower | | Connectivity and manpower | Awareness of the users; technical knowledge of the staff |

**Table VI.3: Users' views**

| Post offices | Main users | Main purpose of the use | Value of the services |
|---|---|---|---|
| Bumthang | Professionals (men) | Study, education, career; business related | Business opportunities; career related |
| Pheuntsholling | Largely students and professionals (boys and girls) | Social interaction; business related; education related; market information | Better connectivity with relatives; better access to education and career-related information |
| Dagana | Farmers, students and professionals (men and boys) | Not provided | |
| Haa | Not provided | | |
| Lhuentse | Professionals and students (men and boys) | Social interaction; study/education related; business related | Better connectivity with relatives; better business opportunities; better access to development programmes |
| Mongar | Professionals and students (men and boys) | Social interaction; health and hygiene | Connectivity with relatives; access to health facilities |
| Paro | Students and professionals | Education and market related | Better connectivity with relatives; better business opportunities; career-related information |
| Punakha | Largely students and professionals (boys and girls) | Study, education; career; business; health | Better connectivity with relatives; better access to education and career-related information |
| Samste | General | Social interaction: business related; market information | Better business opportunities; better access to development programmes |
| Tsirang | Farmers (men) | Study, education, career; business; health | Better business opportunities; better access to development programmes |
| Wangdue | Students and professionals | Business related; market related | Connectivity to relatives; business opportunities; career and education related |
| Zemgang | Largely students and professionals (boys and girls) | Study and education related; social interaction | Connectivity to relatives; business opportunities; career and education related |
| Wamrong | Farmers (mainly men) | Social interaction; health and hygiene | Connectivity to relatives; business opportunities |
| Deothang | Farmers | Social interaction; study and education | Better connectivity with relatives |
| Rangjung | Students and farmers | Study and education related | Business opportunities |
| Kanglung | Not provided | | |

# ANNEX VII QUESTIONNAIRE

## Functioning and usage of the telekiosks and VSAT facilities

The survey collects data from the villages around a post office that is hosting a telekiosk. The postmaster fills up the Questionnaire after securing relevant and necessary inputs. The survey requires information on the following:

### Post office/telekiosk based-information

1. Name of the location of the post office/telekiosk:
2. No. of employees in the post office:
3. Is there any dedicated person for the telekiosk?
4. If not, who manages the functions of the telekiosk?
5. What is the kind of training imparted to the person managing the telekiosk?
6. What are the opening times of the telekiosk?
7. What are the opening times of the post office?
8. What is the annual total (telekiosk excluded) revenue generated by the post office?
9. What is the main source of revenue?
10. What services are provided by the telekiosk?
11. When did e-post service begin?
12. How many post offices are using e-post services?
13. What is the percentage of e-post of the total mail volume?
14. What are the major problems of introducing e-post? (tick the main problems)
    Technical, Manpower, Software, Equipment related, Delivery problems
    Any other (mention)
15. What is the total cost and revenue generated per year since inception?

| Year | Running cost | Capital cost | Total revenue |
|---|---|---|---|
| | | | |

16. What are the major problems faced in running/managing the kiosk?

| Major problems | Main | Occasional | Rare |
|---|---|---|---|
| Connectivity | | | |
| Machine malfunctioning | | | |
| Technical knowledge | | | |
| Managing the users | | | |
| Power breakdown | | | |
| VSAT malfunctioning | | | |
| Manpower shortage | | | |

17. What are the major steps required to improve the services, accessibility and management of the kiosk? Rank the following in terms of importance:

| | Rank in terms of importance |
|---|---|
| Building awareness of the villagers: | |
| Technical knowledge of the staff: | |
| Adequate software: | |
| Appropriate content: | |
| Updating machines and instruments: | |
| Maintenance of the equipment: | |
| Any other: | |

18. Which telekiosk service is mostly used? Rank the following in terms of number of users:

| | Rank in terms of number of users |
|---|---|
| Service: | |
| Telephone: | |
| Telefax: | |
| Internet: | |
| E-mail: | |
| Photocopy: | |
| Scanner: | |

19. Who are the main users?

| | Men | Women | Boys | Girls |
|---|---|---|---|---|
| In percentage: | | | | |
| | **Students** | **Professionals** | **Housewives** | **Farmers** |
| In percentage: | | | | |

20. Kindly provide details of the telekiosk usage as per the following table:

| Year | Telephone | | Fax | | Scanner/ photocopy | | Internet | | E-mails received and delivered | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Duration in hours | Revenue | No. of pages | Revenue | No. of pages | Revenue | Duration in hours | Revenue | Number | Revenue |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

21. What is the name and distance of the farthest (from the post office) village that accessed the telekiosk service?

22. Kindly provide the details (as shown in the table) of the villages between the farthest village and the post office. Include also the farthest village:

| Villages | Distance from the PO | Many regular users | A few regular users | Many occasional users | A few occasional users | No users |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

23. General information on the villages:

| Villages | No. of house -holds | Total population | Literacy (%) | Electricity | | | Distance of the facilities (km) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Regular | Rare | No electricity | School | Market | Health centre | Main road |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

24. Economy of the villages:

| Villages | General condition | | | % population dependent on: | | | Main marketed products (approx. value in Bhutan currency) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Prosperous | Average | Poor | Agriculture | Service | Crafts | Agr./ Horti. | Poultry/fishery/ animal produce | Crafts |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**Responses from users (at least 20 users from the villages served by your post office)**

1. Number of respondents: Male: Female:

2. Occupation of the respondents:
   Farmer Crafts Service Students Housewife

3. Purpose of communication:

| | Mainly | Occasionally | Never |
|---|---|---|---|
| Social interaction | | | |
| Study/education-related | | | |
| Business-related | | | |
| Profession-related | | | |
| Career-related | | | |
| Health/Hygiene-related | | | |
| Market-related | | | |
| Security-related | | | |

Note that the sum of the entries in a row should add up to 20, i.e. the total number of respondents.

4. Perception of the respondents about the value of the access to ICTs:

| | Respondents' perceptions |
|---|---|
| Cheaper connectivity with the relatives | |
| Better business opportunities | |
| Better access to health facilities | |
| Better access to developmental programmes | |
| Better access to education/career-related information | |
| Information on farm productivity improvement | |

Note that one respondent can have more than one response.

### Connectivity by VSAT at six locations

1. The amount of voice traffic (in minutes)
2. The amount of Internet usage (in minutes)
3. Tariff for voice traffic
4. Tariff for Internet usage
5. VSAT system reliability – length of time of connectivity breakdown
6. Efficiency of solar panels – reliability
7. Battery backup – was it sufficient and effective?
8. Did the antennae and other outdoor equipment function well in all weather conditions? If not, what were the problems? (describe)
9. Did the staff responsible feel well equipped to maintain the system on a day-to-day basis? How did they respond in cases of malfunction? (describe)
10. What was the incidence of seeking help from Thimphu? Number of incidents?
11. What were the major logistical issues in maintaining the VSAT network?
12. Did the laptops function properly?
13. What were the major problems?
14. What was the mechanism of providing troubleshooting for both laptops and the VSAT system?

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