An Overview of the Uganda Rural Connectivity VSAT Project – Project History & End of Pilot Examination of Sustainability

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ICT for Education Program
World Bank Institute Human Development (WBIHD)

Authors and Contributors

The World Bank Institute's ICT for Education Program and World Links

The World Bank Institute's 'ICT for Education' program and World Links began as one program in mid-1997 as an initiative of Mr. James D. Wolfensohn, President of the World Bank, to help bring the developing world into the information age through its future leaders – students – and to build cultural awareness among them in the face of an ever-more global economy and society. In 1999, World Links spun off from the World Bank as an independent non-profit organization. Since its inception, World Links has expanded to over 25 developing countries in Africa, Asia, the Middle East, and Latin America. World Links is a global learning network linking thousands of students and teachers around the world via the Internet for collaborative projects and integration of technology into learning. Currently, approximately 200,000 students and teachers in these countries are collaborating over the Internet in over 900 schools with partners in over 25 industrialized countries on projects in all disciplines. World Links has provided sustainable solutions for mobilizing the equipment, training, educational resources and school-to-school, NGO and public-private sector partnerships required to bring students in developing countries online and into the global community.

This report is produced by the World Bank's 'ICT for Education' Program. It aims at providing a comprehensive picture of a two-year pilot project on the use of VSAT technology to bring rural connectivity to schools in Uganda. For any enquiries about the project please contact the individual authors whose name appears on the paper.

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TABLE OF CONTENTS

Executive Summary

The Uganda VSAT Rural Connectivity Project

The Uganda VSAT Rural Connectivity Project was part of an ongoing international initiative by the World Bank Institute's 'ICT for Education' Program (formerly World Links for Development - WorLD) and its partner NGO World Links organization to pilot new concepts in technology and pedagogy to integrate Information and Communication Technology (ICT) in education in developing countries. Uganda was the first World Links country program, established in 1997, and was the first of the now twenty-seven World Link countries in Africa, Latin America, the Middle East and Asia to pilot the use of this technology as part of its country program.

The pilot permitted fourteen geographically dispersed Ugandan high schools and one national teachers' college to gain access to high-speed Internet connectivity and modern computer technology through the use of VSAT (Very Small Aperture Terminal) satellite dishes.

The dishes and attendant satellite reception equipment were purchased with generous financial support from the *Bill and Melinda Gates Foundation*. Other important partners included *Schools Online* (a California-based non-profit organization that provided ten of the participating schools with computer labs and networked PCs and printer), *SchoolNet Uganda* which played the lead coordinating role on the ground, *Verestar* (satellite bandwidth provider during the first year), *AFSAT Uganda Ltd* which provided the satellite bandwidth provider during the second year and handled the installation and commissioning from the beginning of the project, the *Ministry of Education and Culture* which paid for the duty clearance of the satellite equipment and finally, the most important partners and beneficiaries, the *students and teachers* in the participating institutions.

The pilot officially began in January 2002 and lasted for two years until end of December 2003.

The Pilot's Objectives

The Uganda VSAT Pilot aimed at:

- Testing whether a nationally distributed VSAT network would be workable in serving a network of schools in a developing country;
- Examining whether the school-based telecenters (SBTs) would be sustainable – technically, financially and organizationally – in doing so, and;
- Assessing what impact the school-based telecenters would have on both the schools – including students, teachers and administrators – and the members of the communities around them.

Project Description

Pre-Launch Assessments

A series of activities were performed before the official launch of the pilot. These included mainly an Assessment of the World Links Program, which had been active in Uganda since 1997, a Technology Feasibility Study and a Community Needs Assessment.

The A*ssessment of the World Links Program* concluded that the program had had a noteworthy impact on both teachers and students in Uganda, particularly with regard to attitudes toward technology and the development of new technological skills. However, it also noted that there was room for improvement in the fact that student use of ICT still appeared to be heavily

concentrated in computer science and word processing courses, thus indicating limited acquisition of general ICT skills. In addition, teachers reported that they lacked time to implement new technologies.

The same assessment indicated that the lack of adequate and reliable connectivity in Uganda had impacted the growth in ICT usage among students – especially in rural communities. Indeed, all of the Internet connectivity under the World Links project prior to the VSAT project had been via *traditional dial-up links* to a local Internet Service Provider (ISP). Thus, the need to expand access to more rural areas of Uganda via an innovative solution – given the absence of telephone infrastructure in most of these areas – was recognized. The most suitable technology identified to provide the connectivity was via two-way satellite connections using VSATs.

Once this solution had been identified, a *Technology Feasibility Study* was commissioned in order to make a list of specifications that would be used for the Request for Proposals (RFP). The resulting recommendations focused on scalability, affordability, financial and technical sustainability as well as a number of technical characteristics, specific to the rural African setting and the use that would be made of the connectivity.

A *Community Needs Assessment* was also organized. It surveyed the ICT-related needs and interests of a number of local communities at selected sites in Uganda, through stakeholder meetings and interviews. The overall findings of this assessment revealed high interest from schools, business communities and local government units. It was widely believed that the project would have great potential for mitigating the shortage and lack of variety in teacher-learning materials and that exposure of students to computers would increase their educational achievement and greatly enhance their ability to be employed after school.

Although enthusiasm was high, there remained a series of challenges to the schools' participation: education budgets tended to be strongly oriented towards primary education and poor household incomes as well as disparities in access to education limited the reach of the program. In addition, the schools' ability to participate in the project varied a great deal, mainly as a result of resource availability and infrastructure development.

Technological Description

Initial Technological Set-Up

Based on the Technology Feasibility Study's key recommendations, a Request for Proposal (RFP) was sent out in June 2000. Over the coming months, eight proposals were received and after evaluation of ability to both meet technical requirements and keep costs down, Verestar, a global communications solutions provider was chosen.

Simultaneously, a number of logistic and organizational steps were taken: site surveys were organized in order to locate the best locations for the VSATs, shipping and licensing issues were studied, a technical coordinator was hired by SchoolNet Uganda to oversee the implementation of the project, computers and local area networks were installed in the schools and, finally, training workshops were conducted, focusing on the ICT-training of headmasters and teachers as well as sustainability trainings for the school-based telecenters.

Verestar presented the winning bid for the project and assembled a number of partners including Gilat (VSAT equipment manufacturer), AFSAT (local support, installation and maintenance), and UUNET (Internet provision). The VSAT system selected used a national network of 2.4 meter dishes operating in the C-band, with an asymmetric link, including a download bandwidth of 256 Kbps shared among the network of participating sites, and an upload bandwidth of a dedicated 32 Kbps per site.

With this set-up, ten of the fifteen participating sites had stand-alone VSATs, a server and at least ten PCs on a local area network (LAN). In addition to this, the eleventh site had an onward connection to four other schools via a point-to-multipoint Spread Spectrum wireless link through Ethernet bridge equipment. Importantly, the connection cost was a total that was divided between the fifteen schools, thus making them all interdependent. The World Bank's 'ICT for Education' Program and World Links subsidized half of the connection fees (i.e. US$ 200 per month per school).

The Need for a New Provider

In January 2003, for a variety of reasons, Verestar terminated its VSAT hub services. This had dramatic implications for the Uganda VSAT Project, as the fifteen schools were disconnected from the Internet and a new vendor had to be found to provide the connectivity. This resulted in eight to ten months of downtime for all the schools in the year 2003.

After analyzing several possibilities, AFSAT was chosen to take over Verestar's role, based on its cost, availability, reliability, ability to "recycle" existing equipment and ability to conform to the original key recommendations.

The new set-up was based on KU-band instead of C-band. All fifteen schools had their own standalone VSAT, which meant that they were all independent. The 'ICT for Education' Program and World Links paid for the new equipment, using the money that had been set aside for subsidizing the second year's connection costs.

In terms of cost, the new set-up had much lower installation / up-front costs (equipment costs were 40% lower) as well as connection costs (30% lower). However, because World Links had subsidized half of the connection costs during the first year, what the schools paid in connection fees actually increased. In addition, available bandwidth for both download and upload was lower with AFSAT, although still largely sufficient for the 10 computers-per-school planned for.

Usage and Uptime

During the first year, uptime – and payment – was impressively high (the fifteen schools were online for 71% of the year). The rare downtime was caused mainly by rebel activity, which did not allow students to go to school, and some problems with excessively fragile Gilat IDUs (In-Door Units). The inbound and outbound bandwidths were both largely sufficient for the fifteen schools and usage proved to be high.

The most significant difference between the original set-up and the AFSAT set-up in terms of bandwidth payments was the fact that, with AFSAT, the schools became independent in terms of payments: they each paid AFSAT directly for the full connection fee, without any subsidy. With this new arrangement, uptime and bandwidth payments decreased to 57% over the second year. However, this decrease only affected certain schools. Six schools stayed online 100% of the time. Problems in other schools were due to a variety of causes: a few were affected by rebel activity; others underwent internal administrative problems or changes that affected the role of ICT within the schools.

System usage grew from the first to the second year and also varied by school, mostly depending on the number of computers per school. Indeed, some schools expanded their computer labs beyond the original scope of the project, which led them to use significantly more bandwidth than was allotted to them. Several solutions were envisaged to solve the problem of excessive usage, including the possibility of putting content on an off-line web server.

Sustainability

One of the most significant issues tested in the Uganda VSAT pilot was sustainability: were the computer labs turned into effective community learning-centers? Did they reach the surrounding

communities? How could the schools make their school-based telecenters sustainable? Could they use them for revenue-generating activities?

Throughout the pilot, the schools were engaged in several trainings on community learning center sustainability, where they learned how to plan for SBTs, what to use them for and analyzed the opportunities and challenges they offered.

School Commitment and Lab Sustainability

Since the overall goal of the VSAT project was to provide long-term rural access connectivity, a critical component was working with the selected sites to ensure long-term sustainability. It was agreed that the schools and other host institutions be responsible for financing the labs' capital costs as well as recurring costs and for providing security and staffing. World Links and its partners agreed to provide the VSAT equipment, a series of professional development workshops and on-going pedagogical and technical advice through support from the national SchoolNet Uganda team.

With continuity in mind, the schools generally established steering committees that were in charge of the SBTs, deciding what directions to give them, opening hours, revenue base and how to enhance sustainability.

World Links actively promoted the sites' development as school-based telecenters, where the labs would serve the school exclusively during the day and open to the community at different hours, giving community members access to the computers and the Internet at a commercial rate.

The SBTs Clients and Services

Two main types of SBTs emerged from the pilot: some that were more school-oriented and others that were more community-based.

The first type addressed mainly the schools' needs, focusing on the students, teachers and school administrators. These were financed mainly through student fees or with the support of Parent and Teachers Associations.

The second type was more open to the community around them. In addition to the schools themselves, their clients included such members of the community as NGOs, businessmen, out-of-school youth and adult learners. Their services were generally more varied, including renting the lab for trainings. They were financed not only through student fees but also through revenues from secretarial-related activities or trainings.

At the end of the two years, the picture in terms of costs was rather positive: most costs (equipment and connection) had come down significantly. In addition, over the second year, 6 schools out of 15 had achieved 100% uptime and payments. The other schools had had varying success but only 4 schools had been offline all of the time, two of them because of rebel activity and the two others because of administrative problems, not because of any inability to pay.

Additional Services

The telecenters were designed first and foremost for educational purposes: their main aim was to help both students and teachers improve their learning and teaching experience. This main aim taken into consideration, the telecenters also needed to be sustainable and provide significant opportunities for the rest of the community and for the school to create a stronger connection with the community of which it was part.

The telecenters, with support from SchoolNet Uganda, were encouraged to develop a number of additional services that could create value for their community – and therefore be revenue generating – and promote the long-term sustainability of the school-based telecenters. A variety of such initiatives were tested in the telecenters, including:

- HIV/AIDSWEB – working with students and teachers to promote HIV/AIDS education and prevention activities in school-based telecenters. Several SBTs were also used to offer online HIV/AIDS counseling for youths.
- YouthIT and Entrepreneurship Training – providing out-of-school youths in Uganda with useful skills for obtaining employment and creating new businesses, using the school-based telecenters as training and ICT-service centers.
- SBT and EFA – using the SBT infrastructure to demonstrate the role of ICT in the attainment of the Education For All (EFA) Millennium Development Goal, by using ICT to make teaching and learning more interactive.

Going Forward: Lessons Learned

The Uganda VSAT Project officially ended in December 2003 but the SBTs remain in place and active. During an SBT Evaluation Workshop in the middle of the pilot participants expressed a desire to continue to belong to an umbrella organization after the end of the pilot. It was decided that SchoolNet Uganda would carry on in the role of main coordinator and administrator.

As this report was written, an evaluation of the two-year pilot was being put in place, that would look at a number of areas, including: technology, sustainability, viability of the telecenter concept, educational impact, institutional issues and policy issues.

However, even before the completion of this evaluation, a number of lessons can be derived from the Uganda Rural Connectivity VSAT Project.

Main Successes

Some of the pilot's main successes lie in the attention that was given to implicating the schools, generating enthusiasm for the project and increasing its value through synergies with other projects.

Box 1 – Main Successes

- A thorough community needs assessment preceded and gave its direction to the project.
- The project generated a high general level of enthusiasm.
- The SBTs were used and enhanced through synergies with other projects, thus repeatedly proving their value.
- SchoolNet Uganda was established as a necessary coordinating structure.
- A certain degree of financial sustainability was reached, proving that schools in rural areas in developing countries can successfully house telecenters that can create revenue-generating value for their community.
- With adequate equipment, training and minimal technological support, most schools were able to ensure their technological sustainability.
- Despite the difficulties of setting up connectivity in rural Africa, sufficient technological quality was reached to provide a satisfactory user experience.
- Feedback from different members of the community (students, teachers, other members of the community) showed overwhelming user satisfaction.

Main Challenges

The main challenges are linked to the difficulties of sustaining – financially, technically and organizationally – such a project without further outside intervention.

Box 2 – Main Challenges

- The choice of the service provider had a significant impact on what became one of the main issues of the pilot: downtime.
- It was vital to select adequate, sturdy equipment and include at least a minimal level of technological support when choosing a service provider.
- ICT finances within the telecenters had to be clearly separated from the school's budget so as to ensure the SBTs independence and continuation.
- Demand for the SBTs had to be encouraged, for instance through active outreach efforts.

Key Lessons

A series of key lessons can be extracted from the project, focusing on the importance of continuing support, on the technological particularities of an ICT project in Africa and on sustainability issues.

Box 3 – Key Lessons

General Lessons

- It is important to have "champions" to support innovative projects.
- Coordination and continuous training are key to moving the project forward.
- The regulatory environment can have a decisive impact on cost and sustainability.

Technology Lessons

- VSAT-related technologies can be proprietary, thus expensive and difficult to handle.
- Technology evolves and must be reassessed regularly.
- Reliability and sturdiness of the technology can be the most important factor.
- KU-band functions in tropical climates despite its reputation.
- Partners must be chosen carefully with the long-term in mind.
- The trade-off between initial equipment cost and recurrent cost must be analyzed, taking into consideration the aims and means of the project.

Sustainability Lessons

- A motivated, long-term leadership can ensure the persistence and success of the project.
- ICT finances must be separated from other finances within the telecenters and schools.
- As long as people see value in the ICT service, they will pay for it.
- Synergies with additional activities increase the value and outreach of the SBTs.
- Location has an impact on the SBTs' ability to generate support from the community.

Looking Forward

Looking forward, there are significant opportunities for the development and expansion of the school-based telecenter concept. The main building blocks for an expansion – a service provider, a coordinating organization, and the experience – to other schools in both Uganda and the rest of Africa are in place. Challenges will include scaling up the model, ensuring its long-term sustainability and making sure that it answers a real demand and reaches the target populations who need it most.

Introduction

This paper provides an overview and history of the Uganda VSAT Rural Connectivity Project and an examination of the sustainability of this kind of project after two years of existence of the pilot. The pilot officially began in January 2002 and lasted for two years through the end of 2003. The report is a consolidation of all the material that has been developed and documented about the project.

The documents that are referenced throughout the report are accessible on the Internet. They are listed along with their URLs in the "Key Documents" table at the end of this report.

For general overviews of the project, please refer to ***Wireless School Internet Connectivity*** and presentation ***ICT for Rural Access - Uganda Case Study*** in the "Key Documents" table.

Background & Context

On Jan 18, 2002, Africa's first National Wireless Satellite-Based Schools Project was officially launched at Ndejje Senior Secondary School in Lowero district, Uganda.

Thanks to new satellite dishes, fourteen Ugandan high schools and one national teachers' college gained access to high-speed Internet connectivity and modern computer technology. Geographically dispersed throughout eleven rural districts around the country, eleven of these institutions received Very Small Aperture Terminal (VSAT) satellite dishes, while four additional schools were later connected to Jinja's school (Busoga College Mwiri) satellite dish via terrestrial wireless spread spectrum connections.

The Honorable Dr. Edward Khiddu-Makubuya, Uganda's Minister of Education and Sports, presided over the launch event and stressed the national importance of the project for helping Ugandan youth and teachers bridge the digital divide.

Dr. Khiddu-Makubuya stated that, "*This VSAT project would play a vital role in enhancing the strategic objectives of the Ministry, as a tool for achieving universal access, providing equitable and quality education, and enabling effective communication to support decentralization*".

Commenting on the importance of the project for his school, the headmaster of Mbale Senior Secondary School in Eastern Uganda said that the project would greatly enhance teachers' professional development, as well as enable students to keep abreast of the latest international developments and use the web to put the school on the global map.

The wireless satellite-based school connectivity project is part of an ongoing international initiative by the World Bank's 'ICT for Education' Program (formerly World Links for Development - WorLD) and its partner NGO World Links organization to pilot new concepts in technology and pedagogy to integrate Information and Communication Technology (ICT) in education in developing countries. Uganda was the first World Links country program established in 1997, and was the first of the now twenty-seven World Link countries in Africa, Latin America, the Middle East and Asia to pilot the use of this technology as part of its country program.

The project received generous financial support for the satellite equipment from the ***Bill and Melinda Gates Foundation***. Six other important project partners also supported the Ugandan VSAT project:

- ***Schools Online*** (a California-based non-profit which has teamed up with World Links in a number of countries) provided ten of the participating schools with computer labs of networked PCs and printer;
- ***SchoolNet-Uganda*** played the lead role on the ground;
- ***Verestar*** provided the Internet bandwidth and teleport services for the first year;
- ***AFSAT Uganda Limited*** was chosen to provide the Internet bandwidth and teleport services after Verestar had to be replaced, at the end of the first year. AFSAT also handled the school-based VSAT installation and commissioning from the beginning of the project;
- ***The Ministry of Education and Sports*** paid for the duty clearance of the satellite equipment;
- The most important partners – and beneficiaries – were the ***students and teachers*** at the participating institutions themselves.

For the initial press release, please refer to ***World Links Press Release***.

About the World Bank Institute's 'ICT for Education' Program, and 'World Links'

The World Bank Institute's 'ICT for Education' program and World Links began as one program in mid-1997 as an initiative of Mr. James D. Wolfensohn, President of the World Bank, to help bring the developing world into the information age through its future leaders – students – and to build cultural awareness among them in the face of an ever-more global economy and society. In 1999, World Links spun off from the World Bank as an independent non-profit organization. Since its inception, World Links has expanded to over 25 developing countries in Africa, Asia, the Middle East, and Latin America. World Links is a global learning network linking thousands of students and teachers around the world via the Internet for collaborative projects and integration of technology into learning. Currently, approximately 200,000 students and teachers in these countries are collaborating over the Internet in over 900 schools with partners in over 25 industrialized countries on projects in all disciplines. World Links has provided sustainable solutions for mobilizing the equipment, training, educational resources and school-to-school, NGO and public-private sector partnerships required to bring students in developing countries online and into the global community.

Uganda was the first pilot country for the World Links program, with three schools initially connected to the Internet in July 1997. The program has since expanded to 50 schools in the country, with 1920 teachers and over 30,000 students participating in the program. World Links was instrumental in helping to establish SchoolNet Uganda, the first NGO in the country dedicated to information technology and education.

About SchoolNet Uganda

SchoolNet Uganda is a national network of professional educators and schools whose vision is to transform the Uganda educational system from an *industrial* model (learning by assimilation) to a *knowledge-based* model preparing youth in Uganda to effectively enter a global economy based on knowledge, information and technology.

SchoolNet Uganda's mission is to make graduates of Uganda's education system more globally competitive. SchoolNet Uganda supports Ugandan educators and learners by providing

pedagogical and technical expertise and advice, infrastructure and human resources, coordination, training and capacity building and developing smart local and international partnerships in the areas of:

- Internet Connectivity and Appropriate Technology;
- Content and Curriculum Development;
- Human Resources Development and Capacity Building; and,
- Community Responsibility and Development.

SchoolNet Uganda's objective is to work in partnership with all of Uganda's educational institutions (public or private, primary, secondary or tertiary) to setup their ICT facilities and to develop the technical and pedagogical capacity necessary to use ICT to enhance teaching and learning.

Key SchoolNet Uganda activities include:

- Creating awareness of the use of ICT in education through press articles, education ICT demonstrations, word of mouth, conferences, seminars and exhibitions;
- Lobbying and advocating for the utilization of ICT in education at all levels of government, business and civic society;
- Working in partnership with educational institutions to develop their ICT facilities, Internet connectivity options and technology plans;
- Developing ICT skills and facilitating skill transfer through a phased professional training program;
- Outsourcing for cheaper, innovative and adaptive hardware and educative software;
- Nurturing ICT talents through ICT holiday camps, website development competitions and participation in international competitions like Think Quest;
- Encouraging and facilitating the generation of local content;
- Connecting Uganda educators and students to their worldwide counterparts for collaborative project-based learning (in areas such as sustainable development, environment and HIV/AIDS) and for promotion of cross-cultural understanding;
- Providing on-going pedagogical, technical and business plan development support;
- Developing partnerships with national and international organizations interested in using ICT to enhance teaching and learning and to promote community responsibility of schools;
- Monitoring and evaluating the pedagogical impact of ICT on the Uganda education system.

For examples of SchoolNet Uganda monitoring and coordinating activities, please refer to ***Example of Quarterly Report*** and ***Monthly Newsletter Oct 03***.

Initial Impact of Program Prior to VSAT Implementation

In late 2000 and early 2001, the World Links program contracted SRI International to conduct a detailed evaluation of the impact of the program. For the detailed report please refer to ***World Links Uganda Evaluation***. The key conclusions from the report are the following:

- The Ugandan World Links project had noteworthy impact on both teachers and students, particularly with regard to attitudes toward technology and the development of new technological skills. The Program also touched on pedagogical practice, as survey respondents reported moderate levels of student collaboration as a result of the Program. Most important, perhaps, was the fact that participant teachers believed that the World Links program had significantly improved students' employment prospects.

- The report stated that, despite this progress, there was room for improvement in the implementation of World Links in Uganda. Student use of ICT appeared to be heavily concentrated in computer science and word processing courses, a fact that suggests that acquisition of general ICT skills was limited. Teachers reported that they lacked time to implement new technologies and to use their new technological skills. Equally important, they suggested that the lack of a nationwide policy on technology in education was a major barrier to program implementation. Technological shortfalls, such as deficient hardware and software and poor Internet connectivity, remained problems.

- In light of these challenges, the report suggested that the Ugandan Ministry of Education, working with World Links program staff should:

  (1) Devise a national policy on ICT in education, with a strong emphasis on goals for students' educational attainment and the integration of technological skills across many academic disciplines. This policy should maximize access to hardware, software, and the Internet. The plan should engage both public and private sectors in Uganda to fund ongoing access to technology.

  (2) Develop new educational goals that promote ICT use for basic skill development and problem solving. The current curriculum and assessment goals in Uganda are at odds with the use of ICT and the pedagogical goals of World Links. These goals and practices should be better aligned to sustain systemic change supported by the use of ICT.

  (3) Create mechanisms and structures to support teacher collaboration and high-quality program implementation in Uganda. This effort should include creating additional time for teachers so that they can plan and collaborate to use ICT in the classroom. Efforts should also be made to strengthen the integration of technological skills across disciplines and target teachers from different subject areas for training in interdisciplinary collaborative projects.

  (4) Assign technical support staff to help teachers maintain equipment and integrate ICT for use in instruction. Consideration should be given to cost-effective models for providing technical support (e.g., outside vendors, using trained students, using teachers).

  (5) Create incentives for the creation of innovative collaborative projects and give recognition to teachers and schools for the success that they achieve. Establish clear criteria and specific rewards for teachers and schools that engage in innovative projects with schools outside of Uganda.

The Need for Rural Connectivity

All of the Internet connectivity under the World Links project prior to the VSAT project had been via traditional dial-up links to a local Internet Service Provider (ISP). Based on the evaluation conducted by SRI, the lack of adequate and reliable connectivity had impacted the growth in ICT usage amongst students – specifically in rural communities. In order to address some of these issues, the World Links project recognized the need to expand access to more rural areas in Uganda. The main challenge however was the fact that in many of these rural areas, telephone infrastructure did not exist and therefore an alternative access solution was needed. The most suitable technology identified to provide the connectivity was via two-way satellite connections using Very Small Aperture Terminals (VSATs), which are small satellite ground stations. The connection to the Internet would be made via geostationary satellites and a backhaul to a high-speed link in the USA or Europe.

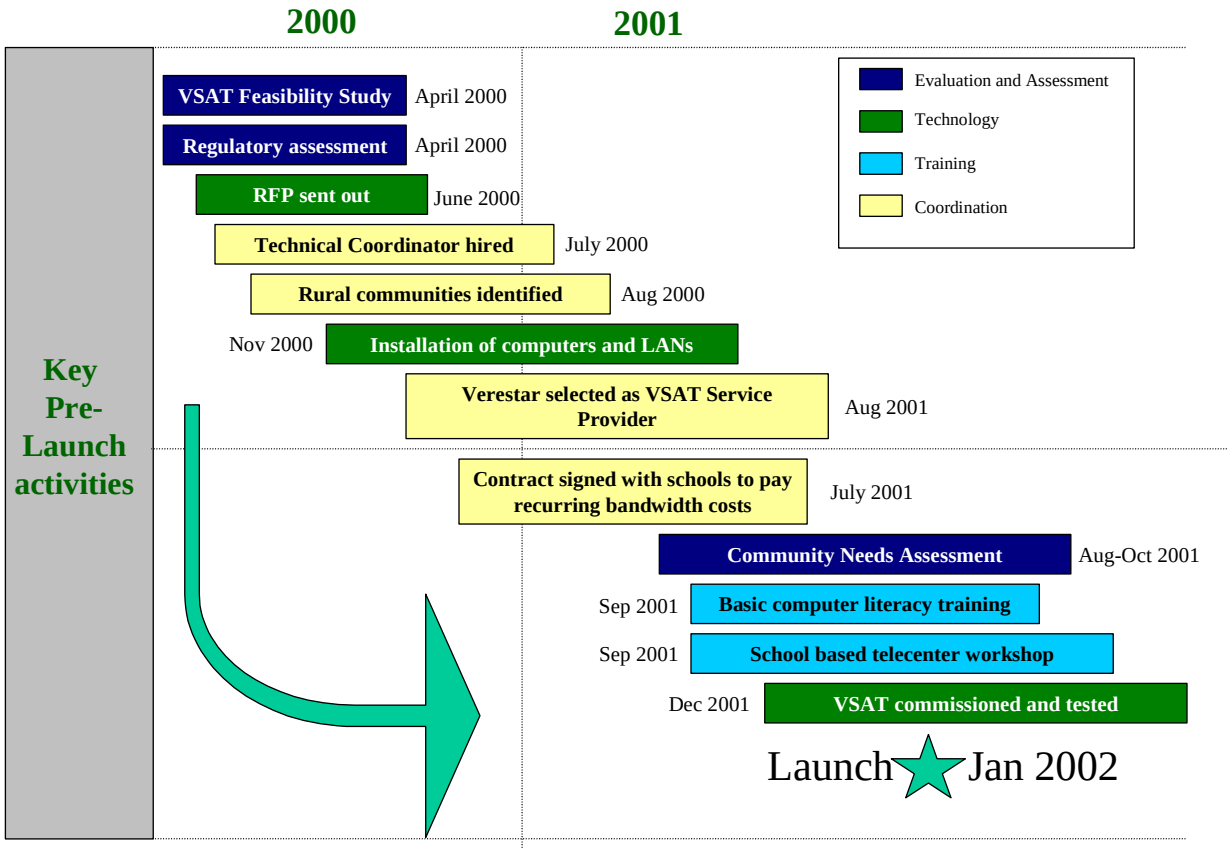
In attempting to expand connectivity to rural areas, a number of key questions needed to be addressed. These issues included:

- Whether the VSAT technology and computers would work in very rural areas;
- Whether the equipment required would be affordable and sustainable;
- What community needs would be met by this project and how;
- Whether the recurrent costs could be met by the schools and/or the community (at a subsidized rate in the short term);
- What the pedagogical impact of providing Internet access would be.

The Gates Foundation Grant

The *Bill and Melinda Gates Foundation* offered a generous grant of USD 300,000 that covered the costs of the VSAT and wireless equipment for the first set up (including the VSAT equipment, the Spread Spectrum Wireless Router and the installation), half of the recurrent Internet connectivity costs and all of the computer lab software for 11 schools.

Pre-Launch Activities



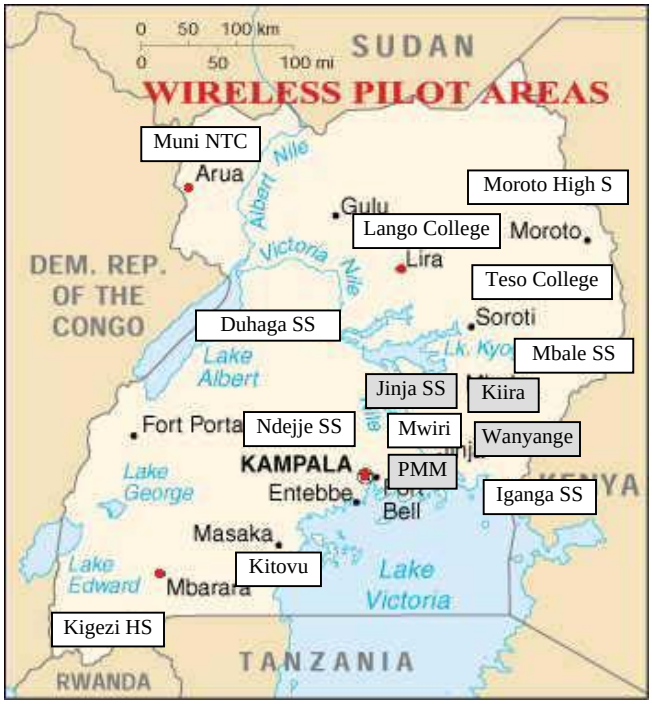
Rural School Selection

Based on the Gates Foundation grant, a total of 15 schools located in different parts of Uganda were selected for the VSAT pilot project. (See Map of Uganda below).

Ten schools: Kigezi High School (Kabaale), St. Henry's Kitovu (Masaka), Ndejje SS (Luwero), Iganga SS (Iganga), Mbale SS (Mbale), Teso College Aloet (Soroti), Moroto High School (Moroto), Lango College (Lira), Duhaga SS (Hoima) and Muni NTC (Arua) were selected to have stand-alone VSATs with no capacity to distribute Internet to other schools in the pilot stage.

Each of these schools would have its own VSAT (antenna, wireless units, routing equipment), a server and at least 10 PCs on a local area network (LAN).

One additional school, Busoga College Mwiri was strategically selected to have an onward connection to four other schools (Kiira College Butiki, Wanyange Girls, Jinja SS and PMM Girls) via a point-to-multipoint spread spectrum wireless link, so that a total of 15 schools would participate in the project. Mwiri would have Ethernet bridge equipment linking it by wireless spread spectrum connection to the other four schools which effectively would join its LAN. Spread spectrum systems operate in the ISM (Industrial, Scientific and Medical) band (around 2.4 GHz), which is license free. Very little maintenance is required with a wireless Ethernet LAN. With the appropriate monitoring software, the central school, Mwiri (with the VSAT), could monitor and control the traffic from the four remote sites.



Whilst the initial pilot project would initially concentrate on the 15 schools in Uganda, there was perceived to be a much wider need for connectivity to African schools and, if the pilot proved successful, connections could be offered to a far higher number of schools around the continent. This would ensure greater economies of scale and mean that overall costs of the connectivity could be significantly reduced.

VSAT Technology Feasibility Study and Request for Proposal

In early 2000, the project team commissioned Mark Bennet from Cambridge, UK to write a report that would identify the key recommendations regarding the VSAT Pilot and suggest the way forward. This document was also used in putting together a request for proposal (RFP) and in ultimately identifying the VSAT service provider Verestar. The following key recommendations have been extracted from this report and provide an overview of the key criteria used in selecting the vendor. For more detail, please refer to ***Recommendations for VSAT Connectivity***.

Key Recommendations/ Requirements:

In developing the specifications for this pilot, the choice of the technology platform was based on meeting the following key recommendations:

- The system would need to be highly scalable from an initial group of 11 VSATs up to possibly 1,000 in a few years time.
- The solution would need to be affordable even with low numbers of schools (for example, if the pilot stopped after the initial 11 schools were launched), even though the costs would clearly be greater until additional sites were added and indeed might need some kind of subsidy or forward-pricing.
- The schools themselves should ultimately be able to bear all running costs in order for the system to be sustainable. This meant very low recurrent monthly figures.
- The Internet facilities to be used by the schools included e-mail (the major application); file transfer (small scale); web browsing (at acceptable speeds so as not to discourage use of the system and including graphics elements and multi-media where appropriate to the teaching); IP multi-casting (sending out materials overnight to all schools simultaneously); and some reasonable level of interactivity, especially in the future as the number of schools would grow (to include low-quality video sharing, although not in the initial instance).
- Local ICT skills required in the schools should be minimized.
- Some schools would serve as centers that would provide onward connectivity via point-to-multipoint spread spectrum microwave links, and would therefore need additional bandwidth capabilities on the satellite link (and ability to control the use by individual schools).
- Many countries in Africa could eventually share the system in order to achieve real economies of scale.
- Higher capital costs were acceptable if it meant lower operational costs, as establishing capacity for local sustainability was the most important factor for scaling up the project.
- Over time, increased bandwidth could be added as Internet experience and skills became more sophisticated. (Also, hopefully, the cost of bandwidth would decrease with time).
- Project managers did not wish to purchase, build or maintain their own hub but rather wish to use the facilities of an existing provider who would manage all facilities on their behalf.
- If possible, it would be best to avoid highly proprietary systems.
- The pilot project would run for an initial period of two years. After this time (as well as at six months intervals during the pilot phase) a major review would be conducted to take account of changes in Internet usage and new technologies. There should therefore be flexibility in looking at and being able to discuss (and eventually switch to) new technologies.
- The VSAT systems would operate in the C-band (due to climatic conditions and the unavailability, at this time, of better technologies given the project's characteristics).
- The hub should be based on a high-speed part of the Internet (e.g. in Europe, USA or South Africa).
- No PSTN lines or microwave links would be available for a return link to the Net in these rural areas, and two-way VSAT operation was therefore necessary.
- Throughput rates on the pilot project should be at a reasonable level in order for users to not be discouraged from using the facilities.
- Ability to closely monitor and control network usage had to be available.

Community Needs Assessment

The Study: From August to October 2001, World Links commissioned a team of researchers from Makerere University to conduct local community surveys at the selected sites around Uganda. Through stakeholder meetings and interviews, the researchers gathered basic demographic information and made recommendations concerning potential community partners.

The overall findings of this report revealed high interest from the schools, business community and local government units. Several of the teachers interviewed in the survey observed that the project had great potential for mitigating the shortage and lack of variety in teaching-learning materials across all school levels and for vocationally oriented out-of-school youths and adult learners. These and other findings from the report were useful in identifying community clients who could benefit from the ICT resources and training available at each site.

The Communities Enthusiasm: Despite the weak economic base in the communities surveyed, there was overwhelming enthusiasm and support for the VSAT project. There was a widespread belief (though without tangible justification) among those interviewed that exposure of students to computers would increase their educational achievement and greatly enhance their ability to be employed after school. The education community (teachers, school inspectors etc.) as well as municipal officials thought that integration of ICT would improve their own performance as well as commitment. The business community held similarly high expectations of ICT.

Low Financial Capacities: However, the development budgets in all the districts were characterized by low local revenue collection with the bulk of the budget being financed predominantly by donors and central government grants. While education was a top priority in all districts, the bulk of the finances went to primary education. Post-primary education was being financed mainly through student fees and PTA contributions. The poor household incomes constituted the leading limitation to secondary school education. Coupled in some areas with negative perceptions with regard to western education and Uganda's political history, the low revenues due to unequal household incomes influenced the pattern of gender, geographical and rural-urban disparities in education. There were also disparities in access, completion and achievement in education. There was increasing economic apathy as one traveled northwards away from Kampala.

Reaching the Out-of-School Youth: While there was high demand for secondary education and technical and vocational training, the opportunities available were not equitably distributed. They were skewed in favor of urban males and those living in close proximity to Kampala. Among youths, males were invariably engaged in the transport sector especially cycle transport, while females dominated food vending. Petty trade and cultivation were also widespread occupations for out-of-school youths. Most sectors of the economy (formal & informal) were not optimally exploited. It was found that these could benefit from the integration of ICT as a medium for information access and dissemination.

Differing Capacities: Although most of the institutions visited and consulted were keen to participate in the project, their capacity to participate varied mainly as a result of resource availability and infrastructure development. Some schools for example had ICT-friendly buildings, furniture, electricity, telephone access, computers, some level of technical expertise and the possibilities for raising funds to sustain the technology. Others however were faced with financial constraints, which were an underlying threat to successful implementation of the initiative especially in the poorer districts. A deliberate effort needed to be made in some cases to support the development of the technology.

Potential Benefits Dependent on Existing Infrastructure: Educational institutions with established supportive infrastructure and technology formed the bulk of potential users in the

different districts. Not only were they enthusiastic about the possibilities of accessing ICT through the VSAT project but also they were willing to explore ways of raising some extra money that would enable them to contribute to the project. The schools that were in close proximity to the host institutions and who had supportive infrastructure expressed the most enthusiasm. They were eager to explore the possibilities of connecting to the VSAT through a similar wireless spread spectrum link arrangement to that in Jinja. Schools with poorer infrastructure were keen to come to some arrangement with the host institutions regarding how they could access and utilize their facilities. Some of the more remote schools although keen would not be able to tap into the VSAT project directly but could benefit through shared information. There was also considerable enthusiasm expressed by local government units and departments, NGO's, commercial IT cafés, secretarial bureaux and various business establishments. However, their state of supportive infrastructure development as well their proximity to the VSAT would determine their potential to benefit from the project.

Improving Teaching and Learning: Several of the teachers interviewed in the districts observed that this initiative had great potential for mitigating the shortage and the lack of variety in teaching-learning materials across all schooling levels and for vocationally oriented out of school youths and adult learners. It also offered the potential of lowering the cost of accessing these materials. The National Curriculum Development Centre (NCDC), for example, had the intention of making available various educational resources on-line through its project 'Curriculum-Net'.

Improving Institutional Efficiency: One of the anticipated benefits of this technology expressed by potential users was institutional efficiency, which to a large extent depended on the capacity to communicate accurately and rapidly. Most potential users indicated that they expected to be able to access and disseminate information more rapidly and preferably at a minimal cost. Makerere University together with the national Joint Admissions Board (responsible for processing applications and admissions to institutions of higher learning) indicated plans to avail the option of on-line applications and admission processing. This would benefit potential applicants to institutions of higher learning.

Career Guidance and Information: Information relating to career guidance and to training opportunities available both inside and outside the country was not found to be easily accessible in educational establishments. This was blamed mainly on financial constraints and was identified by young people in the districts as an area of need. On line guidance would go a long way in answering this need for low cost provision of information on available educational, vocational and occupational opportunities. It would also help young people identify suitable options.

Teacher Up-Grading: It was observed that the technology would provide an invaluable opportunity for teacher up-grading. Teacher training institutions, such as the Department of Distance Education and that of Science and technical Education (DOSATE) could use these facilities to make their programs more accessible and more effective for the teachers based in rural schools. DOSATE for example, was in the process of developing an in-service training program for science teachers, with in-built creditable course units enabling teachers both to improve their performance and to upgrade their formal academic and professional qualifications. This program was provided with on-line interactive components to mitigate the costs usually incurred by teachers in attending full time courses at the university premises and the associated risk of losing their jobs due to prolonged absence from their duty stations. This was identified to be an added return to teachers with access to the Internet.

Findings from two of the selected project sites are highlighted below:

Mbale Senior Secondary School is located in Eastern Uganda and borders the Republic of Kenya. This day school, situated in the Mbale township some four hours drive from Kampala, Uganda's capital city, has over 2,000 students and is the largest secondary school in the eastern

region. The school staff, excited by the Internet connectivity provided by the project, looked forward to opportunities for teacher professional development and for improving school efficiency in the management of finances and student data. Senior staff believed that connectivity would ensure that their students keep abreast of latest developments around the world and they hoped to use the Internet to establish an interactive public relations platform that would enable the school to put itself on the global map. (This is another key component of the World Links and SchoolNet Uganda Programs – to reverse the typical North-to-South flow of Internet-based information and to promote the acquisition and dissemination of locally produced content from developing countries.) A number of surrounding institutions expressed interest in utilizing the Internet and computer resources and training at Mbale Senior Secondary, including a primary teachers' college, a technical college, several surrounding secondary schools, a public library, district education offices, a rural water and sanitation project, and other government projects and offices. For sustainability, all participating schools agreed to pay a monthly access fee to offset Mbale's operating costs.

Muni National Teachers' College (NTC) is located in Arua District in northwestern Uganda, some 520 kilometers from Kampala. Bordered by Sudan in the North and the Democratic Republic of Congo in the West, travel to Arua is often complicated and dangerous due to the spillover of military action taking place across both these borders. Most of the regional economic activity is small scale or subsistence farming. The College receives energy from the Uganda Electricity Board only five hours a day (7 p.m. to 12:00 a.m.) and must supplement this power during the day through its own generator. Notwithstanding this challenge, the director and faculty of the college were ecstatic to be part of the project. Access to information technology in the district was extremely limited – and their lecturers would acquire useful skills to enhance their teaching and learning and to improve their student's chances of employment upon graduation.

Please refer to ***Community Needs Assessment*** for more information.

The Initial VSAT Implementation Process

Initial RFP & Vendor Selection Process

Based on the key recommendations identified in the VSAT Feasibility Study, a Request for Proposal (RFP) was sent out in June 2000 to multiple vendors. Over the coming months, eight proposals were received. Each of them was evaluated based on the ability to both meet the above requirements and keep initial capital costs and recurring monthly costs to a minimum. For more information on the initial RFP, please refer to ***Request for Proposal***.

The Verestar Solution

Verestar, a global communications solutions provider, presented the winning bid for the project and assembled a number of partners including Gilat (VSAT equipment manufacturer), AFSAT (Local support, installation and maintenance), and UUNET (Internet provision). The hub – a *Gilat Skystar Advantage* – would manage the traffic from New Jersey, USA. The traffic would be directed through an Intelsat satellite located in the Atlantic Ocean region and servicing Africa.

The VSAT system selected would use a national network of 2.4-meter dishes operating in the C-band. (Due to climatic conditions, C-band (3 – 6 GHz) was less susceptible to interference from heavy rains as its wavelength is much bigger than the size of a raindrop). The system would be full duplex (two-way) so no PSTN (Public Switched Telephone Network), microwave links or optical fibers were needed for a return link. The link was asymmetric – i.e. more bandwidth came to the schools than went out from the schools. The download bandwidth, 256 Kbps shared among the network of participating sites, guaranteed that each site had a minimum of 64 Kbps to operate simultaneously. The Committed Information Rate (CIR) was 64 Kbps. Any school was able to

"burst" or obtain higher bandwidth (within the total amount) if other schools were not using it. The upload bandwidth was a dedicated 32 Kbps per site during the pilot phase.

Ten of the fifteen participating sites would have stand-alone VSATs (i.e., antenna, wireless units, routing equipment), a server and at least ten PCs on a local area network (LAN). In addition to the VSAT equipment identified above, the eleventh site, Busoga College Mwiri would have an onward connection to four other schools in Jinja via a point-to-multipoint spread spectrum wireless link through Ethernet bridge equipment. With a wireless Ethernet connection, the four "remote" sites would require very little maintenance and their bandwidth usage could be tracked and controlled by Mwiri (the VSAT "hub" site) with appropriate monitoring software.

Installation and Testing

Before the VSAT project could be officially launched, the following logistics issues needed to be addressed:

1) Site surveys – for each selected site, the best location for the VSAT dish needed to be identified with respective preparations.
2) Shipping – VSAT hardware needed to be shipped from South Africa.
3) Licensing – an agreement needed to me made between Verestar and the local VSAT partner and license holder – AFSAT.
4) Installation of terminals – AFSAT technicians needed to visit the 11 sites.

The original launch date was originally hoped for October 2001. However, due to all of the outstanding logistical details, the launch was eventually pushed back to January 2002.

Costs of the Original Set-Up

Description	Per unit / per site (11 sites – real costs)	Per unit / per site (costs allocated to the 15 sites)	Total
Upfront Costs			
Gilat Skystar terminals (11 terminals)	$6,708	$4,919	$73,788
Buy back for changing service		($367)	($5,500)
Airfreight from South Africa (11 terminals)		$444	$6,660
Installation (11 terminals)	$3,100	$2,273	$34,100
Site Survey (11 sites)	$450	$330	$4,950
Wireless Equipment (4 sites)		$2,228	$33,415
Extra cables for Arua and Moroto Installations		$39	$585
Total:		**$9,867**	**$147,998**
Monthly Recurring Costs			
Space segment and internet connectivity from US Hub (for 15 sites)		~$407	$6100
VSAT License – Annual license was $7722		~$43	~$644
Total per month:		**~$450**	**~$6744**

For the detailed contract with Verestar, please refer to ***Verestar VSAT Service Contract***.

School-Based Telecenter Logistics

While the World Links program was identifying and finalizing the selection of Verestar as a service provider, key activities in supporting the VSAT implementation included:

- Hiring a Technical Coordinator to oversee the implementation and all respective components (computer lab set-up, training, surveying, technical visits);
- Hiring a Small Business and Community Development Specialist who was responsible for management training, business planning and sustainability planning for the project;
- Setting up computers and local area networks within the schools, and;
- Conducting training workshops in preparation for VSAT connectivity and sustainability.

Technical Coordinator

In July 2000, a Technical Coordinator was hired by SchoolNet Uganda to oversee the implementation of the VSAT project. In doing so, the Technical Coordinator would work with the National Coordinator to ensure that the 15 selected VSAT schools be equipped with the necessary equipment and skills to ultimately become functioning and sustainable community learning centers. For the next year, the SchoolNet Uganda coordinators worked with the fifteen sites to identify IT resource teachers within the schools and administrators to oversee the computer labs during and after school hours.

Computer Lab Set-Up

With the generous donation of Schools Online (a California-based non-profit which teamed up with World Links in a number of countries), participating schools were provided with computers, networking equipments and printers. Most of the schools were equipped with ten computers, a laser printer and scanner, all connected via a Local Area Network. These computers would later be connected to the Internet via the VSAT connectivity. In the interim, the computer labs were used for basic IT use and computer proficiency trainings such as understanding the Windows Operating System, MS Word, Excel and PowerPoint.

Headmaster and Teacher Training

The fifteen sites involved in the project joined the other SchoolNet Uganda schools in an ongoing series of professional development workshops. These workshops took heads and teachers from a basic exploration of computer literacy and application topics through a deepened understanding of the use of ICT in the classroom. The following modules were part of the standard training program:

Phase 0 – Basic Computer Literacy Training

Phase 1 – Introduction to the Internet for Teaching and Learning: (40-hour workshop) Introduced fundamental concepts, technologies, and skills necessary for introducing networked technology and the Internet to teaching and learning; initiated discussion of new possibilities, generated basic email projects.

Phase 2 – Introduction to Tele-Collaborative Projects: (40-hour workshop) Introduction to educational tele-collaboration: from activity structures to the creation, design, implementation and dissemination of original projects.

Phase 3 – Curriculum and Technology Integration: (40-hour workshop) Developed skills and understanding of how to create, incorporate and facilitate innovative classroom practices that integrate networked technology and curricula. Created at least one collaborative publication that reflected the week's activities and encourages future.

Phase 4 – The Diffusion of ICT Innovations: (40-hour workshop) Developed skills and understanding of how to create, evaluate and diffuse innovative classroom practices that

integrated networked technology and curricula while addressing social and ethical concerns. Created at least one collaborative publication or activity to promote the dissemination of instructional technology's best practices.

Community Learning Center Sustainability Training

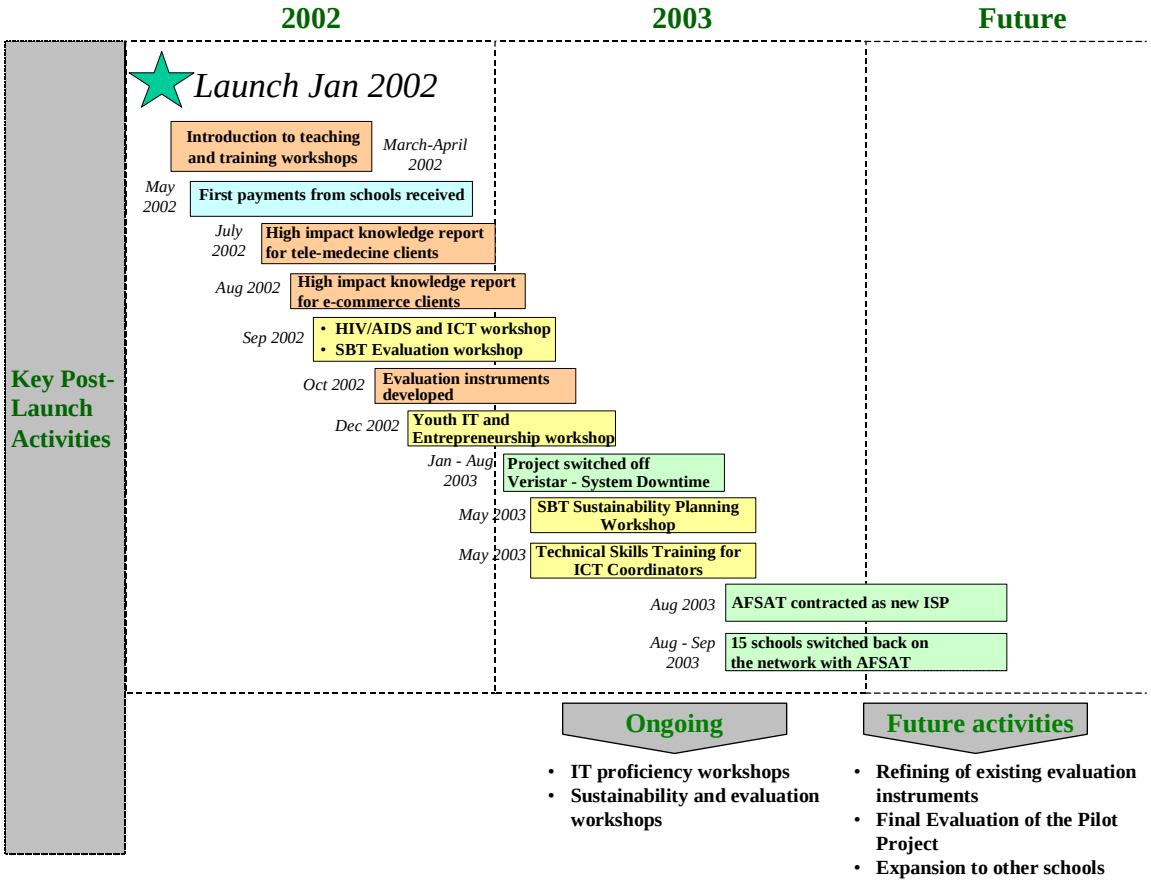
In addition, a specific workshop was developed around the notion of sustainability and how to make the school-based telecenters sustainable in the long-term:

Workshop on Planning for School-Based Telecenters: (40-hour workshop) Developed understanding of why and how to create school-based telecenters that provide access to ICT resources for schools and community populations. Addressed the importance of this model for center sustainability. Stakeholders included policymakers, headmasters, and ICT resource teachers.

As participants graduated from each workshop, they became responsible for introducing the concepts learned and for training other teachers in their schools. Specific courses offered to the VSAT schools during the implementation period included:

- **Phase 0 - Basic computer literacy training** – Course that was conducted at each of the VSAT sites between June 2001 and September 2001.
- **Workshop on Planning for School-Based Telecenters –** Workshop that explored the opportunities and challenges associated with the SBT model. Topics discussed included identifying and matching potential clients with service opportunities, timetabling and business plan development. It was attended by headmasters and World Links-trained IT resource teachers from the fifteen schools in September 2001 in Jinja, Uganda.

The Project: Timeline and Technological Aspects



Project Launch

The VSAT service was finally launched on January 18, 2002. While the eleven sites hosting the VSAT were prepared for the launch, the four additional schools using spread spectrum equipment from the Busoga College in Jinja were not ready for service until July 2002. It took an additional six months to install the necessary spread spectrum link.

In general, over the first year, most of the VSAT sites showed good records of uptime. However, for those schools that did experience problems, downtime was significant. For example, Iganga (3 months), St. Henrys (3 months) and MTC Muni (10 months) all experienced problems with their in-door units (IDUs). The following table lists each of the schools involved in the project and their respective system uptime for Year 1. It also details which schools were able to pay the $200 bandwidth costs per month during the first year. Schools that had technical problems did not pay bandwidth costs for months when their systems were not functioning. For more information on the initial configuration please refer to ***VSAT Overview Nov 01*** and ***VSAT Site Parameters***.

First Year

System Uptime and Bandwidth Payments

Bandwidth payments by VSAT pilot schools for January - December 2002

School	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total	Effective Payments (%)	Comments
Lango College	Lira	200	200	200	200	200	200	200	200	-	-	-	-	1,600	**67%**	*Not yet paid up due to paralisis caused by rebels*
Teso College	Soroti	200	200	200	200	200	200	200	200	200	200	200	200	2,400	**100%**	*Sept-Dec payment was an upcountry cheque which was banked 17th Oct and took 4 weeks to be credited on the bank account*
Mbale S S	Mbale	200	200	200	200	200	200	200	200	200	200	200	200	2,400	**100%**	*Sept-Dec payment was an upcountry cheque which was banked 17th Oct and took 4 weeks to be credited on the bank account*
Iganga SS	Iganga	200	200	200	200	-	-	-	200	200	200	200	200	1,800	**75%**	*IDU was faulty May-Jul*
NTC Muni	Arua	200	200	-	-	-	-	-		-	-	-		400	**17%**	*IDU faulty Mar-Jul, LNB & Transmitter still faulty*
Kigezi High	Kabaale	200	200	200	200	200	200	200	200	200	200	200	200	2,400	**100%**	*Sept-Dec payment was an upcountry cheque which was banked 17th Oct and took 4 weeks to be credited on the bank account*
Duhaga SS	Hoima	200	200	200	200	200	200	200	200	200	200	200	200	2,400	**100%**	*Sept-Dec payment was an upcountry cheque which was banked 17th Oct and took 4 weeks to be credited on the bank account*
St. Henry's	Masaka	200	200	200	200	-	-	-	200	200	200	200	200	1,800	**75%**	*IDU was faulty May-Jul*
Moroto High	Moroto	200	200	200	200	200	200	200	200	200	200	200	200	2,400	**100%**	
Busoga College	Jinja	200	200	200	200	200	200	200	200	200	200	200	200	2,400	**100%**	
Ndejje SS	Luweero	200	200	200	200	200	200	200	200	200	200	200	200	2,400	**100%**	
PMM Girls	Jinja	-	-	-	-	-	-	-	200	200	200	200	200	1,000	**42%**	*Jan-Jun spread spectrum link not yet installed and Jul had been paid for in 2001. Sept-Dec payment was an upcountry cheque which was banked 17th Oct and took 4 weeks to be credited on the bank account*
Kiira College	Jinja	-	-	-	-	-	-	200	200	200	200	200	200	1,200	**50%**	*Jan-Jun: spread spectrum link not yet installed*
Wanyange Girls	Jinja	-	-	-	-	-	-	200	200	-	-	-	-	400	**17%**	*Jan-Jun: spread spectrum link not yet installed. They took time in delivering the final cheque*
Jinja SS	Jinja	-	-	-	-	-	-	200	200	-	-	-	-	400	**17%**	*Jan -Jun spread spectrum link not yet installed, School had internal admin problems even when SchoolNet was ready to install the wireless link, school was told to show interest in participating in the pilot by paying Jul-August unused bandwidth. School lost direct line-of-site and mast was installed by Nov1st,2002. Link not yet installed by Nov 2002*
												Total		**25,400**	**71%**	

For more information on the schools' bandwidth payments during 2002, please refer to ***School Bandwidth Payments for 2002***.

During the first year of the pilot, system uptime – and bandwidth payments – was impressively high: indeed, the 15 schools were on-line (and paying) 71% of the time. In addition, this number includes the 4 schools that were connected via spread spectrum link six months later than the others, in July. Without including these schools (that could only have been online for half the

year), the percentage of uptime was 85%. Two main issues caused occasional downtime during the first year:

- First, some schools were affected by rebel activity in their area (for example Lango College). In these cases, the students did not go to school and the bandwidth was not used, thus not paid for.
- Secondly, there were problems with some IDUs (In-Door Units). Indeed, on Gilat Skystar Advantage systems, IDUs tend to be extremely fragile, being sensitive to variations in electric power supply. As power supply was uneven in many of the connected schools, two IDUs broke down and were not repaired for months (for instance, Muni NTC, where the IDU was faulty from May to July). The third faulty IDU was in Iganga SS: this school's IDU developed an Ethernet problem. Because of this, the school was offline from May to July.

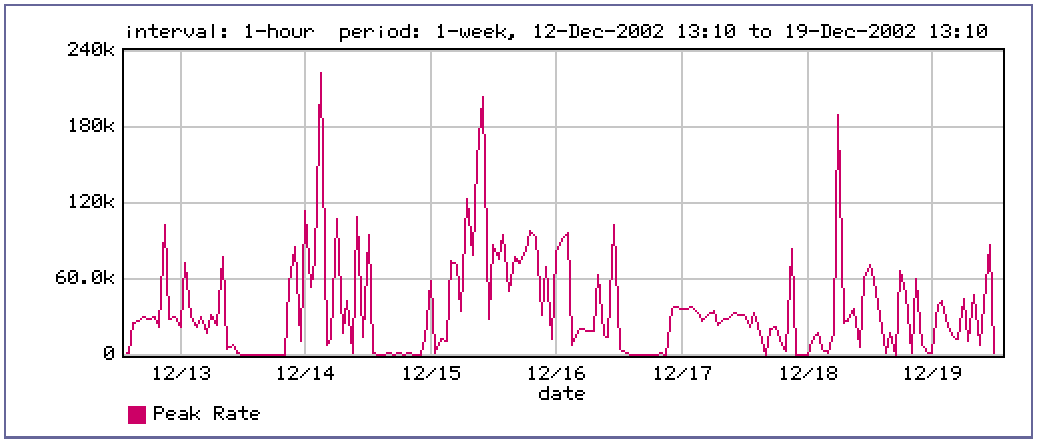
Despite these occasional issues, however, most schools managed to stay online for most of the year, with 8 out of 15 schools having no problem at all throughout the year.

System Usage

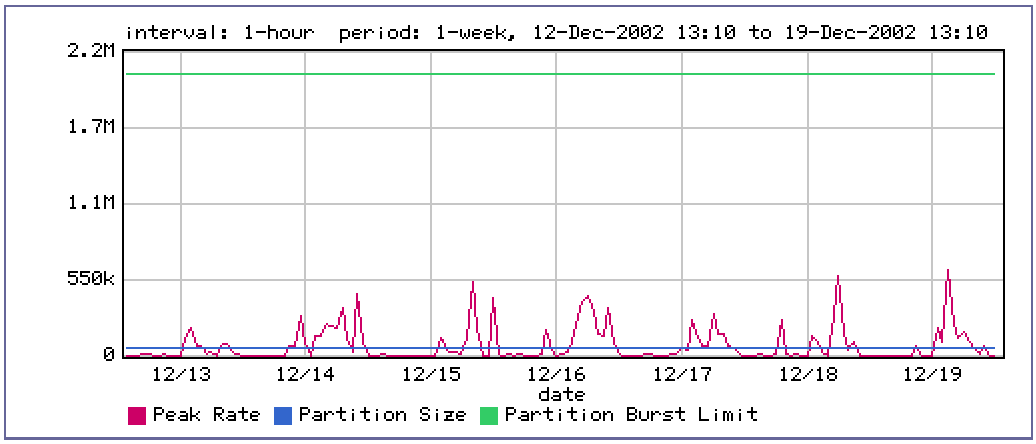
With Verestar, the inbound and outbound bandwidth was largely sufficient for the fifteen schools. As described above (in the "Initial VSAT Implementation Process"), the fifteen schools shared 256 Kbps in terms of download bandwidth, with possibilities to "burst" or obtain higher bandwidth. As is seen in the indicative chart below (cf. Weekly Inbound), the total bandwidth taken up by the fifteen schools was generally below 120 Kbps with occasional peaks as high as 230 Kbps. In terms of upload bandwidth, each school had a dedicated 32 Kbps that was also largely sufficient.

The tables below were provided by Verestar and detail the inbound and outbound usage for all fifteen schools combined for the week of December 13-19th 2002.

Weekly Inbound (World Links -> Verestar)



Weekly Outbound (Verestar -> World Links)



For more information on the schools' bandwidth usage during 2002, please refer to ***World Links Usage Report*** in the "Key Documents" table at the end of this report.

The Change from Verestar to AFSAT

The Need for a New Vendor

In January 2003, for a series of reasons (primarily financial problems and lack of demand), Verestar terminated its VSAT hub services. This had dramatic implications for the Uganda Rural Connectivity VSAT Project, as the fifteen schools were disconnected from the Internet and a new vendor had to be found to provide the connectivity.

This resulted in eight to ten months of downtime for all the schools in the year 2003 as the schools were only re-connected to the Internet between August and mid-September of 2003.

New Vendor Selection Process

There was no formal RFP (Request for Proposal) to find the new vendor for several reasons, the most important of which was that a request for proposal had already been organized in 2001, thus there was a reasonably clear knowledge of which companies could provide connectivity in Uganda, including the ones that may have entered the market between 2001 and January 2003.

Trips were made to Nairobi and Kigali to look at similar installations, and in the end, three main alternatives were short-listed: AFSAT, Artel Communications (based in Kigali, Rwanda) and Gilat Alldean (based in Nairobi, Kenya).

The choice of service provider was based mainly on:

- Cost;
- Availability;
- Reliability;
- Similar technology and ability to "recycle" existing equipment;
- Service provider's ability to comply with the initial key recommendations for VSAT Connectivity.

Artel Communications, based in Kigali (Rwanda) was not chosen because its solution proved too expensive and did not allow for the use of much of the existing equipment. Also, their networking monitoring software platform could not support Linux-operated Internet servers. This would have caused significant – and expensive – change to the school intranets.

Gilat Alldean, based in Nairobi (Kenya), offered a solution that was less costly and that also allowed the schools to adapt the existing equipment, but they did not have a license to use their Nairobi hub to operate in Uganda.

Finally, AFSAT was chosen: it had the license to operate in Uganda and offered a robust, sustainable as well as cheaper solution than the other providers. In addition, it worked with VSATs that had a one-year warranty and it offered readily available and affordable technological support with spare parts that would be reasonably priced compared to C-band equipment. This was especially important in light of the number of problems that had occurred during the first year with faulty C-band IDUs.

It was therefore particularly important, when choosing a new provider, to look at cost, availability and technical aspects but also to take into consideration the fact that VSAT providers worked with proprietary technologies which made it harder to change from one provider to another as this change implied many additional costs when previous equipment and systems were not compatible with new ones.

AFSAT – Description

AFSAT Communications Ltd (ACL) is a privately owned company. The majority shareholder is the Modern Africa Fund Managers, an OPIC-backed venture capital fund of US$105 million fully invested in African companies. Two other shareholders are the Wilken Group and Milas Ltd. AFSAT is currently the largest VSAT operator in Africa and has been in operation as a private company since 1994. At present, AFSAT covers seventeen countries in Africa in cooperation with local subsidiaries and partners to provide local sales and product support.

AFSAT services Uganda's SBTs via its Ugandan branch, AFSAT Communications Uganda Limited (ACUL). For more information on AFSAT, please refer to http://www.afsat.com

Comparison: the New Solution vs. the Original Set-Up

The main difference between the original set-up and the new, AFSAT solution is the technology used: KU-band instead of the original C-band. This has implications in terms of equipment, cost, quality and available bandwidth for each school.

Technological Implications:

Between the original RFP in 2001 and the beginning of 2003, KU-band satellite coverage had become available in Uganda. AFSAT's solution was based on KU-band instead of C-band. KU-band functions at higher frequencies than C-band and requires less radio power than C-band. For this reason, KU-band antennas are much smaller and much cheaper than C-band antennas. Also, KU-band has fewer technical restrictions than C-band, which means that users can quickly set up satellite links and start transmitting. It is a sturdier system that requires less maintenance than C-band. The only real disadvantage that KU-band has in comparison with C-band is that it is suffers from rain fade, although this has greatly been improved recently. This however has not been a serious limitation on the Internet and data traffic that the schools have transmitted, as the issue of rain fade mainly affects video transmissions (as opposed to data transmissions).

Set-Up and Cost Implications:

Originally – as mentioned earlier – ten of the schools had stand-alone VSATs (for C-band) and one had a stand-alone VSAT with an onward connection to four other schools via a point-to-multipoint spread spectrum wireless link using Ethernet bridge equipment.

This set-up implied additional costs in terms of routers and wireless equipment to transmit to the four schools that had no VSATs. This meant that the fifteen schools were interdependent and had to raise funds collectively to pay for the connectivity. The fifteen schools shared equally in the

bill since the costs were for the entire system. In addition, the equipment was bought outside of Uganda, which implied high costs in custom duties etc. Finally, the contract included no maintenance support.

With the new set-up, all fifteen schools had their own VSAT. This meant that each school was independent and that there were no costs of transmitting via wireless to other schools. In addition, the new equipment (and any further equipment that would be required) was bought in Uganda, thus reducing the taxes that had to be paid.

The cost structure of the new installation was also very different:

- The new set-up had much lower installation/up-front costs than the Verestar set-up: equipment costs were 40% lower (the new terminals cost $4,212 instead of the original $6,708 per terminal[1]) and installation[2] costs were four times lower ($910 instead of $3,550 per site with a terminal).
- The monthly connection costs were lowered by more than 30% (from $450 to $305). More importantly, the costs were attributed to each school instead of being collective. Finally, AFSAT provided a maintenance / support service in the form of a "hotline" that could help the schools in case of problems and was included in the license cost.
- Importantly, because the recurrent costs were subsidized (by $200) during the first year, the schools only paid $207 per month in connectivity fees. Therefore, with the new set-up the amount they had to pay actually went up from $250 (i.e. $450 minus $200) to $281.

Description	Per unit/per site (11 sites – real costs)	Per unit/per site (costs allocated to 15 sites)	Total	Per unit/per site (15 sites)	Total
	Original Set-Up			**AFSAT Set-Up**	
Upfront Costs					
Terminals	$6,708	$4,919	$73,788	$4,212	$63,180
Wireless Equipment		$2,228	$33,415	$0	$0
Airfreight	$605	$444	$6,660	$0	$0
Installation and Site Survey	$3,550	$2,603	$39,050	$910	$13,650
Total:		**$10,194**	**$152,913**	**$5,122**	**$76,830**
Monthly Recurring Costs					
Space segment and internet connectivity from US Hub (for 15 sites)		$407 *(Because of subsidy, schools paid $207)*	$6,100 *(Raised collectively)*	$281	$4,212 *(Paid individually)*
VSAT License:		$43	$644 *($7722 in total per year)*	$24 *(Includes maintenance and support)*	$366
Total per month:		**$450** *($250 with*	**$6,744** *($3744 with*	**$305**	**$4,578**

[1] In addition, the initial set-up included a cost of wireless equipment for the schools that had no terminal of their own. If the costs of Terminals and Wireless Equipment are summed and allocated to the 15 sites, the total cost of equipment (terminals + wireless) is still approximately 40% lower with the new set-up

[2] "Installation costs" include both Installation and Site Survey

		subsidy)	*subsidy)*		

Quality Implications:

In the original set-up, the schools were sharing a dedicated pipe. As was described above, the link was asymmetric and the fifteen schools shared 256 Kbps, with a guaranteed minimum of 64 Kbps with the possibility to "burst" or obtain higher bandwidth.

Both the download and upload bandwidth were largely more than was needed for the schools, given the original set-up of ten computers per school. There was actually a large amount of "unused" bandwidth.

With the new set-up, each school has 1 Gb per month in total, which amounts to 45 Kbps for download and 20 Kbps for upload, therefore less than the original set-up.

	Verestar Set-Up: (Per school)	**AFSAT Set-Up: (Per school)**
Download	256 Kbps[3] (Minimum 64 Kbps)	45 Kbps
Upload	32 Kbps	20 Kbps

For the detailed contract with AFSAT, refer to ***AFSAT Contract***.

System Characteristics with AFSAT

System Uptime and Bandwidth Payments (From August 2003 to April 2004)

The most significant difference between the original and the new set-up in terms of bandwidth payments was the fact that, with AFSAT, the schools became independent in terms of payments. They each paid AFSAT directly the full amount of the cost without subsidy. Previously, they paid collectively and World Links subsidized half of the bandwidth cost.

With the new set up, where the schools paid all of their bandwidth –no subsidy –, uptime and payments decreased (from 71% previously to 57% currently). However, this decrease firstly affected only certain schools (not all of them) and for different reasons.

Firstly, 6 schools managed to remain online and to make 100% of their payments on time. Of the other schools, there were four main types of reasons for not managing to stay on-track:

- Two of the schools were situated in zones of rebel activity, thus students did not attend school. These schools remained off-line during the whole period.
- In two other schools, there were internal problems within the administration and the ICT project was used as one of the subjects to debate, thus causing delays in payments.
- In one college, priorities changed and the main issue became to solve an electrification problem as the college was off the country's electricity grid.
- Finally, in four schools, management changed and the new administration changed priorities. This underlined the importance of having a "champion" who would maintain the continuing importance and status of the project.

[3] The 256 Kbps for download was shared by the 15 schools, guaranteeing a minimum of 64 Kbps per school

KU-BAND VSAT Schools Bandwidth Payment - August 2003 to April 2004

Name of School	Location	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total	Effective Payments (%)	Comments
Busoga Collage	Jinja	281	281	281	-	-	281	281	281	281	1,967	**78%**	*Bandwidth for Aug/Sep/Oct was paid in Jan 04. Off-line in Nov and Dec because of late payments - NOT inability to pay. Paid for Jan to Apr 04 in Feb 04*
Duhaga Secondary School	Hoima	281	281	281	281	281	281	281	281	281	2,529	**100%**	
Iganga Secondary School	Iganga	281	281	281	281	281	281	281	281	281	2,529	**100%**	
Kigezi High School	Kabaale	-	-	-	-	-	-	-	-	-	-	**0%**	*Has remained offline because of administration problems around the arrival of a new headmaster*
Kiira College Butiki	Jinja	281	281	281	281	281	281	281	281	281	2,529	**100%**	*Small outstanding balance due to exchange rate variations between the date when the check was written and the date when it was cashed*
Mbale Senior School	Mbale	-	-	-	-	-	-	-	-	-	-	**0%**	*Off-line. Administration and management weakness to buy into and therefore prioritize the ICT department*
Moroto High School	Moroto	-	-	-	-	-	-	281	281	281	843	**33%**	*Paid in Feb 04 for months of Feb to Apr. Before then, did not pay, thus was off-line*
Ndejje SSS	Luweero	281	281	281	281	281	281	281	281	281	2,529	**100%**	*Balance of US$33.80 due to inflated US$ exchange rate*
PMM Girls Secondary School	Jinja	281	281	281	-	-	-	-	-	-	843	**33%**	*Stopped paying in Nov. Problem of prioritization in spending, NOT inability to pay. Off-line*
St Henry's College Kitovu	Masaka	281	281	281	281	281	281	281	281	281	2,529	**100%**	
Wanyange Girls School	Jinja	281	281	281	281	281	281	281	281	281	2,529	**100%**	
Muni NTC	Arua	281	281	281	281	281	-	-	-	-	1,405	**56%**	*Late payments. School is 100% government-aided and needs to wait for funding from government, which is often delayed. Afsat gave them a grace period and maintained them online Jan and Feb 04 despite non payment. Were disconnected in Mar 04*
Lango College	Lira	-	-	-	-	-	-	-	-	-	-	**0%**	*Off-line. Low student turn-up because of insecurity caused by rebel activity*
Teso College	Soroti	-	-	-	-	-	-	-	-	-	-	**0%**	*Off-line. Low student turn-up because of insecurity caused by rebel activity*
Jinja High School	Jinja	281	281	281	281	281	-	-	-	-	1,405	**56%**	*Arrival of new headmaster in Dec who has had to clear outstanding debt. Commitment to ICT remains. School remained online (Jan to Apr inc.) and is expected to pay soon.*
										Total	**21,637**	**57%**	

For more information on the schools' bandwidth payments during 2003, please refer to ***School Bandwidth Payments for 2003***.

System Usage

System usage has differed a lot by school, depending on several factors: date when connectivity was restored, number of computers in the computer lab, etc.

Although most of the schools stayed within their allotted bandwidth, there were some exceptions. For instance, two schools (St. Henry's College Kitovu and Duhaga Secondary School) used significantly more bandwidth than was allotted to them. In October and November 2003, they used nearly 4 Gb/month (instead of the planned 1 Gb/month).

There are three main reasons for this: First, both schools bought more computers than the 10 that the system was designed for. For instance, one of the schools (St. Henry's Kitovu) bought 90

computers in 2003. Second, after eight months of downtime, there was renewed enthusiasm for the Internet, thus usage increased. Third and finally, in these schools, the students paid a fee for the connectivity. It was therefore hard for the school officials to restrict Internet usage.

Several possible solutions were discussed to solve the problem of excessive usage. One possibility was to put content on an off-line web server. On the positive side, this could limit usage while still giving students access to content. However, it was a difficult solution to implement, especially in the cases of schools where students paid for the connectivity.

Another solution that was mentioned was the creation of passwords that would be required for downloading.

The Project: Sustainability

General Impact After Year 1

Two main workshops analyzed the themes of "Lab Sustainability" and "Lessons Learned":

- The first workshop, in September 2002, concluded on the first phase of the project: it looked at where the project was, what the "next steps" were and what changes would be required to ensure the success of the second phase.
- The second workshop, in May 2003, came after Verestar had stopped providing connectivity. During this workshop, the decision was taken to change the technological set-up and hire AFSAT. Also, this workshop focused on how to reduce costs and ensure sustainability in the longer term.

The September 2002 Workshop

In September 2002, a one-day sub-regional workshop, took place at Colline Hotel, Mukono and was attended by Headmasters and IT Coordinators from many of the VSAT schools as well as Ministers of Education and development practitioners from Botswana, Rwanda, Zimbabwe and the USA. It was intended to share lessons learned and experiences with School-based Telecenter (SBTs). The participants shared views on a variety of issues, which included:

- Technological performance;
- Pedagogical impact;
- Professional development of teachers;
- SBT sustainability;
- Timetabling of users;
- Control of pornography;
- Telecenter management and financing;
- Challenges and lessons learned and;
- Future plans.

For more information on the results of this workshop, please see ***SBT Evaluation Workshop Report***, ***SBT Evaluation Workshop-Appendix***, ***SBT Workshops Mission Report*** and ***End of Year 2002 Report*** in the "Key Documents" table at the end of this report.

During the workshop, presentations were made by IT coordinators from the VSAT schools, focusing on detailing and analyzing SBT Clients, Services, Finances and Main Successes and Challenges:

VSAT SBT Clients

In School Clients

- Students
- Teachers
- Administration

Out of School Clients

- NGOs
- Business Community (telecenters used for training etc.)
- Members of the Community

VSAT SBT Services

In-School Services

- Basic computer literacy: word processing, e-mail, spreadsheets,
- Research,
- Tele-collaboration,
- Providing links with other organizations globally,
- Search for scholarships and fund raising opportunities,
- On-line application to universities and career guidance,
- Other high impact services for school and communities.

Out of School Services

- Mainly email and Internet,
- Secretariat-related activities,
- Training activities: the schools were used by NGOs and the business community as centers for training, mainly on computer literacy,
- Telemedicine (possibly).

Financing the VSAT SBTs

Sources of Financing (and Cost Reduction)

- Students*:* the students themselves represented a large majority of the financing, in most of the cases in the form of student fees. They generally paid between US$2 and US$5 per student per term (i.e. per 4-month period),
- Teachers, who paid when they used the computers for private work,
- Parents and Teachers Associations (PTAs),
- Community outreach programs that targeted business people and NGO's,
- Focus on reducing costs: the SBTs resorted to students trained in hardware maintenance and troubleshooting instead of making use of more expensive technical staff.

Accounting

- In many instances, the headmaster was responsible for overseeing the SBT finances,
- In many (but not all) cases, there was a commitment on the part of the school to ensure that the funds collected were really applied to IT activities in the school.

VSAT SBT Management Successes and Challenges

Key Successes

- Increased communication via the Internet and schools' increased exposure. "*Our students are coming closer to the community*",
- Increased IT literacy in the school communities,

- Improved networks: the schools were able to interact with the other members of SchoolNet Uganda. "*The VSAT project has brought us together*",
- Improved teacher research skills,
- Community outreach and utilization: the community around the school was in position to use the lab to find information and communicate,
- Public relations: the schools became hubs of activity in their areas. "*Members of Parliament, politicians and district officials do come to the lab*",
- Improved image of the school. "*The center has focused the students to appreciate the need to co-exist with the community*",
- Attracting new clients from surrounding areas.

Main Challenges

- How to balance the school needs versus the community needs,
- Future financial sustainability of the center, especially if PTA was banned in schools (The Ministry of Education and Sports was phasing out PTA charges and introducing Universal Secondary Education),
- Timetabling of computers: students complained of limited time on computers,
- Limited number of computers as well as old computers,
- In a few cases, underutilization of the telecenter by the outside community (due to a variety of reasons, among which techno-phobia etc.),
- In a few cases, distance from school to the rest of the community,
- Lack of add-on services (e.g. printing),
- Unsatisfactory lab hours – need to adapt to the variety of schedules and needs of the telecenter users (students, teachers or members of the community)
- Overloaded teachers – how to minimize the impact of teachers moving to higher paid profession based on new IT skills,
- Technological break-downs – the technology had not yet stabilized and the system broke down at times,
- Power failures and lack of power in a few places resorting to generators,
- Financing the telecenters – making sure the revenues that were meant for the telecenters were actually used in this respect,
- Competition from other computer centers. "*Some competitors want to disorganize our program*",
- SchoolNet Uganda response time regarding technical matters could have been better,
- Techno-phobia: many teachers were still afraid of using the technology,
- Political instability: for example, in Lango college, rebel activity paralyzed the SBT

The May 2003 Workshop

In May 2003, the **Sustainability Planning Workshop for SBTs** was held at PMM Girls School in Jinja (one of the SBTs) to review progress and challenges ahead for SBT sustainability planning. The workshop was organized by a technical team from SchoolNet Uganda and attended by ICT coordinators and teachers.

The participants discussed issues such as ways of reducing operational costs, improving efficiency and sourcing technical support. In the workshop, participants also designed a series of benchmarks that they have since then used as a checklist to ensure compliance with objectives and progress. For the list of benchmarks, please refer to ***VSAT Benchmarks for Sustainability***.

For more information on this workshop, please refer to ***VSAT SBTs Sustainability Planning Workshop Report*** in the "Key Documents" table at the end of this report.

School Commitment and Lab Sustainability

Since the overall goal of the VSAT project was to provide long-term rural access connectivity, a critical component was to work with the selected sites to ensure long-term sustainability. It was agreed that the schools and other host institutions be responsible for underwriting the lab's capital costs (e.g. chairs, desks, etc.), financing recurrent costs (e.g. satellite bandwidth, maintenance, paper, toner, diskettes), providing security (e.g. burglar bars) and staffing. World Links and its partners agreed to provide the VSAT equipment, a series of professional development workshops on how to most effectively use the technology in the classroom, and ongoing technical and pedagogic advice through support from the national SchoolNet Uganda secretariat.

Based on previous experience in other SchoolNet Uganda schools, phone and Internet connection costs as well as license costs were typically the greatest recurrent costs that schools had to underwrite.

Average recurrent costs for World Links school labs connecting via landline or wireless (cellular or spread spectrum) were of US$280 a month for bandwidth (as long as the schools stayed within the 1 Gb per month limit) and of US$250 per year (i.e. around US$ 20 per month) for the license (including telephone technical support). In most cases, the schools and parent-teachers associations would finance these costs. Because of the unique nature of the VSAT project and the higher recurring costs, World Links agreed to partly subsidize these costs by underwriting half the recurring costs, i.e. half of the US$407 a month per site with Verestar for the first year. (Initially, World Links was to pay half of the US$407 for the two years of the project, but this changed since the amount budgeted for year 2 was needed to buy the VSAT equipment in 2003 when AFSAT was chosen to replace Verestar. The subsidy also became less necessary when the cost of connectivity decreased to US$281 per month in the second year.

As was previously mentioned, during the first year of the pilot, Verestar charged $6100 per month for connectivity to all fifteen sites. The costs of connectivity were equally distributed among the network of fifteen schools. Because the satellite footprint covered all the sites in the country, there were no additional connection charges for this connectivity (e.g. no telephone surcharge). During the second part of the pilot, AFSAT charged both connectivity and license per school.

Recognizing that connectivity and lab maintenance costs are a significant factor for school participation, particularly in rural communities, World Links worked with the participating schools in providing assistance from international and national staff and actively promoting the sites' development as school-based telecenters. In school-based telecenters, the schools' labs serve students and teachers during the day, and remain open to the community on evenings, weekends and holidays. By paying a nominal fee for computer and Internet access and training, these community clients help underwrite the labs' running costs.

Additionally, World Links & the 'ICT for Education' Program at the World Bank have been supporting SchoolNet Uganda with two full-time consultants to work with the participating sites. The Community Development and Small Business Specialist as well as the Special Projects Consultant are working with stakeholders at each of the VSAT sites to further develop their business plans for serving clients both during and after school hours. This particularly emphasizes linking these sites with the development needs of the community. For example, after-school clients include women entrepreneurs, out-of-school youth, HIV/AIDS NGOs and youth groups. Development agencies have facilitated this linkage by further subsidizing the recurrent costs associated with the use of the ICT resources and training at the sites by and for these client groups.

It was the hope that after 2 years, each of the fifteen sites would be able to come up with the access costs in order to become completely self-sustaining.

Since VSAT technology was rather new, it was also believed that recurring costs would come down considerably during those 2 years so that further subsidies would not be needed.

Two years down the line, in 2004, the picture in terms of costs is rather positive, although there remain issues to solve: all the costs have come down significantly. Most importantly, connectivity costs have decreased by over 30%. In addition, as seen in the "System Uptime and Bandwidth Payments" analysis for 2003-04, six schools have achieved 100% uptime and payments. The other schools have had varying success but only four schools have been offline all of the time: two of them because of rebel activity and the two others because of internal problems within the administration. No school has been "down" because of an inability to pay, thus validating the proposition that most schools are capable of obtaining the US$300 per month necessary to pay for the connectivity (and license) either through student fees or through additional revenue-creating activities.

Ongoing Training

As previously mentioned, the fifteen sites involved in the project joined the other SchoolNet Uganda schools in an ongoing series of professional development workshops.

The training could be divided into two main types: pedagogical and technical training on the one hand and sustainability-oriented training on the other hand.

Pedagogical and Technical Training:

These workshops took heads and teachers from a basic exploration of computer literacy and application topics through a deepened understanding of use of ICT in the classroom. The additional training offered included:

Pedagogical Training:

- March – April 2002 – **Phase 1 – Introduction to Teaching and Training** workshops conducted at each of the VSAT sites,
- May 2002 – **Phase 3 – Curriculum and Technology Integration** centralized workshop.

Technical Training:

- May 2003 – **Technical Skills Trainings** for ICT coordinators.

Sustainability-Oriented Training:

These workshops gave teachers and heads of establishments the opportunity to look at ways to find revenue sources to increase the sustainability of the SBTs. One main workshop of this type was organized in May 2003, covering the issue of planning for sustainability for the schools.

Additional Services – Promoting Sustainability

It is important to note that the telecenters were first and foremost designed for educational purposes: their main aim was to help both students and teachers improve the learning experience. On one hand, they aimed at providing students with access to additional and complementary sources of knowledge and training. On the other hand, they sought to help teachers enrich their students' learning by helping them develop and share new content.

These main aims taken into consideration, the telecenters provide significant opportunities for the rest of the community and for purposes other than purely educational. Importantly also, if these

telecenters were to establish a long lasting, effective presence, they had to become sustainable, and one of the ways of doing this was to offer revenue-creating additional services.

In order to increase the usefulness and promote the long-term sustainability of the VSAT community-based learning centers, a number of additional services were identified. Two community development specialists were hired in 2002 to oversee the exploration and implementation of these activities.

Below are described some of the initiatives that were tested in the telecenters, some with more success than others. They give a good overview of the opportunities and challenges the telecenters face.

HIV/AIDS - AIDSWEB

The 'ICT for Education' program has been working with students and teachers in Africa since early 2000 to promote HIV/AIDS education and prevention activities in school-based telecenters via the AIDSWEB Project. Early results from the project suggest that technology can play a complementary and useful role in helping combat this horrible pandemic.

The 'ICT for Education' program and the World Bank's AIDS Campaign Team for Africa (ACTAfrica) designed an initial online collaborative project on HIV/AIDS prevention and care. In early 2000, with project support from *Wired* magazine, fifteen schools in Ghana, South Africa, Uganda and Zimbabwe participated in the project using the ICT resources and training available at the World Links Internet Learning Centers (ILCs) established in schools and community learning centers in each of those four countries. As part of the project, students of the Namilyango College in Uganda, after participating in a *Challenge of HIV Prevention* online project activity, went out in their community and interviewed various authorities. "*We really liked the field visit that we made to various places, finding more about the opinions of other people on HIV/AIDS, interviewing elders and challenging them, and being asked our opinion on the struggle [against AIDS] by our elders*".

For more information on the AIDSWEB project, please refer to ***Fighting the Insidious Killer***, ***AIDSWEB Program Brief*** in the "Key Documents" table at the end of this report.

See also the AIDSWEB website at http://www.worldbank.org/worldlinks/aidsweb/

In September 2002, an *HIV/AIDS and Information and Communications Technology* workshop was co-hosted by the *Education Development Center's Dot.Com* project, the *Uganda AIDS Commission* (UAC), the *Uganda AIDS Control Project* (UACP), and Uganda's *Ministry of Education and Sport*. The workshop, linked to the VSAT-schools project, explored school computer lab use for broader community development activities, as a continuation of the World Banks' AIDSWEB project designed to explore the role of ICT in linking youth with HIV/AIDS information sharing and prevention activities.

The objectives of the workshop were to explore ways in which the school-based telecenters (SBTs), and more broadly ICT in general, could enhance and support the work of HIV/AIDS organizations, school-based HIV/AIDS awareness and prevention activities, and to understand how ICT was being used or could be used in this field in Uganda and worldwide.

The workshop facilitator, Ms. Beatrice Beinomugisha, Lead Trainer for *Straight Talk Foundation*, a well-respected reproductive health NGO, led participants through topics such as: discussing HIV/AIDS NGOs current information, education and communication (IEC) strategies and what role ICT had and could play in these; the AIDSWEB project (with presentations by students and teachers from Botswana, Uganda, and Zimbabwe); and preparing action plans for proactively linking the NGOs with the VSAT school-based telecenters for technology use and complementary peer education training activities.

The next steps following the workshop included working with SchoolNet Uganda to organize two to three local HIV/AIDS and ICT training activities (e.g. Teso College, Lango College and Duhaga VSAT school-based telecenters) to build upon the linkages established between these SBTs and rural HIV/AIDS organizations. With EDC support, additional project areas include delivering online Adolescent Reproductive Health counseling to in- and out-of-school youth at the SBTs (partnering with Straight Talk) and providing ICT literacy and entrepreneurship training to AIDS orphans. In addition, AIDSWEB continued to work with the *Uganda AIDS Control Project*.

In December 02, an independent evaluation of the AIDSWEB Project was completed. It showed distinct knowledge gains about HIV/AIDS prevention and treatment when comparing participating and non-participating youth: among other findings, AIDSWEB project participants were twice as likely to accurately guess the four leading methods (transmission) and mode (prevention) as those not participating in the project.

Online HIV/AIDS Counseling for Youths

This project was part of the effort to promote HIV/AIDS education and prevention activities in school-based telecenters, and originated as a follow-up to the September 2002 *HIV/AIDS and Information and Communications Technology* workshop.

Three SBTs (Lango College, Ndejje Secondary School and Duhaga SS) participated in a project that included online guidance and HIV/AIDS counseling services to students. The project aimed demonstrating the integration of ICT in HIV/AIDS prevention and care services as well as expanding and diversifying opportunities for access to Adolescent Sexual Reproductive Health (ASRH) information and services for young people in and out of school. Over 1,000 youths were expected to benefit from the project services that started in August 2003.

For more information, please refer to: ***HIV/AIDS Online Counseling Services Description***.

YouthIT and Entrepreneurship Training

Youth unemployment was a significant societal challenge in Uganda in that the formal sector could not fully absorb youth from schools, let alone those with little or no formal educational or job-related skills. This type of unemployment contributed to the social and economic problems faced by communities throughout Uganda. The problem was worse for young women, out-of-school youth, and those youth with family issues due to the impact of the HIV/AIDS epidemic.

The 'ICT for Education' Program's Youth Information Technology Micro-enterprise (YouthIT) pilot project provided 440 in- and out-of-school youth in Uganda with useful skills for obtaining employment and creating new businesses. The project linked training in ICT with entrepreneurship skills development at eleven schools across Uganda – six of them being VSAT schools. With the combined training, it was hoped that participating youth would develop new ICT-based businesses and/or provide existing businesses with ICT-based services. Business linkages and mentorship were also formed with business leaders involved in local Rotary and Junior Achievement chapters.

The project was a partnership between international and national organizations including Ministries of Education, Rotary Clubs, national 'ICT for Education' programs (i.e. SchoolNet Uganda, Zimbabwe-WorLD), the World Bank's 'ICT for Education' Program and Junior Achievement International.

With a combined training in ICT and entrepreneurship skills, participating youth could make a positive impact in their respective communities. Bringing these skills back to the community aimed at helping alleviate poverty and creating sustainable development in the following ways:

- YouthIT entrepreneurs could create local businesses (ICT-based or using ICT to promote a product that was made within the community;
- YouthIT graduates could become ICT contractors for national or international companies requiring assistance with their IT systems (i.e. web page, back-office applications);
- The knowledge gained could be passed on to other members of the community who could then incorporate these skills in similar ways;
- It could demonstrate early linkages between the impact of investing in youth livelihood development and links with youth health issues, e.g. lowering youth susceptibility to HIV/AIDS prevalence through youth economic empowerment.

In December 2002, a one-week trainer-of-trainers workshop was held to kick of the project. Two teachers from each of the ten selected sites attended along with ten Rotarians. The training focused on preparing the instructors in training youth to become IT entrepreneurs while encouraging mentorship with Rotarians and other business professionals within the community.

The project contracted a community development specialist along with the Council for Economic Empowerment for Women in Africa (CEEWA) in developing training material as well as oversight for the project. Training commenced in 2003 in eleven schools throughout Uganda. In addition, the project was presented at the Africa Rotary Convention in Nairobi where it attracted the keen interest of a number of African countries.

Until now, the YouthIT project has proven to be extremely successful. It is currently expanding – thanks to the donation of used computers – to new centers and is getting an enthusiastic response from the trained youth, as one of them explained: *"I am very grateful to God that this project came about…So far I have learned something about using a computer. […] After this project I hope to start up an income generating business. I am looking at dealing in ladies' wear and accessories."* The project also helped to highlight the value the telecenters could bring to the community.

The project also contributed to the ongoing sustainability of the VSAT sites in that schools receive payment for training activities in renting the computer labs: for instance, one school was paid the equivalent of approximately US$450 (almost two full months of connectivity cost) for hosting 2 trainings of 40 hours each. In addition, as the trained youth start to run their own businesses or to support community businesses, it is expected they will pay to use the labs for these purposes.

Currently, the training is still going on and, due to the project's success, its leaders are trying to secure additional funding in order to scale it up.

For more information on the project, please refer to ***Youth IT Overview Presentation*** and ***Youth IT Project Overview*** in the "Key Documents" table at the end of this report.
In addition, please refer to the project website: http://www.worldbank.org/worldlinks/youthit

SBT and EFA

The SBT infrastructure in Uganda was also used as an opportunity to demonstrate the role of ICT in the attainment of the Education for All (EFA) Goal in a project called the "SBT-EFA Project".

The main purpose of the SBT-EFA Project was to demonstrate the role ICT could play in reaching the Millennium Development Goals of Education for All in terms of ensuring quality and relevance of basic education. The pilot project was expected to make teaching and learning more interactive thereby increasing students' learning achievements in three upper primary schools within the vicinity of the telecenters.

The project focused on teachers/educators of upper primary schools as an entry point. A total of 30 teachers from 3 schools in 3 districts of Uganda underwent computer literacy training,

followed by electronic content development skills training. Over 800 students were expected to gain from the projects intervention at class level as their respective teachers learned to use project resources in classroom teaching. The project spanned from November 2003 to May 2004 and will be evaluated in 2004.

An electronic Basic Education Resource Bank was created, composed of upper primary school curriculum and selected Ministry of Education recommended instructional materials. The Resource Bank also featured supplementary readers, class examinations, past papers and teaching materials identified from a variety of sources or digitized by individual teachers involved.

The project was piloted at one primary school within the vicinity of each of the 3 SBTs: in Iganga - Iganga Boys primary (Iganga Secondary SBT), Kabale –Kigezi High Primary (Kigezi High SBT) and Hoima – Duhaga Boys primary (Duhaga Secondary SBT).

For more detail on this project, please refer to ***Uganda SBT-EFA Project Briefing*** and to the project's webpage at http://www.worldbank.org/wbi/ictforeducation/html/uganda.html

Other Projects

A series of other projects were piloted in the SBTs, most of them with the aims of increasing the sustainability of the telecenters as well as their usefulness to the community while testing the usefulness/effectiveness of different types of projects.

Telemedicine

A rural telemedicine service was conceived in Moroto district as part of the on-going World Bank Knowledge Economy/Energy for Rural Transformation (KE/ERT). The KE/ERT is aimed at developing replicable models for the use of Information Technologies in the development process. The specific choice of telemedicine as a desired knowledge service was identified during consultations with World Links/SchoolNet-Uganda team members, the district administration in Moroto and the Moroto VSAT school-based telecenter. This was intended to extend the utility of the VSAT school-based telecenter beyond the school to the community.

An eNeeds and eReadiness survey was carried out in Moroto targeting doctors of Matany and Moroto hospitals. The World Bank's Knowledge Economy Program provided financial support for the process through the World Bank's Energy for Rural Transformation and WorLD Program. Health workers were trained in the use of ICT in the delivery of health services.

The rural telemedicine project was supposed to help medical officers in Moroto and Matany hospitals gain regular access to expert knowledge resources to improve delivery of health services, by developing a point-to-point exchange of medical data (text and small sized images) for purposes of consultation, confirmatory tests and advice, providing access to medical information updates for on-line continuing medical education and documenting the experiences from the project for possible replication elsewhere.

The doctors were trained, computer literate and ready to participate but the project suffered from lack of funding and remains, for now, on hold. For more information on this project, please refer to ***Rural Telemedicine Project***.

Additional Projects

In order to increase sustainability and usefulness to the community, some of the SBTs have also been used for trainings (especially computer literacy trainings) and as Internet Cafes. In addition, there were proposals for other types of projects, for example an e-commerce project that was not undertaken because of difficulties with the partner NGO. For the project proposal, please refer to ***Project Proposal for Rural E-Commerce***.

Looking Beyond Year 2

Need for Future VSAT Replacement?

One of the great challenges in the "Digital Age" is the constant need for change and upgrading in technology. With these changes come additional costs and time spent in upgrading technology.

At the end of the first year (officially January 18th, 2003) Verestar discontinued its services and therefore a new VSAT solution was required to ensure the ongoing operation of the VSAT technology. A replacement was found with AFSAT and the change from C-band technology to KU-band technology. However, this had important implications in terms of downtime (around 6 to 7 months for most schools involved) and in terms of finances as new VSAT equipment had to be bought. In addition, no acquirer was found for the "old" (one year old) equipment.

This hurdle was surpassed successfully: a new provider was found, the new solution was more cost effective than the previous one and, importantly, more reliable in the long term.

However, questions remain for the future: it is hoped that the current solution will last longer than the first one did, as AFSAT is a local company and has an established business in the region, but there is no guarantee. Furthermore, it is expected that hardware and satellite space prices will continue decreasing, which could lead to cheaper – and hopefully compatible – solutions for new schools joining the network.

To conclude, when examining sustainability, it is important to take into account changes in technology and costs of upgrading.

Becoming a Self-Sustaining Network

During the SBT Evaluation Workshop, participants discussed at length what should be done after the pilot. They expressed a desire to continue to belong to an umbrella organization after the pilot project ended. "*Some schools have just started [been connected to the internet] and we are witnessing a withdrawal. I ask SchoolNet secretariat to make all possible links and negotiations to see that the project does not phase out,*" a participant suggested.

The Headmaster of Duhaga Secondary School suggested that SchoolNet Uganda make a proposal for the management and sustainability of the SBTs. This proposal would be discussed by the stakeholders and submitted to the Ministry of Education and Sports. This view was shared by many of the participants with one saying "*There is need to have an organized body to continue with this project...We are grateful for this project because it has brought a phenomenal change in the way we teach and students learn. I would like to see it spread to other schools...SchoolNet should put in place a system so that we can organize ourselves*".

The SchoolNet Uganda National Coordinator said that SchoolNet Uganda was leading significant capacity building among teachers as part of a strategy to ensure sustainability. "*Once you solve the technical problems, the costs go down*", he observed. He added that SchoolNet Uganda is introducing High Impact Services that could not be easily duplicated in addition to developing an interactive database driven website (http://www.schoolnetuganda.sc.ug/) as a platform for collaboration and sharing experiences.

It was since decided that SchoolNet Uganda would continue in the role of main coordinator and administrator after the pilot's end. Its main roles after the end of the first two years are to:

- Provide a management structure for the VSAT infrastructure;
- Offer and co-ordinate both technical and pedagogical training;
- Ensure maintenance, service and spares;
- Be responsible for network monitoring, and;

- Help schools develop and maintain their sustainability and expansion models.

VSAT Expansion

The change in technology from the original Verestar configuration (combining C-band VSATs with wireless links) to the current AFSAT set-up had a significant impact on the possibilities for VSAT expansion as well as the form this expansion could take.

The Verestar configuration, with the "hub" and "remote" sites, offered an interesting model for a national program of expansion to other sites, by expanding around VSAT sites through wireless links. As ideal as this solution seemed, it did pose issues, especially given an unclear policy environment in Uganda, regarding the possibility to use spread spectrum technology to provide Internet access. As long as the legal environment was not clear for schools offering this service, no school other than the pilot Jinja would be allowed to extend their access to the community through wireless links.

With the new AFSAT configuration, national expansion takes an entirely different form. There are no more wireless links, therefore the expansion will have to take place via an increase in the number of VSATs.

Although this type of expansion does not provide an opportunity to lower overall operating costs in the same way the previous configuration did, it does bear some significant advantages.

- First, since the costs of equipment and implementation have significantly decreased (costs of equipment have almost been divided by two and costs of installation by four), and are likely to continue decreasing, there is an increased chance for a high number of schools to be able to afford this kind of set-up.
- Also, the likely continuing decrease in the cost of connectivity (already a decrease of over 30% since 2001) will give schools that are already connected a chance to increase their bandwidth, thus increasing quality of service and connection speed.
- In addition, KU-band has a great advantage over C-band in the fact that there is much more available space on KU-band, thus less chances of congesting available bandwidth and speed by adding new schools to the network.
- Finally, the fact that each school is independent and pays for its connectivity by itself – although under the chaperoning umbrella of SchoolNet Uganda – will give each school more freedom to design the exact set-up that best fits its desires, needs and characteristics (e.g. number of computers, usage, types of revenue-creating activities).

For future managing of the VSAT expansion in Uganda, several variables should be monitored: changes in technology and in the cost of technology, user demand and whether it drives network expansion (i.e. school and community clients actively supporting more sites and greater bandwidth acquisition etc.) These will be important variables to gauge interest in and use of the Internet in rural communities.

Cost Evaluation – Examining Sustainability

In examining sustainability and total costs associated with the VSAT project, costs were broken down into the following components:

- Capital equipment costs – VSAT hardware, wireless spread spectrum equipment, hardware replacement after Year 1, computer lab equipment (e.g. computers, printers).
- Non-recurrent costs - management start-up costs, training workshops, site survey, community needs assessment.

- Recurrent costs - satellite Internet connectivity, equipment depreciation, management (2 SchoolNet Uganda employees) and computer lab maintenance.

The costs below are a combination of actual figures and estimates as it has been difficult to get exact figures for costs specifically related to administration and management. Hardware costs are based on actual figures. In examining sustainability, it is important to account for depreciation costs associated with the VSAT hardware and computer lab equipment.

In addition, equipment had to be replaced. Depreciation costs dropped dramatically from Year 1 to Year 2 based on the fact that new VSAT equipment is considerably cheaper, though at the expense of a significant write-off in Year 1 for original capital equipment. All depreciation figures are based on 5 years expected life. For further details on the figures below, please refer to ***Cost Analysis for VSAT Project***[4] in the "Key Documents" table at the end of this report.

Description	Total Costs	Total costs per site (15)	Total Costs per site (15) per month
Capital Equipment Costs			
VSAT – Year 1	$147,998	$9,867	
VSAT – Year 2 Replacement	$76,830	$5,122	
Computer Lab	$263,250	$17,550	
Subtotal:	**$488,078**	**$32,539**	
Non-recurrent costs			
Administration	$29,341	$1,956	
Professional Development Training (Start-up and year 1)	$14,992	$999	
Professional Development Training (Year 2 forecast)	$4,997	$333	
Subtotal:	**$49,330**	**$3,289**	
Recurrent costs (Year 1)			
Management costs	$16,318	$1,088	$91
VSAT Connectivity	$80,922	$5,395	$450
VSAT Depreciation	$29,593	$1,973	$164
Computer lab monitoring & fun.	$105,600	$7,040	$587
Computer lab depreciation	$65,813	$4,388	$366
Subtotal:	**$298,246**	**$19,883**	**$1,657**
Recurrent costs (Year 2)			
Management Costs	$18,760	$1,251	$104
VSAT Connectivity	$54,932	$3,662	$305
VSAT Depreciation	$15,366	$1,024	$85
Computer lab monitoring & fun.	$105,600	$7,040	$587
Computer lab depreciation	$65,813	$4,388	$366
Subtotal:	**$260,470**	**$17,365**	**$1,447**
Minus depreciation expense:	($176,584)	($11,772)	
Total Cost of Pilot:	***$919,540***	***$61,303***	

[4] "Computer Lab Equipment" costs as well as "Computer lab monitoring and functioning" costs only count the 10 computers per school budgeted for the project, not the computers that were added by a few schools, outside the scope of the project

Evaluation of the Pilot Project

In 2004, a project evaluation will be performed to address the following key questions:

- Is a nationally distributed VSAT network workable within the context of serving a national network of schools in a developing country?
- Is the equipment that is required for such a system affordable and sustainable?
- How will the equipment be maintained and at what cost?
- Can the recurrent costs be met by schools and additional clients using the school-based telecenters in the after-school hours?
- What is the educational impact of providing fast Internet access to rural schools in developing countries?
- What is the educational impact on out of school youth and adult learners?

These are some of the questions that the 'ICT for Education' Program and its international and national partners are committed to exploring. In carrying out this evaluation, the program recently contracted the Natoma Group who designed the following evaluation instruments. These will most likely be incorporated in the evaluation in 2004.

- **Telecenter General Information** - This form outlines the general information that needs to be collected about the school-based telecenter.
- **Document Analysis Guide** - This guide is designed to help systematically collect and organize documents, materials and resources pertaining to the school-based telecenter.
- **Interview Guide** - This guide provides interview information-intake sheets and questions to facilitate interviews with school-based telecenter stakeholders.
- **Stakeholder and Client Discussion Guide** - This guide is the primary instrument for assessing the relationship of clients or prospective clients to the telecenter and to information in general. This guide can be used to interview one client or to conduct a focus-group session with up to six clients or other stakeholders.

For these four forms, please refer to **Telecenter General Information**, **Document Analysis Guide**, **Interview Guide** and **Stakeholder and Client Discussion Guide**.

Successes, Challenges and Lessons for Future SBT Projects

A number of lessons can be derived from the Uganda Rural Connectivity VSAT Project, even before the evaluation that will take place in 2004.

These concluding lessons can complement the lessons (successes and challenges) that were highlighted during the September 2002 Workshop and described earlier in this report (for these mid-project lessons see: "The Project – Lab Sustainability and Lessons Learned After Year 1")

Successes and Challenges

Main Successes

- *Community needs assessment*: The community needs assessment organized at the beginning of the pilot was crucial in giving information on the way different members of the community would see the project, possible interest and potential directions for increasing sustainability.

- *High general level of enthusiasm:* Most schools and many members of the communities in which the project was led maintained a high level of enthusiasm regarding the project despite a number of issues (rebel activity, significant downtime during the change from one connectivity provider to another), defending the project and ensuring its continuation past a series of obstacles.
- *Synergies with other projects*: Synergies between the VSAT project and other projects were exploited successfully. For instance, the telecenters were used successfully in the implementation of further projects such as the "SBT and EFA" project or AIDSWEB. This was a great success in the sense that it not only helped these projects be successful on their own but also helped enhance the sustainability of the telecenters and finally, demonstrated the VSATs' (and the telecenters) usefulness for a variety of activities that can bring value to different members of the communities.
- *Establishment of SchoolNet Uganda as a coordinating structure*: The establishment of SchoolNet Uganda is one of the factors of the VSATs project success. This entity is set to remain past the end of the pilot and to ensure the sustainability, coordination and monitoring of the fifteen telecenters. It will also encourage the sharing of best practices between schools and the development of the network to include more schools in the future.
- *Financial sustainability*: The VSAT pilot project has proven that schools in rural areas in developing countries can successfully house telecenters that can be financially sustainable, creating enough value for the community to allow them to raise sufficient funds to ensure their livelihoods.
- *Technological sustainability*: The pilot also proved that, with adequate equipment, training and minimal technological support, most schools can ensure their technological sustainability.
- *Technological quality*: Despite the difficulties of setting up connectivity in rural Africa, the VSAT project has overwhelmingly demonstrated the ability to provide sufficient bandwidth for a satisfactory user experience.
- *User satisfaction*: Feedback from different members of the community (students, teachers, other members of the community) has shown overwhelming satisfaction with the project, with significant improvements in teaching and learning experiences as well as a feeling of being connected to the rest of the world. (This, particularly, is to be detailed further in the project evaluation that is to be conducted in 2004).

Main Challenges

- *Choice of the service provider*: The choice of the service provider (both at the beginning and the second time) had a significant impact on what became one of the main issues of the pilot: downtime. This issue underlined the importance of analyzing the different potential solutions in detail before taking a decision.
- *Technological support*: During the first year, the main technological issue was due to faulty IDUs and the time it took to repair them. This highlights the importance of choosing adequate, sturdy equipment and of including at least minimal technological support in the contract with any service provider.
- *ICT finances within the telecenters*: In certain cases, telecenters were not able to make their bandwidth payments because funds that had been raised for ICT were used for other projects that were deemed of a "higher priority". This would not have been possible – or

at least would have been limited – if a separate budget had been created for ICT within the schools.

Key Lessons

General Lessons

- *Need for a champion*: It is important to have "champions" i.e. people who believe in the project and will defend it, push it forward within the organizations and the communities and ensure its continuation after the end of the pilot.
- *Importance of coordination*: Coordination (be it by the two hired coordinators or by a local overseeing structure like SchoolNet Uganda) is key to moving the project forward, and to motivating and encouraging its main participants. This coordination helps ensure the exchange of best practices, lessons learned and advice.
- *Importance of continuous training*: Training is a significant part of the coordination and motivation effort. It helps make sure that, even when people –and in particular champions –move on, they can be replaced by other motivated, knowledgeable people.
- *Regulatory environment*: The regulatory environment must be taken into consideration. For instance, a spread spectrum wireless link may be a cheaper option than VSATs in all the schools but, if schools are legally not permitted to transmit to other schools, in the long run, this is not a viable solution.
- *Unpredictable elements*: Especially in areas of the world like Uganda, there are bound to be unpredictable elements, such as rebel activity, that have to be taken into account in determining the relative success of a pilot/project.
- *Demand assessment:* A precise demand/needs assessment must be organized before the project's start. Indeed, in absolute terms this type of project is always attractive but it is important to find out in which ways it can really add value for the different members of the community. This knowledge can improve its financial sustainability as well as the long-term support for the project within the community.

Technology Lessons

- *Governmental support*: Tariffs and transportation greatly increase the cost of already very expensive equipment. Agreement by the government to cooperate in the project by waiving tariffs can go a long way to ensure financial sustainability and increase school participation.
- *Proprietary technologies*: Projects dealing with VSATs must take into consideration the fact that several of the required technologies tend to be proprietary. This can make the change to a different provider costly, complicated and lengthy.
- *Technological evolution*: Technological solutions – and their costs – must be reassessed relatively frequently as VSAT technologies (and ICT in general) evolve very quickly, and become obsolete equally quickly.
- *Solid technological solution*: It is particularly important to find an extremely reliable technological solution when dealing with remote areas, in tropical climates and when electricity supply is irregular. In addition, in cases where the telecenters have very limited resources –both financial and human– it is crucial to have a technology that is dependable.

- *KU-band*: Despite its reputation for fragility and the issue of rain fade, in cases of data transmission (vs. video transmission), KU-band is largely adequate, even in tropical climates as in Uganda.
- *Partners*: Time and effort must be put into choosing reliable partners who can guarantee a long-term commitment, experience of the area –especially when it is a "difficult" region to operate in as Africa is –, and flexibility (e.g. AFSAT made exceptions, on occasion, to give some of the telecenters more time and flexibility to make their payments).
- *Monitoring network usage*: There is a need to monitor and control network usage, for instance, to avoid incidents where some telecenters either use more than their share or more than their contract allows for.
- *Technological support*: Some –even very limited– degree of technological support must be provided, specially given the fact that technologically savvy human resources are rare in the telecenters. In certain cases, small, easily fixable technological issues can cause long-lasting paralysis that could easily be solved via telephone assistance if available.
- *Trade-off between initial equipment cost and recurrent cost*: The trade-off between the initial cost (of equipment and installation) and the future recurrent cost (connectivity and technological support) must be analyzed, taking into consideration the aims in terms of numbers of schools participating, the levels of technological knowledge of the school personnel, the level of financial sustainability that will be reached and in how much time etc.
- *Licensing*: Limitations in licensing agreements can be a drawback in choosing a partner in this type of project.

Sustainability Lessons

- *Continuity in the leadership*: A motivated, long-term leadership must be maintained to ensure the persistence of the project *per se* as well as continuous innovation and efforts to improve sustainability and impact on the community.
- *ICT finances within the telecenters*: Sustainability and continuity are improved when the ICT finances are separated from other finances within the telecenters.
- *Value creation*: As long as people see value in the ICT service, they will pay for it, thus improving sustainability.
- *Partners for additional activities*: Additional sustainability-enhancing activities that can create value for the community as a whole must be done in partnership with reliable, knowledgeable – of the area and of the service – partners who must also be viable in the long-term. This permits to combine the telecenters' expertise in ICT with the partners' expertise in other areas. It is important to focus on core competencies and gain access to others' core competencies through partnerships.
- *Location*: The importance of the telecenters' location must not be underestimated. If the telecenter is too far from the community (ex. on top of a hill), it must not expect to finance itself thanks to the community. In the case of remote telecenters, financing will have to come mostly from student fees. In the case of telecenters located in dangerous areas, the failure rate is likely to be higher.
- *Community support*: In order to ensure sustainability and usage –by other members of the community–, support must be obtained early in the process from the community's main opinion leaders.

Looking Forward

Future Opportunities

- *Expansion*: The main building blocks for an expansion to other schools in both Uganda and the rest of Africa are in place, i.e. the service provider, the coordinating organization and the experience.
    - *The service provider:* AFSAT has an established presence in Africa. It offers a solid technological solution that is solid and adapted to the particular circumstances of sub-Saharan Africa. In addition, and importantly, it has shown to have the necessary flexibility required when dealing with rural clients in developing countries (for example, making exceptions for certain telecenters and accepting late payments in a few cases).
    - *The coordinating organization:* SchoolNet Uganda has been set up and is active. It houses the experience, knowledge and human capital that will be required to support any further expansion and can be replicated in other countries.
    - *The experience:* The pilot project has shown that a school-based telecenter can be financially and technologically sustainable and bring value to different members or the community, a result that encourages further expansion.
- *Additional Services*: The existing school-based telecenters have successfully offered a range of additional services that have brought additional value to the communities. There is a significant opportunity to develop the array of additional services they offer, in order to bring new sources of value to the community.

Future Challenges

- *Scaling Up*: As was previously mentioned, the building blocks necessary for expansion of the project are present. However, this expansion will still be a challenge, mostly because of financial reasons. Indeed, the initial equipment costs (computer lab and VSATs) are high. In addition, the need for a champion in each school remains significant.
- *Reaching out to out-of-school youth*: The pilot project has mostly been successful in bringing value to students and teachers. However, one of its initial aims was also to reach out to out-of-school youths. In the future, a particular effort might have to be made in order to effectively reach these targets.

Finally, the evaluation that will take place in 2004 will provide a number of more precise lessons, for instance on themes such as: increase in educational achievement, target populations reached, enhanced ability of students to be employed etc.

For more information on lessons learned please refer to ***Uganda SBTs – Rural Access*** in the "Key Documents" table at the end of this report.

Key Documents

Document Name	Date	URL	Pages	Content
Written documents (Word and PDF files) ***(in order of appearance in the report)***				
Wireless School Internet Connectivity	Jan 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44177	5	Article written by Anthony Bloome for TechKnowLogia: general overview of the pilot
World Links Press Release	Feb 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44178	2	Press release announcing VSAT launch
Example of Quarterly Report	June 2003	http://website166.worldbank.org/etools/library/latestversion.asp?44179	4	Quarterly Report, by SchoolNet Uganda, on the VSAT SBTs with highlighted activities and focus on selected schools
Monthly Newsletter Oct 03	Oct 2003	http://website166.worldbank.org/etools/library/latestversion.asp?44180	4	Monthly Newsletter with VSAT project updates, by SchoolNet Uganda
World Links Uganda Evaluation	April 2001	http://website166.worldbank.org/etools/library/latestversion.asp?36051	8	Country report evaluating World Links program to date – does not include VSAT pilot project
Recommendations for VSAT Connectivity	April 2000	http://website166.worldbank.org/etools/library/latestversion.asp?44181	20	Recommendations regarding the use of VSAT in Uganda – VSAT technical overview
Community Needs Assessment	Oct 2001	http://website166.worldbank.org/etools/library/latestversion.asp?44182	78	Community needs assessment for all VSAT sites, done by Makerere University
Request for Proposal	June 2000	http://website166.worldbank.org/etools/library/latestversion.asp?44183	6	RFP sent to VSAT vendors
Verestar VSAT Service Contract	Aug 2001	http://website166.worldbank.org/etools/library/latestversion.asp?44184	10	Agreement for VSAT connectivity
VSAT Overview Nov 2001	Nov 2001	http://website166.worldbank.org/etools/library/latestversion.asp?44185	7	General overview of the Pilot
VSAT Site Parameters	Jan 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44186	6	VSAT site parameters and configuration for each site
World Links Usage Report	Dec 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44187	2	Report that shows bandwidth usage for December 02 (inbound and outbound)
AFSAT Contract	Aug 2003	http://website166.worldbank.org/etools/library/latestversion.asp?44188	10	AFSAT Contract
SBT Evaluation Workshop Report	Sept 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44189	21	Report on the September 2002 workshop that involved ICT teachers, headmaster and practitioners discussing School-based Telecenters.
SBT Evaluation Workshop – Appendix	Sept 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44190	14	Appendix to report on September 2002 workshop, with detail by school

Document Name	Date	URL	Pages	Content
SBT Workshops Mission Report	Nov 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44191	4	Anthony Bloome's report on his visit to Uganda – discusses HIV/AIDS workshops and evaluations on telemedicine and e-commerce
End of Year 2002 Report	Jan 2003	http://website166.worldbank.org/etools/library/latestversion.asp?44193	13	End of year 2002 status report on the project, including achievements, recommendations and detail by school for selected schools
VSAT Benchmarks for Sustainability	May 2003	http://website166.worldbank.org/etools/library/latestversion.asp?44194	1	List of benchmarks designed during the May 2003 Sustainability workshop to track sustainability of SBTs
VSAT SBTs Sustainability Planning Workshop Report	May 2003	http://website166.worldbank.org/etools/library/latestversion.asp?44195	4	Report on the May 2003 workshop which involved ICT teachers, headmaster and practitioners discussing the sustainability of SBTs
Fighting the Insidious Killer	July 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44196	4	Article written by Tony Bloome discussing AIDWEB project
AIDSWEB Program Brief	July 2003	http://website166.worldbank.org/etools/library/latestversion.asp?44197	6	AIDSWEB program brief, including project background and deliverables
HIV/AIDS Online Counseling Services Description	Aug 2003	http://website166.worldbank.org/etools/library/latestversion.asp?44198	2	Description of the Online HIV/AIDS Counseling initiative
Youth IT Project Overview	Nov 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44199	2	General description of Youth IT Project in Uganda and project partners
Uganda SBT–EFA Project Briefing	Dec 2003	http://website166.worldbank.org/etools/library/latestversion.asp?44200	3	Project Briefing on the SBT-EFA project with mission, objectives and project design
Rural Telemedicine Project	July 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44201	16	Report that details how medical professionals can benefit from telemedicine in Moroto district
Project Proposal for Rural e-Commerce	Aug 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44202	17	Proposal that includes key findings of e-readiness survey and opportunities for e-commerce through telecenters
Natoma Group Evaluation Documents:	Oct 2002			Set of documents designed to be used in performing the evaluation of the Uganda VSAT Pilot
Document Analysis Guide		http://website166.worldbank.org/etools/library/latestversion.asp?44243	7	
Telecenter General Information		http://website166.worldbank.org/etools/library/latestversion.asp?44245	11	
Interview Guide		http://website166.worldbank.org/etools/library/latestversion.asp?44247	13	
Stakeholder and Client Discussion Guide		http://website166.worldbank.org/etools/library/latestversion.asp?44249	12	

Document Name	Date	URL	Pages	Content
Uganda SBTs – Rural Access	Sep 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44208	3	Article by Meddie Mayanja (SchoolNet Uganda coordinator) in TechKnowLogia on the VSAT project, including achievements and challenges
Spreadsheets (Excel files)				
School Bandwidth Payments for 2002	Nov 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44209	2	Spreadsheet from Allen Luyima detailing payments made by each school for each month.
School Bandwidth Payments for 2003	Mar 2004	http://website166.worldbank.org/etools/library/latestversion.asp?44211	1	Spreadsheet from Allen Luyima detailing payments made by each school for each month.
Cost Analysis for VSAT Project	Dec 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44212	4	4 spreadsheets: one examining all costs associated with project for Start-up and Year 1, one with costs for Year 2, one summarizing and 1 with an analysis done in Year 1 of where money would come from to pay for Year 2
Presentations (PowerPoint files)				
ICT for Rural Access – Uganda Case Study	Dec 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44213	22	Presentation made by Robert Hawkins at World Bank's Gender & Digital Divide Rural Connectivity Conference 12/02/02.
YouthIT Overview Presentation	Dec 2002	http://website166.worldbank.org/etools/library/latestversion.asp?44214	28	Overview of Youth IT project - benefits within the World Bank, Logistics for pilot implementation