

Pacific Association for Clinical Training e-Learning Telecommunication Infrastructure Assessment in the U.S. Affiliated Pacific Islands

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Abstract (A)

This paper summarizes the key points of a technology and telecommunications infrastructure assessment conducted by the University of Hawai'i Telecommunications and Information Policy Group (TIPG) on behalf of the Pacific Association for Clinical Training (PACT). It includes an overview of telecommunication infrastructure and services in the U.S. Affiliated Pacific Islands (USAPI) jurisdictions. The objective is to review the technical capacity, in the USAPI, to support PACT e-Learning programs and activities. Telecommunication infrastructure is fundamental for successful and sustainable e-Learning programs. This paper outlines the capabilities that may be available for multipurpose uses including health, education, research and other public service applications. (PHD 2007 Vol 14 No 1 Pages 57 - 65)

Introduction

The Pacific Association for Clinical Training (PACT), in planning for the most effective and efficient means of delivering health-related education and training programs in the U.S. Affiliated Pacific Islands (USAPI), recognized that delivery of these programs through e-Learning may potentially increase program distribution and participation. However, major constraints of e-Learning in the USAPI are technical, particularly in telecommunication capacity, access, and cost. In order to plan for the development and implementation of appropriate and innovative e-learning modules, PACT, in partnership with the Telecommunications and Information Policy Group (TIPG) of the University of Hawai'i (UH), conducted a technology and telecommunication assessment in the USAPI.

The information collected from the assessment is useful for the planning of health education and training and also for improvement in the facilitation of public service network development across various user sectors. These sectors include, but are not limited to, health, education, and government. There are several successful examples of multipurpose and shared networks in the Pacific Islands. These examples include partnerships, between health and education agencies, that facilitate

the sharing of telecommunication equipment, service costs, and skilled human resources (that work together in the operation and maintenance of systems).

Components of effective e-Learning Programs (B)

There are many factors that contribute to effective e-Learning activities in any sector. This paper does not address all of them. Some factors will briefly be discussed and will identify where technology fits into the overall objectives of e-Learning. Successful implementation requires an institutional framework that will address partnerships, accreditation, and certifications among and between education, health, and/or professional institutions; an institutional business plan for sustainability including faculty/teacher compensation, participant registration, support, and program overhead; intellectual property rights; and, finally, the management of learning and teaching objects. Many of these factors require institutional leadership support, individual faculty/staff champions and resources.

Since e-Learning generally means that the learner and the teacher are in different locations, it is essential for the content, focus, and topics to be relevant, appropriate, and adaptable to the learner's environment (e.g., culture, way of doing things, laboratory conditions, un/available supplies and equipment). In developing e-Learning courses, pedagogy and e-Learning instructional design needs to take into consideration the technical capacity of the hosting institutions and learner. The application of educational technology in teaching is more than knowing how to use a computer. It is also knowing how to incorporate appropriate computer applications to enable and enhance learning. Technical infrastructure

is an important fundamental prerequisite that plays a role in determining the appropriate and optimal e-Learning modality. This paper has a primary focus on the available technical infrastructure to support public service applications in the USAPI.

Varying Levels of Development and Funding Support

The level of development, accessibility, and affordability of telecommunication services for distance learning varies dramatically across the USAPI jurisdictions. There are several U.S. Federal government programs that support the development of public service telecommunications networks and services. Some of these programs include the National Telecommunication Information and Administration of the U.S. Department of Commerce, the Rural Utilities Services of the U.S. Department of Agriculture, the U.S. Department of Education and the U.S. Department of Health and Human Services. The Telecommunications Act of 1996 established the U.S. Universal Services Program that is now one of the major factors in the recent expansion and sustainability of networks for health and education.

U.S. Universal Services Program

American Samoa is very advanced in terms of technical infrastructure, partnerships, and programs. Their advanced level is partly due to the establishment of a consortium of government agencies specifically focused on sharing Information and Communications Technology (ICT) resources. This consortium has leadership with a clear vision of the importance and potential benefits of ICT. The consortium understands their eligibility for U.S. Universal Services Funds, and has the ability to leverage existing infrastructure for funding, and has the emerging ICT capacity-building programs for local management and operations of the networks. The LBJ Tropical Medical Center and the Department of Public Health have connectivity in their respective facilities for interactive video teleconferencing and internet access. Guam and the Commonwealth of the Northern Mariana Islands (CNMI) are also eligible for U.S. Universal Services Funds and under the Schools and Libraries Program (E-Rate or educational rate) and have robust networks for kindergarten to 12th grade schools and libraries.

The Rural Health Care Program is intended to provide equal access for healthcare providers in rural areas to the same services at the same cost, as those providers

in urban areas. Originally there were problems with the urban and rural definitions of the Rural Health care Program that prohibited American Samoa, Guam, and CNMI healthcare providers from benefiting from the program. In 2003, the Federal Communications Commission created a special provision that designates these jurisdictions as "all rural." These jurisdictions are now eligible for a 50% discount of "advanced telecommunication services." The E-Rate program has contributed more than \$40 million in telecommunication infrastructure and services support for the schools and libraries in the last 8 years.^a There is an opportunity for the healthcare facilities to now benefit from the counterpart program, although the discount level (50%) is not as high as the E-Rate program (up to 90%). The Freely Associated States (FAS), which includes the FSM, the Republic of Palau, and the Republic of the Marshall Islands (RMI), are not eligible for the U.S. Universal Services Program. Although the FAS vary in

levels of telecommunication infrastructure development, each jurisdiction is in severe need of more accessible and affordable telecommunication services and support. Each jurisdiction has established national ICT policies to address telecommunication costs, existing infrastructure, and future plans for development. However, there are no Universal Services provisions implemented in the FAS.^{b, c, d, e}

National Bioterrorism Program

In the most part, hospital facilities lack sufficient telecommunication infrastructure in both technical and human resources to support operations for telehealth and distance learning. Recently, however many improvements are developing in part through national BioTerrorism (BT) funding from the U.S. Centers for Disease Control and Prevention (CDC) and the U.S. Health Resources and Services Administration. The BT Program is presently funded for a period of 5 years. One of the BT Program objectives is to prepare hospitals and health facilities for emergency response and many multipurpose networks are now being established.

The FSM has made a commitment for all hospitals in FSM to support a 64 kbps leased line connection to the internet through these programs. Local area networks are also being implemented in the hospital facilities.

The Belau National Hospital has implemented an improved first response system utilizing high frequency (HF) and variable high frequency radio systems. The emergency and ambulatory communication systems have extended and have reliable coverage. There is also

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an extension of HF radio communications to dispensaries in remote areas. Most impressive is the interoperability between the hospital, dispensaries, National Emergency Management Office, fire department, policy department, airport, quarantine, customs, immigration, environmental health, Koror State Rangers, and Marine Law.^f

Telecommunication Networks and Services

Private Sector, Internet Service Providers

In the majority of Pacific Islands the Internet Service Providers (ISP) remains a monopoly with the exception of Guam, American Samoa, and CNMI. Dial-up internet costs include a monthly fee of approximately U.S. \$10-20 plus hourly fees from U.S. \$1.95 to \$3.60. The dial-up connection is very slow with actual transmission speeds that are as low as 8 kbps. This slow connectivity increases the cost and prohibits the effective use of many applications. If leased line options are available they are also costly. For example, a 64 kbps circuit ranges from U.S. \$700 to several thousand dollars per month. It is reported that these fees on average are 5-20 times higher than in Asia-Pacific Economic Cooperation developing economies.⁹

Public Service Networks

In the past decade, many public service telecommunication networks have been developed and are available for public service applications such as education, health, emergency management and economic development. This paper will provide a brief summary of these major networks.

American Samoa

American Samoa, American Samoa Distance Education Learning and Telehealth Applications

American Samoa Distance Education Learning and Telehealth Applications Consortium (B)

The American Samoa Government Distance Education Learning and Telehealth Applications (ASG DELTA) Consortium is made up of all major government agencies and educational institutions. The American Samoa Telecommunication Authority donated a 384 kbps circuit from LBJ Tropical Medical Center to the TIPG/ Pan-Pacific Education and Communication Experiments by Satellite (PEACESAT) Network Operations Center (NOC) at the University of Hawai'i. This link is dedicated to public service applications including e-Learning, e-Health, and e-Commerce. The link also interconnects the American Samoa Community College (ASCC), government agencies, the American Samoa Power Authority, and the Pacific e-Commerce Development Corporation (eCDC).

American Samoa Community College

The ASCC campus is connected to the internet through a local area network. There are four video teleconference locations that utilize Polycom and PictureTel codecs (H.323). The systems are located in the departments of Nursing and Continuing Education, and the Small Business Development Center and offices.

ASCC is a member of the DELTA consortium and currently has four strands of single mode fiber on the DELTA/PEACESAT network. Through the DELTA connections ASCC receives interactive video, audio, and data services.

American Samoa Department of Education

The E-Rate network of the American Samoa Department of Education interconnects all public and private schools and the public library. This connection is established through a high-speed fiber optics network on Tutuila Island at 135 mbps rates. The other islands of Manu'a and Aunu'u are connected via microwave at T1 speeds that can support up to three simultaneous video teleconference sessions operating at 384 kbps.

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Pacific eCommerce Development Corporation

The Pacific eCommerce Development Corporation (Pacific eCDC) is a 501(c)(3) private non-profit corporation focused on education and charitable economic development through eCommerce business development. The Pacific eCDC

is an instrumental partner in the design and development of ICT training, computer literacy and e-Learning practices and theory courses. The Pacific eCDC works in collaboration with the DELTA Consortium, Department of Education, ASCC, and the UH's TIPG.

Commonwealth of the Northern Mariana Islands Commonwealth of the Northern Mariana Islands Public School System

The CNMI Public School System (PSS) has also benefited tremendously from the U.S. Universal Service's School and Libraries Division, E-Rate program. The current CNMI PSS E-Rate network consists of T-1 connections between Tinian and Saipan, Rota and Saipan, and Saipan and Honolulu. The CNMI PSS E-Rate network is very robust with a Gigabit Ethernet fiber optic backbone. The hub is connected to 1 Gbps Ethernet segments with a maximum of four nodes per segment. There are two T-1 connections off-island (to TIPG/PEACESAT at UH) for H.320 video conferencing and internet access.

The Northern Marianas College

The Northern Marianas College (NMC) supports

three fully equipped computer classrooms on Saipan and computer labs on Tinian and Rota. For video teleconferencing, an asymmetric digital subscriber line (DSL) 384 kbps is used. The quality of the video teleconference varies as it utilizes the commodity internet.

Guam

Guam Public School System

The Guam Public School System (GPSS) has an E-Rate network which consists of two T1 lines to Honolulu and fiber connectivity between all schools. The GPSS network is primarily a fiber-based 100 mbps Ethernet network with an asynchronous transfer mode (ATM) backbone. ATM is implemented for off-island T1 links to provide certain levels of service, such as H.320 video conferencing priority over data. This prioritization enables quality video conferencing at a defined rate and allows for reallocation of bandwidth for data in the absence of video conference in sessions.

University of Guam

The University of Guam (UOG) is equipped with multiple PEACESAT earth stations that are capable of interactive video teleconferencing and digital data services. UOG has an Accord multipoint conferencing unit that supports integrated services digital network (ISDN) connectivity primarily for on-island use as international ISDN circuits remain costly (U.S. \$86/hour). UOG telecommunication infrastructure enables cross connection of various networks in the Asia-Pacific region. The PEACESAT NOC connects the Guam Education Network and UOG's local fiber distributed data interface, fiber network to the Pacific Islands PEACESAT locations. UOG PEACESAT has an operations staff that facilitates daily programs, manages network scheduling and program requests.

Federated States of Micronesia

College of Micronesia

The National campus in Palikir has a 768 kbps global lease connection through FSM Telecom for internet services. This connection is shared with all state campuses for internet services. The state campuses each have a 128 kbps domestic lease line connection to the national campus through FSM Telecom.

Yap, Federated States of Micronesia

There is a 384 kbps connection from the Yap Department of Education (Yap DOE) Technology Center to FSM Telecom. There is also a 64 kbps circuit from Ulithi High

School to the Technology Center. FSM Telecom has a 256 kbps international link for dial-up internet services. The hospitals, clinics, public library, and historical preservation office are incorporated into the Yap DOE wide area network design.

Republic of the Marshall Islands

Republic of the Marshall Islands PEACESAT Consortium

Although telecommunication access is limited and costs are high in the RMI, a consortium of PEACESAT users consisting of Majuro Hospital, College of the Marshall Islands, Emergency Management Office, and Pacific Resources for Education and Learning (PREL), has taken advantage of various e-Learning programs. This PEACESAT consortium was established to support data and video teleconferencing using the PEACESAT system. Video teleconferencing services are available at the Majuro Hospital (telemedicine room), College of the Marshall Islands (Information Technology Division) and the PREL Service Center. The Majuro consortium is the leading user of PEACESAT video teleconferencing services for e-Learning programs.

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Majuro Hospital

The nurses, physicians, and healthcare providers of Majuro Hospital are ranked as the highest users of the PEACESAT interactivevideoteleconferencing services. Some of the programs include: continuing medical education (CME) including UH Grand Rounds, CME with topics such as treating motor fluctuations in Parkinson's disease, retinopathy of prematurity, skin and wound care treatment, and geriatric care. Other example of health related programs include the RMI diabetes program, Pacific deaf and blind advisory meeting, E Ninau Aku I Ke Kauka (Ask a Doc), and Pacific HIV/AIDS teleconference.

Leroj Kitlang Memorial Health Center in Ebeye

The Ebeye Health Center provides an excellent model for collaborating in developing network infrastructure and maximizing resources. The Ebeye Health Center, through a Department of Interior grant, upgraded a PEACESAT earth station in 2006. The system now supports interactive video teleconferencing and a computer lab consisting of ten computers that were donated by the Department of Health and Human Services (DHHS) Region IX Office of the Regional Health Administrator, Office of Public Health and Human Services, and being coordinated with the World Health Organization (WHO) distance education initiatives in the Pacific. UH's TIPG and PEACESAT worked with DHHS Region IX in

transferring and refurbishing the computers with Ubuntu open source Linux-based software. After careful consideration of the available budget, applications, and computer support in Ebeye, it was decided, together with the Ebeye Health Center Administration, that free, open source software was appropriate. The computers are used in a lab environment and so, in the event that something should go wrong, it will be easier to reinstall the complete Ubuntu program rather than require a skilled computer specialist to reconfigure it. The Ebeye Health Center will evaluate whether or not the Ubuntu open source software meets their needs and applications. To further leverage resources, two Carnegie Mellon University student consultants, through the Technology Consulting in the Global Community Program, provided extended 10-week training for the health center staff in the computer lab, and video teleconferencing and network operations and maintenance. The health center was only required to pay for student accommodations. The collaborating partners included the Department of Interior that funded the system upgrade, the DHHS Region IX Office who donated the laptop computers for the lab, TIPG/PEACESAT who installed the systems and provides the telecommunication services for voice and data at no per minute fee, and the Carnegie Mellon University's student consultant program. This is a very good example of quality planning, coordination, and collaboration for increasing the overall value of funds and effort.

Republic of Palau

Palau Community College

The Palau Community College (PCC) has limited internet access available to students and faculty. PCC utilizes three DSL circuits from Palau National Communication Corporation (PNCC) for internet services. The main DSL 128 kbps circuit connects a total of 149 workstations. The library and Federal programs share another 128 kbps DSL circuit that connects 66 computers. Finally, the Financial Aid Office and College President share a 192 kbps circuit that connects 25 workstations. San Diego State University works with PCC in delivering on-line BA and MS programs.

Palau Ministry of Education

Seventeen of the 20 public schools in Palau connect through the Ministry of Education (MOE) gateway, at 192 kbps, to the PNCC. An internet café, at 128 kbps, and the MOE, at 64 kbps, share the same high bit-rate DSL (HDSL) telecommunication connection to PNCC. There is a wireless network connection between MOE

and Palau High School. Four public elementary schools connect to the MOE by 768 kbps DSL while the other 13 schools use 56 kbps dial-up.

Regional Networks in USAPI

PEACESAT Network and Cross-Connections

PEACESAT is a satellite telecommunication network that supports distance learning, telehealth, and other public service applications. There are no per minute fees to use the service that includes narrowband interactive video teleconferencing, voice conferencing, and access to the internet. The network provides access to affordable services. PEACESAT reliability issues include interruption of services due to intermittent problems with the satellite, earth station equipment, or operations. PEACESAT headquarters at the UH works with the National Aeronautics Space Administration and the National Oceanic Atmospheric Administration in the maintenance of the satellite and space segment to minimize interruption of services. Other issues include the reliability of the local operations managed by the organizations hosting the PEACESAT earth stations. These stations are primarily in education, health, or emergency management agencies. Some jurisdictions are able to provide more reliable services than others. PEACESAT is looking to improve the overall reliability of the network technology and support resources. This effort requires local commitment and continued collaboration.

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The network capacity within the USAPI jurisdictions varies and the PEACESAT network is constrained by the limited total capacity. PEACESAT's role in those jurisdictions with robust networks is to assist in coordinating programs that may be supported by these networks. For other locations without robust networks, PEACESAT's primary role is to assist them in obtaining additional bandwidth and utilizing the available limited resources.

The PEACESAT/TIPG NOC maintains a full 7-day week operation schedule for facilitating video and audio teleconferences, network cross-connections, network scheduling and monitoring, and technical support. The NOC operates two-multipoint video teleconference bridges that enable the cross-connection of direct network links (PEACESAT, Hawai'i State Telehealth Access Network (STAN), and the Pacific Partnering Networks), and switched networks using ISDN or internet protocols. The PEACESAT/TIPG NOC enables cross connections to UH network links including: University of

the South Pacific in Suva, Fiji; via the Australia Academic Research Network AARNET (145 mbps); Japan Asia Pacific Advanced Network (APAN) (145 mbps); and the Internet2 (10 gbps).

World Health Organization Pacific Open Health Learning Network

There are several health centers in the Pacific Islands that have received funding from WHO (for the first year), through the (Pacific Open Health Learning Network) POHLN Project, for a computer laboratory with internet service. The POHLN Centers in the USAPI are located in Palau, Majuro, Yap, Pohnpei, Kosrae, and Chuuk.

^h There are approximately to to 12 Windows XP Professional operating system computers in the lab running off a 56 kbps leased line from local telecom carriers. In general, each laboratory is open for use by hospital staff and the community at large during normal hours of operation.

Open Source Course Management System

Modular Object-Oriented Dynamic Learning Environment

A telecommunication network and supporting services is a fundamental infrastructure required to successfully support e-Learning. There are other systems that further support and enable e-Learning such as course management systems. Moodle is a very powerful open source eCourse management tool that has similar functions as commercial products such as WebCT and BlackBoard. Implementing any on-line eCourse management system may be problematic for Pacific Islands with limited internet bandwidth. In these cases, managing local Moodle servers is ideal for local programs but it may be difficult to support regional programs that need synchronized course materials. Synchronizing the eCourse management systems is difficult since they do not have the ability to update local cache servers through remote updates. PEACESAT assisted PACT, the American Samoa Pacific ICT Academy (PICTA), and the CNMI Public School System in implementations of Moodle. Course material such as syllabi, PowerPoint presentations, handouts, video clips, and web references are stored on Moodle. Moodle also includes interactive discussion forums, on-line quiz features, a grade book, calendar, and many other features that make it easier to manage an e-Learning course.

Highlighted ICT Capacity Building Programs

Always in parallel to assessing enabling technical infrastructure, an assessment of human capacity and

resources in support of the networks and systems is critical. The jurisdictions are approaching ICT capacity development in different ways. Below are highlighted examples of ICT related education and training programs.

Pacific ICT Academy

The Pacific eCDC, ASCC, and UH TIPG/PEACESAT with support from the Offices of the Governor, Congressman Faleomavaega Eni-Hunkin, and the Department of Interior, implemented the PICTA. PICTA provides ICT training for Cisco, Microsoft, and Oracle certifications. In the future the program will include training in Linux and open source applications such as OpenOffice. PICTA enrollment is approximately 22 students from

ASCC and Samoa government agencies. Future cohorts will include private sector and the general community students. The courses are delivered through interactive video teleconferencing between the PICTA computer laboratory on the AMSCC campus and the UH TIPG offices.

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Telecommunication Information Resource Management

UH TIPG/PEACESAT administers the Telecommunications Information Resource Management (TIRM) graduate certificate program. The hybrid program uses video teleconferencing and on-line delivery. Students have participated from Hawaii (Honolulu and Kona), the CNMI (Saipan), American Samoa (Pago Pago), and New Zealand. The Sasakawa Pacific Islands Nation Fund has awarded a grant to support participants from each USAPI jurisdiction for three years. The first cohort will begin in August 2006.

There are a total of five, three-credit courses required for this graduate certificate. The courses are: Telecommunication Systems and Networks (COM 681); Telecommunication and Information Services (COM 682); Information Research and Development Methods (COM 683); Telecommunication Planning and Management (COM 684), and Seminar (COM 680). Moodle, the open source eCourse Management System, is used to organize course materials, teaching/learning objects, assignments and on-line quizzes.

The UH TIPG is considering the development of a health information focused TIRM course because of the need and demand for this type of training in Hawaii and the Pacific Island jurisdictions.

Instructional Technologies, and Distance Learning Practice and Theory

The ASCC, AS DOE, Pacific eCDC, and UH TIPG/ PEACESAT deliver two courses specifically geared toward computer literacy and e-Learning capacity development. They are Instructional Technologies (ED 240) and Distance Learning Practice and Theory (ED 250). Students that complete these courses receive credits through the ASCC. This program develops the capacity of local teachers to effectively utilize and incorporate educational technology in instruction and has been made a required course for the teacher certification program of the AS DOE.

Discussion

The effective application of ICT provides a potential avenue for increased connectivity to information and resources in the Pacific Islands. Moreover, there are associated benefits in terms of local, regional, and international e-Learning, e-Health, and economic development opportunities. However, access and affordability of reliable telecommunication services remain primary problems. These problems are in part due to limited market size, lack of infrastructure, and, in some cases, outdated telecommunications policy, regulatory regimes, and government owned telecommunication monopolies. A critical issue in the implementation of successful e-Learning program in the Pacific Islands is telecommunication service access and cost.

This paper summarizes some of the existing telecommunication networks in the USAPI that support interactive video teleconferencing and internet services for e-Learning, e-Health, and other public service applications. These networks include: Pacific Partnering networks; American Samoa DELTA Network, American Samoa E-Rate Network, CNMI E-Rate Network, Guam PSS E-Rate Network, and the PEACESAT Network. These networks are able to cross connect to other educational institutions in the Asia/Pacific region such as the UH, University of the South Pacific, National University of Samoa, and others through video teleconference bridging services from the UH TIPG/ PEACESAT. It is important to note that these networks do not incur a per minute fee as they are primarily based on IP technologies and not ISDN. This lack of fees is a critical component in the sustainability of e-Learning programs. However, it is also important to carefully analyze network capacity and operations because quality of service of IP based video teleconferencing

cannot be guaranteed and will also impact the quality of the e-Learning program.

Although there are several reliable networks with good connectivity for interactive video teleconferencing and internet services, access to these services from the Pacific Islands is still a major challenge and concern. It is important to recognize that there are some very innovative projects and ideas for bringing connectivity to remote areas or outer islands and islets. Some of these are projects using technologies such as HF radio, and weather systems (e.g., Emergency Managers Weather Information Network) for email and transmission of other information. Last mile solutions may include telephone lines with HDSL technology, coaxial cable, electric power lines (powerline communications), and wireless technology.

In order to achieve a successful collaborative e-Learning program in the Pacific Islands region, some resources must be reserved for ICT capacity building

Those interested in developing an e-Learning program in the Pacific Islands should pursue a multimedia approach to e-Learning where there are varying levels of development.

In order to achieve a successful collaborative e-Learning program in the Pacific Islands region, some resources must be reserved for ICT capacity building. Again, levels of readiness vary within this region. There is, however, an opportunity to use available network infrastructure and, in parallel, provide local education and training in the design, development, and delivery of e-Learning programs in the Pacific Islands region.

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