TV White Space for Development Programs in the Philippines: Implications and Challenges

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Abstract
TV White Space (TVWS) is recognized as an emerging approach to addressing the digital divide, and this has been piloted and tested in several countries all over the world. In 2014, the Dynamic Spectrum Alliance urged the National Telecommunications Commission to use TVWS to serve educational institutions, health centers and government units in far-flung areas. Deployment of the technology in the Philippines has been described as the largest in Asia. The initial trials in the country involved a rural project for registering fisher folks, access to health care and for disaster response. This study aims to provide an overview of the initiatives and implemented programs in relation to the use of TVWS, especially in the remotest areas of the country. The paper draws information from interviews and literature to present TVWS program developments. The study describes the extent of using the technology, the benefits and potentials in responding to problems in the rural areas, and the challenges in existing as well as in future programs.

Keywords: TV white space, ICT, technology and society, rural development

Introduction

The Internet has already shown how it could change various aspects of living. In developed countries, Internet is considered essential in providing extensive economic and social benefits. For decades now, the Internet has created new ways to communicate and socialize; has made new venues and models for businesses and industries to operate; and has also changed the methods of delivering in public services, healthcare and education. The United Nations itself considers it vital to make available the benefits of this technology to developing nations. In 2014, Internet use penetration in developing countries grew by 8.7 per cent, twice as fast as in the developed world where its usage rose by 3.3 per cent. Nevertheless, of the world's 7 billion people, only 2.7 billion have access to the Internet while the vast majority of the 4.3 billion that remain unconnected live in developing countries (Deloitte, 2014). Those who are unconnected are from the world's poorest and most disadvantaged populations due to costs and availability.

Governments and communications and technology institutions have endeavored to come up with strategies to reduce the cost of connectivity, to make available to rural or underdeveloped communities. TV white spaces (TVWS) came out as one of the potential solutions. In November 2008, the Federal Communications Commission (FCC) gave the go to utilize vacant spaces of the TV broadcast bands, called white spaces. These frequencies, left empty when television stations moved to digital broadcasting, are particularly abundant in rural areas. And these are the areas where traditional telecom infrastructure faces a challenge in delivering broadband services.

The FCC, other communication regulator offices such as the Ofcom in the UK and the National Institute of Information and Communications Technology (NICT) in Japan, as well as corporations like Microsoft, Google among others have implemented activities and researches that dealt with TV white space in the areas of development of technologies, cost, regulations and standards, quantitative assessment, and pilot implementations. These activities consequently pointed out the technology's potentials for addressing the digital divide and providing opportunities for interventions in various sectors.

In the Philippines, the implementation of TVWS has been considered to be the biggest in Asia. Undeniably, the Philippines is "never left behind" when it comes to coping with changes and advances in technology and Internet use. Dubbed as the "selfie region" in Asia, no doubt the Philippines is trying its best to provide better connectivity and explore means to improve internet connection in the country.

Based on current information, the Philippines has a modest 52% Internet penetration rate. This figure is nearly a doubled rate from the past 4 years of 27% in 2010. The average connection speed is about 2.1 Mbps, with a little above 8-percent of the users enjoying connection speeds faster than 4 Mbps. In terms of user devices, laptops (45%) are the most preferred over desktops and mobile devices for Internet access. However, with only 20-percent of the total households having computers, a significant portion of the population still do not benefit from the Internet access despite the fact that each Filipino owns at least one phone or mobile device.

The need for connectivity is now compelling especially with claims from the World Bank that for every 10 percent increase in broadband connectivity results in 1.38% increase in GDP. This claim presents both opportunities and challenge in a country where issue on resource mobilization is a challenge.

TVWS in the Philippines is basically a policy intervention and still in its initial phase. The key agency leading this effort is the Department of Science and Technology Information and Communications Technology Office (DOST-ICTO). The will to provide Internet connectivity in public places across the Philippines is in line with "Internet for All" thrust identified in the Philippines Digital Strategy for 2011-2016. Through a project called e-Filipino Program of the DOST, government's efforts in enhancing internet accessibility for Filipinos to accelerate economic, social and educational opportunities end to reduce the growing digital divide in the country. With this goal by the government, there was a noted increase in budget allotted for this and private involvement is highly encouraged as provider for Internet service. TVWS is indeed one among the projects that is part of the bigger plan to increase connectivity in the country.

The concern of this study will focus on how the proliferation of the technology will affect the implementation of development programs. It's been established in previous researches that there are benefits for the use of technology in different aspects of living. This rising importance has urged societies and institutions to review, analyze, enhance and modify management procedures, organizational structure, as well as consider the potentials of ICT in the context of globalization. The potentials of TV white space, which is culled out from researches and trials on the topic, and the prevailing conditions are the core of this study. This paper aims to analyze, based on existing literature, the possibilities and changes that the TV white space revolution will bring to development programs.

TV White Space

White Space refers to the unused broadcasting frequencies in the wireless spectrum. Television networks leave gaps between channels for buffering purposes, and this space in the wireless spectrum is similar to what is used for 4G and so it can be used to deliver widespread broadband Internet.

Typical home Wi-Fi can travel through two walls. White Space broadband can travel up to 10 kilometers, through vegetation, buildings, and other obstacles. Tablets, phones, and computers can all access this wireless Internet using White Space through fixed or portable power stations. The actual amounts of spectrum vary by region, but White Space spectrum ranges from 470 MHz to 790 Mhz. A computing hardware however, cannot directly connect to a broadband spectrum. A separate device is needed to link a receiver that is connected to a regular WiFi hub (Gilpin, 2014).

According to the ITU report "Digital Dividend: Insights for spectrum decisions" (2012), TV white spaces (TVWS) are "portions of spectrum left unused by broadcasting, also referred to as interleaved spectrum". Widely, TVWS are also referred to as those currently unoccupied portions of spectrum in the terrestrial television frequency bands in the VHF and UHF TV spectrum (be it analogue or digital, generally in the UHF band). These TV spectrum "gaps", with advantageous

propagation properties inherent to UHF spectrum (excellent outdoor and indoor coverage and non line-of-sight propagation properties) have been identified in some administrations as an alternative for providing commercial wireless services other than broadcasting. Some of the wireless technologies being explored in TVWS are low-power, machine-to-machine (M2M5) communication devices and low-power wireless broadband applications, capitalizing on the longer coverage ranges achievable with UHF spectrum (Gomez, 2013).

The term "white space" in the context of radio frequency spectrum management refers to portions of radio spectrum that are allocated for licensed use but are not assigned to a particular licensee or are allocated and assigned for licensed use but are not utilized by the licensees at all times or across all geographical locations. There is growing recognition that the white spaces in bands traditionally allocated to television broadcasting (Carlson, J. et al, 2013).

Applications of TV White Space

Carlson, J. et al (2013) claims that Television White Spaces can be used to provide wireless broadband Internet access on a "no-interference no protection" (NINP) basis. A device that uses these white spaces is referred to as white spaces device (WSD) or TVWS device. TVWS were originally established because vacant channels were historically necessary to provide broadcasters protection from harmful interference from other stations. Not all vacant channels are needed for broadcast-to-broadcast interference protection.

In many markets, TVWS also exist because there are few broadcasters – there are dormant channels in areas of lower demand. Lower-power devices can operate in these vacant TVWS channels without causing interference to licensed operations. Although the number and precise frequencies of vacant channels varies from location to location, only a fraction of the available UHF channels are being used at any given time in any given location in South Africa. Topography also impacts on the number of transmitters and the associated number of channels required to achieve coverage. Even after the digital television transition, much of the spectrum in the broadcast bands will remain vacant and available for broadband use. Moreover, advances in technology are facilitating more precision in terrestrial broadcasting planning, which of itself is opening up new white spaces. Available spectrum in broadcast bands has highly desirable propagation characteristics: signals transmitted over TVWS spectrum can travel long distances and penetrate walls and other barriers. As a result, TVWS technology is particularly suitable or delivering Internet access in rural and under-serviced urban areas. Other applications currently identified using TVWS include:

- Last mile access to augment citywide or wide area data networks;
- Data offload from mobile networks;
- Machine-to-machine communications, including smart grid and health care applications;
- In-building media distribution
- Local government and public safety applications; and
- Service to educational and health facilities (Carlson, et.al).

The level of Internet use varies from country to country and the use of TVWS as well largely depends on the country's priority and needs for its use (Carlson, et al., n.d.). The proliferation of TVWS demonstrates that it can bridge the digital divide particularly in underserved areas.

In Kenya, the first trials in using TV White Space included local schools, health clinic, government agriculture office and a library (Graham, 2013). For the white spaces project, the company is working with a Kenyan ISP, Indigo Telecom, and the Kenyan government. The ISP is installing wireless 'base stations' - or masts - that are solar-powered, to get round the lack of mains electricity.

Microsoft has also funded another TVWS project in rural Limpopo, South Africa to help the government's goals of providing low-cost access to Internet among majority of South Africans by 2020. Five schools are part of the project that is a mix of primary and secondary: Mountainview, Doasho, Mamabudusha, Mphetsebe and Ngwanalaka. The schools have been equipped with a range of laptops and tablets along with training to use them in class. Other logistical support like education-related content, solar panels for device charging where there is no access to electricity are also included.

Through a partnership between Philippine Department of Science and Technology's Information and Communication Technology Office (DOST-ICT Office), Department of Agriculture's Bureau of Fisheries and Aquatic Resources (DA-BFAR) and the U.S. Embassy Manila's United States Agency for International Development (USAID), TVWS was explored as a means to deliver broadband connectivity and facilitate mobile fisher folk registration to remote areas in target municipalities. The initiative aims at accessing the BFAR's Fisherfolk Registration System (FRS) directly from the field, enabling municipalities to immediately distribute critical IDs, certificates and licenses to the fishermen that need them. Additionally, field operatives from the Philippine National Police, Bantay Dagat, and BFAR will be able to immediately access and connect to a central database to monitor compliance.

In April 2011, a six-partner consortium, with support from the UK government's Technology Strategy Board, started work on a rural broadband trial network that would use white space radio spectrum to provide broadband connectivity to a small rural community on the south part of the Isle of Bute, Scotland. A key aim was to investigate and demonstrate the potential of white space spectrum for providing broadband access to remote, difficult-to-reach rural areas in challenging terrain (Center for White Space Communications, n.d.). The 18-month project involved the planning and installation of white space radio links from the local telephone exchange to eight premises in the surrounding area, as well as backhaul connectivity from the telephone exchange to the mainland and then on to BT's IP backbone for access to the Internet.

Launched in June of 2011, the Cambridge White Spaces Trial was designed to evaluate both the technical capabilities of the technology as well as potential end user applications and scenarios. The consortium8 explored and measured a range of applications, including rural wireless broadband, urban pop-up coverage and the emerging "machine-to-machine" communication, and found TV White Spaces can be successfully utilized to help satisfy the rapidly accelerating demand for wireless connectivity (Microsoft Research, n.d.).

Meanwhile, in Singapore, the White Spaces Pilot Group (SWSPG) was established in April 2012 with support from Infocomm Development Authority (IDA), the regulator of Singapore. The objective of the pilot group is to promote the Lion City as a leading test-bed and innovative zone for conducting pilot projects using White Spaces technologies, thereby accelerating the adoption of White Spaces technologies locally, regionally and eventually globally. With this goal, they have started with 3 pilot projects that demonstrate the commercial use of TVWS.

In September 2009, the first TV White Space in Claudville Virginia was launched thru the initiative of TDF Foundation who wanted to deliver the benefits of broadband access to a wider community beyond the computer lab. SBI deployed its network architecture through the bandwidth allocation software with off the shelf radio equipment to enable an innovative wireless solution that took advantage of available TV White Spaces channels. These radios were set up at the schools as wells us business users in the community to create "middle mile" connections between the computer lab and the multiple Wi-Fi hot spots installed.

TV White Space in the Philippines

TV White Space potential in the Philippines cannot be underestimated as several efforts are being done to make use of Internet and technologies in bringing service and education to the people who are hardly reached by Internet. The use of TV white space in the country was implemented to aid connectivity and provide social services to the people.

TV White Space for Agriculture
Initially, the implementation of TVWS for connection was in agriculture, particularly in the fisheries department. DOST-ICTO was collaborating with international as well as local partners to set up connectivity the same as Wi-Fi in the far-flung areas of Bohol and facilitate the registration of fisher folks in five municipalities. The initiative will enable local government workers to encode data right in the field and reduce the paper work involved in encoding of entries from the field to the office. Pertinent data can be entered in the database immediately and offices needing this information can access it immediately. The database is needed for the issuance of critical certificates and licenses to fisher folks, and is seen to be vital in tracking the amount of fish being gathered as well as in tracking fishermen in cases when natural disasters strike.

While the main function of the connection is for the registration of the fisher folk, the technology can now provide for the much-needed Internet connection for schools, community centers, clinics and other public institutions within a 10-kilometer radius.

Implications and Challenges
The Philippine fishing sector is beset by problems on inappropriate management of resources (usually of overexploitation patterns) and inadequacies in research and information (i.e. fish catch, catch size per fisherman over a period of time, fishing locations, and environmental conditions), among others. The establishment of the database may lead to an integrated system that will provide fisher folks with relevant data for their appropriate use of resources and managing their livelihood. A dynamic, continually updated relational database, coupled with proper information dissemination and human resource upgrading, will provide the fishery department a

complete range of solutions important for monitoring and control systems. This is still, however, dependent on the design and use of the electronic data.

At the moment, it may be safe to say that the use of TVWS can influence the drive to empower the rural folks through a convenient and valuable registration system, in addition to having access to information relevant to their needs and objectives. In a few year's time, fishermen may become technology savvy and may be able to research information on how they can improve their methods of fishing, sell online, other means of processing their catch, etc. The benefits may not just be to the people, but to the environment as well. Since only registered and licensed fishermen can make use of marine sanctuaries, reefs and mangroves, the system will monitor access to these resources and may aid in preventing overfishing and promoting sustainable use of aquatic resources. If highly successful, the program can be replicated and its benefits will transcend to and transform underserved areas.

TV White Space for Disaster Response

In 2013, the initial purpose of using TVWS for fisher folks' registration was redirected to provide Internet connectivity to help three earthquake-hit municipalities rise from the ruins of a 7.2-magnitude earthquake. The project was pursued in partnership with Filipino-Singaporean TVWS technology firm Nityo Infotech. Nityo Infotech funded the rollout and deployment of the TVWS technology in Bohol, with an investment of about $5 million. This amount was allocated to set up the 100 sites and other technical requirements of the pilot project. A month later, one of the strongest typhoons in the world hit the Philippines, which left 4 million people homeless, destroyed millions worth of facilities and structures, and made the area seemingly disconnected from the rest of the country with the destruction of telecommunications networks. TVWS was instrumental in providing Internet connection, making it possible for families to use social media in contacting their relatives and updating them of their condition.

DOST Undersecretary Louis Casambre, head of the DOST's Information and Communications Technology Office (ICTO), said the successful installation of radio transmitters to provide connectivity to the municipalities helped in emergency response and relief efforts after these natural disasters. The Internet connectivity provided by the TVWS technology continues to benefit local government units and national government agencies in delivering basic government services to the people of the affected municipalities. This has helped as a medium to provide information communication technology to rural areas that are not served by local telecommunication companies.

Implications and Challenges

Experiences on the use of the technology have shown the need for a rapid and cost-effective communications network in the aftermaths of disasters. Further, it has emphasized the importance of setting up a disaster preparedness strategy, which shall integrate a TVWS kit to provide the necessary communication needs for disaster response teams.

The use of TVWS has the potentials of reliably connecting disaster response teams at all times, and at a wider range. Continued developments with the technology may also give rise to supporting greater data use to allow for video transmissions at a relatively

fast speed. Given the right conditions, TVWS can be set up quickly and with more trials, may be used in peer-to-peer networks.

Currently, the use of TVWS in providing connectivity and communication in disaster management, has been under response and recovery phase. Soon, the benefits may be interpolated in disaster mitigation and preparedness. This, of course, would need policy interventions and dialogue with potential beneficiaries.

The effective implementation of this technology may depend on how it is integrated with existing technologies and conventions. The implementers may also have to deal with discrepancies in existing communication infrastructure in different regions. One of the challenges will be on how to maximize the use of existing structures with this new technology.

TV White Space for Health Care

The success of the pilot project in Bohol inspired another initiative of using TV White Space as a medium of connectivity. With UP Manila's- Telehealth Center telemedicine program, called the RxBox project, DOST collaborated with the implementers of the RxBox Project to work hand-in- hand in providing connectivity. The RxBox project aims to enhance the capabilities of health workers in the diagnosis, monitoring and treatment of patients by providing a device, the RxBox, which can capture, store and transmit a patient's physiologic data.

The RxBox is a component of the government's program on eHealth, as a means of addressing the lack of doctors, nurses and health workers in underserved regions of the country. As an eHealth solution, the RxBox, which is equipped with monitors and sensors (blood pressure monitor, ECG, pulse oximeter, fetal heart monitor, maternal tocometer, and a temperature sensor), is a biomedical device installed and health centers to perform basic physiologic measurements. The device facilitates tracking of patient data, generating reports and recording outbreaks.

Implications and Challenges

The Philippines is incessantly frustrated with problems of limited budget, management inefficiency, inadequate number of healthcare personnel and problems with infrastructure and equipment. The program on digital health is trying to overcome some of these issues. The RxBoxes are helping doctors reach more patients in remote areas. In addition to the providing affordably health care programs, these are making health workers more efficient.

Integration of technology may address the lack of health care professionals, and may lead to significant reduction in the costs of health care, but may also pose the challenge of greater responsibility and training for the existing work force. The challenge is the implementation of a well-planned health program with a dynamic IT strategy that could address the current problems and bridge the gaps in health care. In addition, there will be a need for better coordination and management of data, because any threats to the reliability of available information affects a patient's survival.

TV White Space for Education

Schools that are within the range of the areas set-up with TVWS connection can now access information in the Internet. Plans for the use of TVWS in the education sector

is currently being developed by DOST-ICTO for DepEd through the Cloud Top project.

Basically, the project aims to reduce the cost of computer software and hardware by promoting the use of thin clients. Thin clients refer to computers or programs that rely heavily on another computer to do its basic functions. The DepEd shall take charge of providing the learning content while the DOST-ICTO is tasked to deal with the technicalities.

Implications and Challenges

In the Philippines, TVWS use is a great potential to address challenge of providing quality education or learning programs especially in the remote areas of the country. The use of Internet as an information infrastructure has been predicted and is now the current trend that makes communication and information- sharing more accessible. Now that we are living in the so-called information society the value for and of information has become more intense than before. For this reason, initiatives to use the internet in general in the education sector has been witnessed and because of further research and development the use of TVWS was considered as a platform to make internet work even at rural areas to bring education in less than no time and at minimum costs.

For a developing economy like the Philippines, one of the challenges that the country face is the need to provide quality learning programs that will bring about a quality education to its people. The Philippines has more than 6 million young people who are out of education due to circumstances beyond their control, resulting to drop outs and poor academic performance. To innovate on delivering educational service to school-age Filipinos, and increase reach of Filipinos who were out-of school youth, the Department of Education has ventured in CICT and BALS through the Eskwela Project to concretize the use of information technology. These efforts on technology integration and Internet use have offered an exciting and useful tool in the education sector. With the extensive use of TVWS, the implementation of the project may well serve more out-of-school youths and adults, positively affecting the sustainability of the project, and consequently addressing some of the problems in the education sector.

Conclusion

The opportunities which the TVWS can offer in the sphere of education can be really unique but not without challenges. The Internet is a very democratic platform to know and learn about many things. But the usage of information gathered from the Internet must be carefully examined. People who will be using this information must be critical hence, for effective education a mere access to Internet is not enough. People must have critical thinking on the information that they come across.

The use of TVWS is not only limited to the idea that information is available to people. It also is important to know how to process this information and be able to use this to achieve our cognitive, social and economic goals. There has to be ways to make this information practical and responding to people's needs.

The potential of TV White Space to provide coverage for a given area is considered to be cost effective and is therefore being encouraged to be utilized in countries aiming to bridge the digital divide. Mobility of knowledge is now seen as becoming less and less difficult to people but this is without challenge. Transmission of knowledge is just one aspect that TV White Space can provide. There are still concerns in ensuring that providing of quality services should take place in every aspect and sector so that it will result to the over-all goal of bringing development and empowerment to the people.

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