GLOBAL INFORMATION SOCIETY WATCH 2018

Community Networks

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This edition of GISWatch came into being alongside a brand new baby boy. Welcome to the world, Ronan Diga!

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PORTUGAL

HOW TO BUILD A WIRELESS NETWORK AGAINST ALL ODDS: THE CASE OF WIRELESSPT
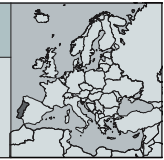
WirelessPT
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https://wirelesspt.net

Introduction

Over the years developing WirelessPT, I found that the biggest difficulties people mention are how to start a wireless network, and uncertainty over how people will embrace the concept and, ultimately, adhere to it. Everyone at some point has specific difficulties, but we all share these deterrents.

To give you an idea about the adversity I faced, this was the scenario: I was 5,500 km away from the town of Moitas Venda where the project would be deployed. Moitas Venda is a civil parish in central Portugal, 6.70 km² in size and with a population of 866 people. The dominant employer is a local tannery, but the parish also manufactures tarpaulins and textiles, and produces marble used in construction. Despite this industrial dynamism, the parish has not seen a lot of investment, and has little infrastructure to attract new industries.

Due to its geography,[1] the town has always been known for difficulties in implementing projects using radio frequencies. I had only Pedro Maximiano, a long-time friend and project partner, to help me, as I faced a disgruntled community with low tech skills, displeased about wireless services following a previously failed wireless project in which some had invested, and old blocked and damaged hardware from that project that I could reuse. No one wanted to or could spend money on wireless networking anymore. On top of it, I had a prejudice towards wireless networking, and knew very little about it.

I was told by someone in the town that since I was not living there I was clueless about how things needed to be done.

The country context was also hardly amenable to setting up a user-developed and managed community network that, in the case of WirelessPT, drew on the potential of open source software to achieve its aims. Policies in favour of community networks had never existed. The idea of sharing resources in a community

was always looked down on with prejudice or at least seen as something that could not make money and was therefore unimportant. Any potential political champions one could find would always want public credit and visibility for their personal brand in exchange for their support, sometimes demanding control and trying to dictate how the project would work.

The obstacles could be summed up as: no funding, archaic politics, isolation, personal egos, selfishness and no support. And without help, for the end-user the investment would be costly.

At least – and although with some boundaries – the 2.4 and 5 Ghz spectrum was free and available for use by citizens.

What exactly is WirelessPT?

WirelessPT.net is an open source mesh network project created, developed and registered by me. In a mesh network, all routers and/or routing devices that are added to it will automatically communicate between themselves in a similar fashion to how the internet works, in this way creating an identical communication system like the internet but without cables or wires or the need for human maintenance. This kind of network concept allows us to create a network and expand it every time we activate another router nearby.

A key advantage is that it does not cost much to develop and implement. At the same time, the network cannot be completely shut down since no one controls all routers or access points and there is no central control point. If one access point goes offline, the network automatically reorganises itself without the dead access point.

The router or routing device used is exactly the same type of router that we can buy in any regular computer store. However, we use a very specific type of software and firmware developed by me which I have named "mvwrt". This software makes the network "self form" and "self heal" in case of any connectivity rupture – any router added to it will automatically detect the rest of the nearby mesh network, and add itself to it while simultaneously expanding it.

The more routers the network has, the wider its coverage will be. Some of these routers can be or will be connected to the internet and in this way all WirelessPT.net users will also have internet access.

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1   It is situated between several small mountains and is elevated compared to other towns.

This type of escalation has been successfully implemented in other places such as Moita, near Marinha Grande, and Videla, which established a 3.5 km link to Moitas Venda with up to 6 Mbits at 2.4 Ghz.

The project is designed to be deployed in a similar fashion to a franchise system where every new local network will follow the documentation on the project wiki and will have its administrator as the first "node owner". A node owner is any person that at his or her own expense sets up a wireless access point and either joins or initiates the project in a new location and who will abide by a user and participant-specific peer agreement.

At the time of writing, only two open source, community-managed wireless projects had been successfully implemented in Portugal. Only WirelessPT is still actively maintained and regulated by a comprehensive user agreement. The other community network has always been closed to a group of developers who administrate it like a private internet service provider (ISP) and have never made it attractive to the end-user.

Making the project relevant to the community

In 2009 I realised that although one or two people could execute the project, I needed to make it open and attractive to people who were not tech-savvy and for whom internet access would be for watching YouTube, updating social media accounts, and using email and voice services (VoIP). So I decided to build an online community using the moitasvenda.net URL to promote the town. This became a portal with a forum, a chatroom where users could communicate, and an encyclopaedia where information about the town's history, culture, traditions, memories, its past and its people were published.

Then a small section for the wireless network was added.

During the next two years a plan was drawn up. I was going to develop an independent and non-commercial wireless network to provide free-of-charge, open and democratic access to the highways of information technology among communities. I wanted to allow those without access, due to poor telecommunication infrastructure or limited financial resources, to gain access to the internet through a cheap, affordable method of telecommunication.

All this would be built by the ordinary citizen, using everyday materials, low-cost equipment owned by the users, and any available resources.

I decided to develop an open source software solution for the network, and also build an online training platform specifically for the wireless community. The training platform includes everything needed to learn, educate and train anyone who

becomes interested in expanding the network in its franchise-type system to other towns. Ultimately the platform would be used to unify all community wireless networks in Portugal.

Getting your feet wet, even if you can't swim

My first trip to Moitas Venda to start the initial deployment was the hardest. I had only three weeks to fix and deploy old broken hardware that was left abandoned by the previous community wireless project, and I had no skills or knowledge on how to manage it. We also had to talk to a number of disgruntled wireless users and investors who had been involved in the previous project – it had failed to ensure sustainability and basic functionality in the town – and we had to convince them to try something different.

In January 2011 – with the assistance of Nuno Carvalho and the extremely crucial help from Pedro Maximiano who always helped set up access points and promoted the project over the years by talking to people in person, by email, using social media and on forums – the network was launched. The technical specs for the network were the following: five broadband fixed-line nodes with access to the internet served nine wireless routers flashed with a DD-WRT operating system, which then distributed the connectivity using WDS Wi-Fi links in the 2.4GHz band via 9-15 dBi omnidirectional antennas.

Thanks to Pedro, all the participant members who had invested in the previous wireless project and bought hardware to set up their nodes decided to be part of WirelessPT. It was for them a way to have internet access for their families at the cost of the hardware investment they had already made and was already installed at their homes. Three of the nodes we set up were owned by local businessmen and women who wanted to extend their home internet connection to their stores, or vice versa.

Given the initial low resources available, the network was open to a limited number of people: only to the node owners, their family and friends and whoever contributed in any way to the project. The initial average bandwidth was 5 to 10 Mbits, allowing the community to browse sites like YouTube. Later, an accidental connection of 3 km was established to a laptop using a wireless USB pen which achieved 1 Mbit.

I left the country in the same month as the launch, and during the next two years the network performance was audited.

Building the network community
node by node

Phase one was a success and gave me valuable information for future development. For example, as soon as the user count increased to an average of 30 users,

or a gateway would go offline, occasional technical problems would happen which revealed the DD-WRT and WDS were limited. Manual administration to fix problems became a burden, hard or impossible to do when remote access was lost.

Simultaneously, a few services that had been implemented, such as IRC chat, a discussion forum, a mail server, a network-attached storage system, a community wiki, VoIP, torrent and even a second-life server, were removed since the network and users were not ready for some of them.

By the end of 2012 a new trip was scheduled to Moitas Venda, and based on lessons learned over the preceding two years, I decided to develop the training platform parallel to the town's previous digital community, but now just for the wireless network and with the objective of sharing my knowledge to provide information and training on how to deploy a wireless network node, whether for a complex solution or do-it-yourself for non-tech-savvy people.

Plans for 2013 had challenges. New firmware and routing protocols were needed in order to eliminate the need for human administration given the lack of expertise in the community. Setting up a node should be possible by non-technical people. Hardware had to be replaced, meaning higher costs, which, given the financial possibilities of the community, and non-existent external financial resources, would be a problem.

Eventually I found the perfect cheap hardware, but at a "cost". I was able to find people selling their home wireless routers on internet community sales sites, many times for a fraction of their store price in either Portugal or where I was. Without any funds to start, the investment in hardware had to be done by me in hopes that people would be interested in what I was developing for them. This led me to scavenge the city where I was based for years to meet strangers selling the hardware I needed.

The next step took into account network performance studies, observations and usage tests done during the first two years in order to develop new firmware specifically and purposefully designed for the environmental characteristics of the community. Based on OpenWrt[2] and using Batman-adv[3] as the routing protocol, a beta version named "mvwrt" was developed.

After three weeks of hardware upgrades and replacements at my own expense, in January 2013 I created a do-it-yourself wireless node kit which facilitated non-techies to plug and play it anywhere.

With the new online wireless portal and Pedro's community communication skills, the network got more people interested in participating as node owners as well as users. The nodes were now 300N wireless routers, their count increased to 14, bandwidth went up to 20 Mbits – there was better throughput and even a few monetary donations for hardware from members.

Carefully planned technical administration boosted the network resources and allowed the number of users to increase. With the cooperation of the community, the wireless spectrum usage of all types of wireless routers in the town was organised in order to maximise the effectiveness of possible bandwidth availability provided by the network while minimising radio frequency "overlapping pollution".

Free to the community

It was now time for another remote audit until the next three-week visit and upgrade in January 2014. Based on a year of study and observation with regard to the network performance upgrades previously deployed, this resulted in a new and stable version of mvwrt firmware, which was now 100% plug-and-play and self-managed without the need for manual administration, which was crucial to solve all the local network administration problems previously found.

The node count increased again, as well as the participation of four women who owned their local business and more than one wireless node which they shared with the community.

Other key people in the network who provided valuable donations either in hardware or money and help were mostly women. For example, my mother proved to be an extremely valuable asset in the town, who – without any technical skills, but following a few simple sets of instructions and stickers – was and still is able to help keep crucial parts of the network running as per remote access needs.

2014 was the year that access to the network became freely open to anyone in the community, with the number of users ranging between 50 and 200 at a time.

Plug and play

The next two visits planned for 2016 were going to be crucial due to the characteristics of the town, the network, its participants, as well as my role as the developer.

Two thirds of the node owners live in Moitas Venda. Half of these people own two nodes. These they use to share their internet service with their second owned property, either a business or residence, using a mesh topology as the travel path to overcome distance and obstacles, and, as a result, saving money since they had no need for a second ISP account.

2   https://en.wikipedia.org/wiki/OpenWrt
3   https://en.wikipedia.org/wiki/B.A.T.M.A.N.

A third of node owners live outside of Portugal, using the network when they return for vacation to the town but keeping their node working during the year. The last group of node owners includes me. I own five nodes, one gateway that serves the community, and several IPCams to monitor the gateway location, my property and weather conditions.

This last third is the tech-savvy group that still works on the network when present in the town and which now also includes Pedro and Ruben Vieira, another network member. Given that the project is located 5,500 km away from me, without any possibility of me fixing any hardware problems that the network encounters, new enhancements were required to the physical structure of the network in order to ensure continuous operation without the need for human intervention. These included the use of self-sustained power supply units in case of technical malfunctions in the electrical grid, as well as rewiring equipment to the electrical grid to prevent downtime due to equipment being accidentally unplugged or damaged because of a poor quality plug or faulty power outlet.[4]

As 2016 arrived, and still operating in the 2.4 GHz frequency, new and improved firmware was deployed. The active node count increased to 22 nodes, new and different antennas were implemented, and bandwidth went up to 30 usable Mbits. Later, with the work of Ruben, the project expanded and created a planned 3.5 km link to the town of Videla.

At the same time, and given the growth of the project, I was invited to present mesh technology at the University of Minho and participated at the international Battlemesh event held at FEUP, the faculty of engineering at the University of Porto, presenting WirelessPT and promoting community networks built by the ordinary citizen.

Since I left the country in May 2016, the network has been running completely on its own: it is self-sufficient, self-managed, self-healing and self-maintained. Contact with the community has been mostly online on social media and using the digital platforms mentioned before. Now the deployment of any wireless node kit can be done by anyone just by plugging it to an electrical outlet.

In 2016 WirelessPT became a registered trademark and after seven years of operation it still performs as planned and all due to one ingredient: "If there is a will, there is a way!"

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4   Hiding power and network cables from humans proved to be very effective in preventing something being unplugged by mistake. In some places, the only way to shut down an access point is by shutting down electricity in the whole house or specific rooms. If a router needs rebooting, the node owner is told to shut down and turn off the electricity at the main electrical supply source. The node owner will not have to look for any plugs anywhere.

Considerations to take into account

Over the years and despite competitive, closed projects and new technologies, open and self-managed community networks still have a place in our society, and great potential in rural regions, even without progressive or supportive country policies.

The key to success when developing an independent community network is not to overload the community with all the bells and whistles, but simply to listen to their needs and how those needs can be met with new, open and shared technologies and resources at a very low cost. Expert developers are not the most important ingredient, and in fact they can even scare the community and lead it to reject the project due to fear and a lack of understanding of the project's technical aspects.

What is imperative is to have trustworthy, key people in the project who are immersed in the community, and are able to engage the population in common community interests, even if these are not about technology, but about the use of technology as a path to achieve a common goal. This will ensure the project's sustainability.

Action steps

In order to succeed, community networks need to develop ways to:

• Be open, transparent and enjoy it.

• Be revolutionary and dare to take a chance.

• Educate and engage communities about resource-based shared economies.

• Envision new ways to achieve a better sustainable society at all levels.

• Be active in causes that are important to the community.

• Learn from other network implementations and do not be afraid to re-invent the wheel.

• Look for individuals who are passionate about relevant interests of the community.

• Work with local businesses for mutual gains or in partnership in order to have their participation in the project.

• Have members engaged in local politics, either as constituents or even as candidates running for office who, if elected, will have a stronger voice that can make a difference to help support these types of community projects.

Perhaps the most important thing that needs to be urgently done is to have the European Union develop regulations that work for community networks.

Community Networks

THE 43 COUNTRY REPORTS included in this year's Global Information Society Watch (GISWatch) capture the different experiences and approaches in setting up community networks across the globe. They show that key ideas, such as participatory governance systems, community ownership and skills transfer, as well as the "do-it-yourself" spirit that drives community networks in many different contexts, are characteristics that lend them a shared purpose and approach.

The country reports are framed by eight thematic reports that deal with critical issues such as the regulatory framework necessary to support community networks, sustainability, local content, feminist infrastructure and community networks, and the importance of being aware of "community stories" and the power structures embedded in those stories.

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