

EXTENDING EDUROAM INTO SOUTH AFRICAN TOWNSHIPS

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Case study

Abstract

Many lower-income students in South Africa experience the digital divide on a daily basis: they have good access to ICTs on campus juxtaposed with little to no Internet access once they go home. This case study examines the deployment of eduroam Wi-Fi hotspots into public municipal libraries located within a low-income community – a township – on the outskirts of a small South African university town. The local South African context and resulting business case for such a deployment is explained. The project faces a number of technical and political challenges, some of which are specific to the selected location and others that may be more universal. These are unpacked in detail before presenting an overview of the selected technical solution: a low-cost, consumer grade wireless bridge linking the University to a strategic high-site close to one of the libraries. Take-up of the resulting service has initially proven significantly lower than expected. Possible reasons for this are discussed, and suggestions for interventions to mitigate these problems are made. The case study provides a model for future deployments and allows other institutions to learn from and avoid mistakes that were made during the examined deployment.

Keywords

eduroam, public library, digital divide, information and communication technologies for development, community networking

1. Introduction

South Africa is a land of contrasts, and the digital divide is a real and growing problem. Our universities are conducting world-class research, and students generally have good access to information and communications technologies whilst on campus. However, despite rapidly growing infrastructure and an evolving regulatory landscape, Internet access remains an expensive luxury for the majority of South Africans (Bhero, 2012).

Rhodes University is a research-intensive university located in the city of Grahamstown which, notwithstanding its city status, is a small semi-rural town in the poorest province in South Africa (DEDEAT, 2013).

The University, which is the smallest in South Africa, has a varied and diverse student population. There is a strong contingent of international students, both in exchange programmes as well as regular full-time students from all over sub-Saharan Africa (Rhodes University, 2011). Its South African students come from equally disparate socio-economic backgrounds. Whilst the majority of students come from upper- or middle-income households, a growing proportion comes from disadvantaged backgrounds.

For these students, home might be an “RDP house”¹ or a makeshift shack in the local township². Access to electricity cannot be taken for granted, nor can Western norms such as water-borne sanitation. Internet access in these locations generally means GSM-based cellular solutions (Mphidi, 2008), which border on unaffordability for students whose sole income may be a state-funded bursary or social grant. They live the digital divide on a daily basis – in the seven kilometres between the University and their home, Internet access goes from being a freely-available basic necessity to being an expensive luxury. This impacts their ability to access online learning

¹ Reconstruction and Development Programme, a low-cost government funded housing programme.

² In South Africa a *township* or *location* is an informal or semi-formal settlement at the periphery of an urban area that resulted from apartheid-era town planning policies.

materials, and noticeably disadvantages them relative to students living on campus (Hodgkinson-Williams *et al.*, 2006).

The local municipality, Makana, is in the midst of a financial and infrastructural crisis. The problems include city-wide water outages that have lasted in excess of a week, and have brought the University to the brink of closure on a number of occasions (Wild, 2013). As a result, the Municipality was placed under provincial administration in August 2014 (Velaphi, 2014).

It is within this context that this paper explores the extension of Rhodes University's wireless network, and specifically access to eduroam, into the local municipal libraries in Grahamstown.

2. An opportunity arises

In South Africa institutionalised community engagement is seen to be a post-apartheid transformation imperative, and thus is now considered one of the three pillars of higher education – the other two being teaching and research (Lazarus *et al.*, 2008). For this reason, Rhodes' Community Engagement office has been working with disadvantaged communities for many years.

In 2013, a joint initiative between the University, Makana Municipality, and a number of local non-governmental organisations (NGOs) saw the establishment of the Joza Youth Hub (JYH) at the Municipality's old administration building in Joza location³. The location is managed by the University's Community Engagement office, and provides office space and infrastructure for a number of projects targeting school-age children living in the surrounding townships.

The lack of traditional communications infrastructure in Joza location⁴ meant that the NGOs at the JYH approached the University for assistance in gaining access to the Internet. They were aware that the University had been providing limited WiMAX-based access to some of the neighbouring schools, and hoped to leverage on the same infrastructure to gain access at the JYH. Unfortunately the topography of the surrounding land meant that any WiMAX customer premises equipment would need to be located well above roof height.

Whilst investigating the problem of connecting the JYH, it became clear that a mast located there might have good line-of-sight visibility to the roof of a building on Rhodes' campus that housed one of the University's main datacentres (*cf.* Figure 1 below). This was completely unexpected – much of the township is obscured by a ridge known as Makana's Kop, and line-of-sight is typically non-existent or well within the first Fresnel zone. A fortunate coincidence of topography places line-of-sight between these particular locations through the only gap in the ridge and outside the Fresnel zone.

2.1. A new high site

The strategic possibilities of a high site located at the Joza Youth Hub were not lost on the Information & Technology Services Division (I&TS) at Rhodes. Whilst the University is located on one side of the city bowl, Grahamstown East is fairly flat, almost plateau-like. This means that a significant proportion of the township would be able to see anything built at the JYH, making it potentially useful as a repeater site. In addition, since the JYH is managed by the University, it is easy to gain access to the site for maintenance purposes.

The University is involved in a number of other community engagement initiatives in Grahamstown East that have expressed interest in obtaining Internet access, and that may be able to benefit from such a repeater site. Thus rather than erecting a simple pole on the roof of the JYH, I&TS readily agreed to sponsor the erection of a proper, permanent lattice mast that might be reused for other projects in future.

2.2. A project emerges

I&TS has toyed with the idea of providing wireless coverage at the main municipal public library in the city centre for many years. However, the benefit to University students is limited as this library is within easy walking distance of the University campus, and empirical evidence from a library survey suggests few

³ For more information about the JYH, see <http://www.ru.ac.za/communityengagement/leftcolumncascade/jozayouthhub/>.

⁴ Copper theft is a major problem in South Africa, and this problem is particularly prevalent in low income areas. To avoid theft, fixed line telephony services in the townships are often DECT-based. This means that copper- and fibre-based technologies (such as ADSL), while widely available in more affluent areas, are not currently available in Joza.

University students make use of the public libraries. Recognising that gaining access to the library would be politically complicated and the rewards limited, no serious attempt has ever been made to achieve this.

During a site visit to the JYH, it was discovered by chance that the old municipal administration complex in Joza location shared a property boundary with one of the other municipal libraries, Duna Public Library. This reinvigorated the idea of providing wireless into public libraries.

That Duna was located in the centre of Joza location (and close to arterial roads) was particularly relevant – a growing proportion of the University’s student population live in the townships that make up Grahamstown East. Providing access to the University’s network (and thus online teaching and learning materials) in more accessible locations has long been recognised as desirable, and realising this has recently become a published priority for our Vice Chancellor.

2.3. Alignment with strategic objectives

The original intention behind this project was to improve access to the Internet and e-learning resources for Rhodes students living within the township. However, it quickly became apparent that the project was more significant than that: by providing access to eduroam, the University was making access available to students from all participating universities. This includes distance learning students registered at other South African universities (particularly the University of South Africa, UNISA, who have in excess of 400,000 distance learning students scattered around the country). In many ways these institutions represent Rhodes’ direct competitors, and the number of their students living in Grahamstown East likely far outnumbers the University’s own students.

Nevertheless, it was widely recognised that the community empowerment benefits far outweighed the potential costs (both financial and intangible) of providing such a service. In addition, the idea was broadly in line with the idea of shared learning support centres as envisioned by national strategy (DHET, 2013). This meant that the project received the full support of both the University’s Community Engagement office and of its incoming Vice Chancellor.

3. Prerequisites

3.1. Availability of funding

The opportunistic nature of this project meant that no provision had been made for it in any budget, and this represented the first stumbling block. Whilst the Community Engagement office had limited funds available for connectivity at the Joza Youth Hub itself, the growing scope of the project put it beyond their means and mandate. Fortunately there was a simple solution.

3.1.1. By students, for students

The University, in common with many universities worldwide, provides network and Internet access in student residences on campus. From the outset, this has been a paid-for convenience service. It is intended to be self-funding on a partial cost-recovery basis. Many of the administrative and support functions associated with this service (including a dedicated help desk) are staffed by students, leading to the mantra “by the students, for the students”.

In 2013 the University took the strategic decision to make provision for student connectivity in tuition fees. As a quirk of how this change was implemented, the service generated a non-recurring surplus in 2013. This retained income was constrained to improving connectivity for students, and providing students with access to eduroam from Duna Public Library seemed like a sensible way to spend it.

Approximate R60,000 (~ €5,000) of this retained income was made available in mid-2014 to establish a high site at the JYH, install a point-to-point wireless connection between the University and the JYH, and provide onward connections to and wireless infrastructure at Duna library.

In 2015, provision was made within the residence network budget for another R100,000 (~ €8,300) towards maintaining the existing infrastructure and expanding it to other public libraries in town. It is anticipated that this will be recurring community engagement funding in future budgets.

3.2. Access to the libraries

With funding for the project secured, the next major hurdle was to arrange access to the libraries to install wireless access points.

As early as 2008, I&TS had had informal discussions with the then Municipal Manager about access to municipal sites, with particular reference being made to the main library. The idea of connecting libraries was mooted again in 2011 during a meeting with municipal councillors⁵. Whilst these predated the University's adoption of eduroam, on both occasions the idea of improving connectivity in the public libraries was met favourably, and so no major objections were expected.

However, as noted in the Introduction above, Makana local municipality was placed under provincial administration during 2014. The Municipal Manager was dismissed and, as a result of systemic infrastructural problems, the relationship between the University and the Municipality was strained. This meant that, now that the project was a reality, it was unclear who in the Municipality to approach and who might grant permission.

The University's Community Engagement office instead suggested a "grassroots" approach, seeking permission from the library management rather than the municipal Council itself. They facilitated a meeting between I&TS, various library staff, the municipal ICT manager, and a local support group ("Friends of the Library").

3.2.1. Grahamstown's libraries

Grahamstown has five municipal public libraries: Grahamstown Public Library, Duna Public Library, Community Library, Fingo Library, and Extension 9 Modular Library (Makana, 2013). Of these, three – Duna, Fingo, and Extension 9 – can be characterised as serving the townships. Grahamstown Public Library is located in the city centre and Community Library is in a medium-density residential area⁶.

The approximate location of these libraries is shown in Figure 1 below.

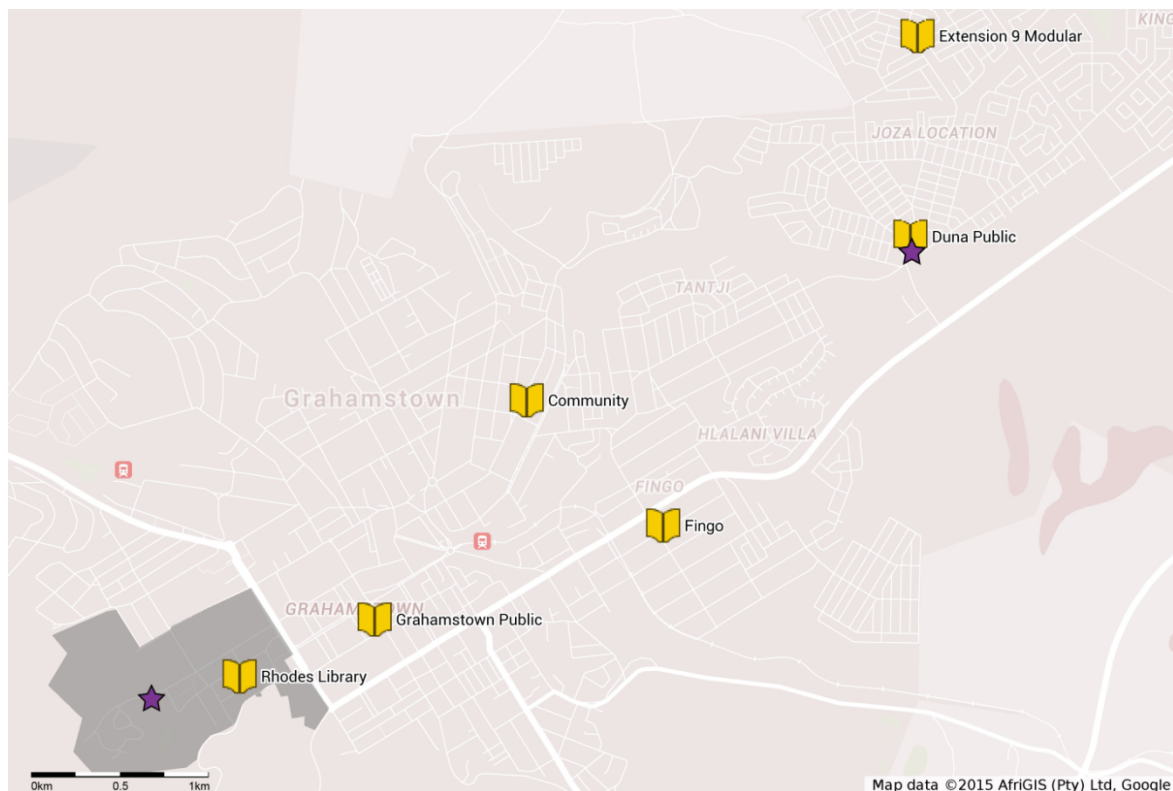


Figure 1 - map showing public library and high site locations

⁵ This formed part of the discussions surrounding the "Friendship Co-operation Agreement" between Makana Municipality and Raseborg Municipality in Finland.

⁶ Community Library is in Currie Park, which was declared a "coloured area" under apartheid legislation. It is now a medium-density residential suburb consisting predominantly of low- to middle-income houses.

The grey outline on the bottom left of the figure above⁷ shows the extent of Rhodes University's campus. The two stars indicate the locations of the high sites: on Rhodes' campus (African Media Matrix building, housing the School of Journalism & Media Studies and a datacentre) and at the Joza Youth Hub.

3.2.2. Library priorities

During the aforementioned meeting with the municipal library staff, the University suggested that its priority was those libraries furthest from campus – and in particular, Duna Public Library, since establishing the high site at the Joza Youth Hub was both a prerequisite and a premise of the project.

However, the municipal library staff made it clear that their priorities included the library hall and study area at Grahamstown Public Library. As the library was within 30 metres of existing University-owned fibre optic cable, this condition was readily agreed to. However, doing so did reduce the funding available for other libraries during 2014.

4. Details of the deployment

4.1. High sites

4.1.1. Mast at the Joza Youth Hub

The mast at the JYH is a free standing, 12 metre modular lattice mast from a commercial supplier. It consisted of four 3 metre segments that were assembled on site and then bolted to a concrete plinth cast into the ground.

The 12 metre height was chosen as a compromise between three factors:

- It provided clear line-of-sight to as many sites as possible (a function of increasing height);
- It was below the height at which local civil aviation regulations required additional warning lighting and the publication of a NOTAM (notice to airmen); and
- It was the maximum height that the mast specifications allowed for without additional stabilising guys. This was particularly important as there was not sufficient space to allow for guy lines.

In addition to the materials, the construction of the reinforced high-strength concrete plinth was subcontracted to a local builder. However, in order to reduce costs, all other work was undertaken either by volunteers or by I&TS staff.

In particular, all the digging and trenching was done by student volunteers who had been assigned to one of NGOs at the JYH. For some of these students, it was the first time they had undertaken this sort of manual labour.

Inclement weather delayed the final erection of the mast by several weeks, and resulted in the flooding of the newly dug trenches. These had to be emptied before work could continue, and this was done by a bucket brigade that included some of local school children who came to the JYH for extra lessons.

The mast itself was also assembled and erected by volunteers who gave up their Saturday to help out. Unfortunately assembly of the segments took substantially longer than expected, and by the time came to raise the mast only four people remained. It was raised manually using nothing but a rudimentary block and tackle.

Nevertheless, despite the generous contributions of various volunteers, erecting the JYH mast cost a substantial proportion (about 60%) of the available budget.

4.1.2. Mast at Africa Media Matrix

The mast at the Africa Media Matrix building was constructed on top of the flat roof of the building. It is a 4.5 metre lattice mast of the same construction as the one at the Joza Youth Hub. The mast is secured to a 1×1×0.2 metre reinforced concrete block that was cast *in situ* on the roof of the building (it sits on rubber matting, so the mast is not directly attached to the building; it is held in place purely by the mass of the block).

⁷ The map is also available online <http://goo.gl/zRIrFA>.

The concrete block was cast by the University’s building maintenance section, and the mast erected by I&TS staff. This meant that the only direct costs associated with erecting the AMM mast were for materials.

By virtue of the height of the building, the top of the mast is located between 15 and 18 metres above ground level.

4.2. Wireless backhaul

Given the potential future use of the JYH as a repeater site, it was desirable to both provide as much bandwidth as possible to the JYH as well as to provide a reliable link. However, the limited budget ruled out the use of licensed spectrum. It also ruled out many enterprise-grade wireless solutions, which left us looking at commodity products targeting low-cost WISPs.

In South Africa, use of the 2.4GHz band is restricted to indoor deployments. In addition outdoor use of the 5GHz band is limited to 1W EIRP (ICASA, 2013). These presented a design constraint when it came to the selection of radio equipment and high gain antennae.

Finally, there was some concern about the potential wind loading on the mast at the JYH – particularly as it was un-guyed and at its maximum design elevation. This constrained the physical size and profile of the antennae.

After much deliberation, a pair of Ubiquity PowerBeam ac (PBE-5AC-500) wireless bridges was settled upon. These are 802.11ac wireless devices with an integrated 27dBi gain antenna. They operate in the license-exempt 5GHz band, and have type-approval from the local regulator.

4.2.1. Link-budget calculations

Radio Mobile⁸ is free software for doing RF propagation simulations, and can be used to perform link-budget calculations for outdoor Wi-Fi links (Fox, 2014). This software was used to predict the received signal strength, and thus estimate the bandwidth that might be available on the AMM↔JYH link. The results of the simulation are shown in Figure 2 below.

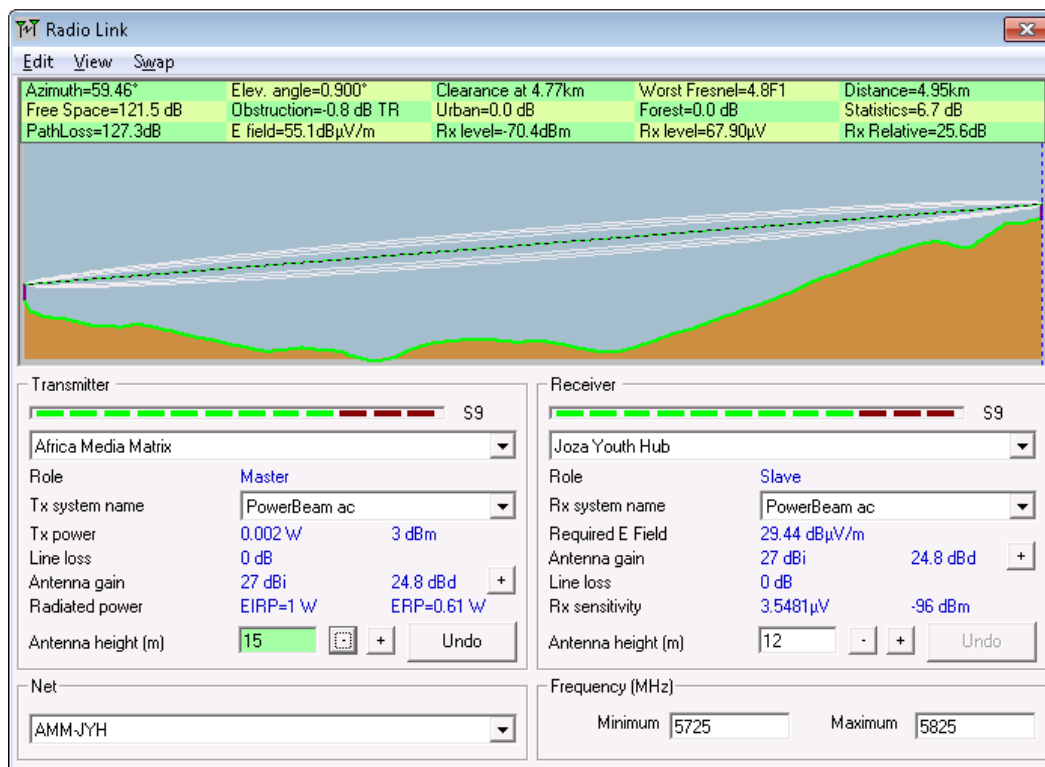


Figure 2- RF propagation simulation for AMM↔JYH link

⁸ Radio Mobile is available from <http://www.cplus.org/rmw/english1.html>.

The Makana's Kop ridge referred to in section 2 above is just visible as a slight rise on the far right-hand side of the topography diagram.

Coupled with information from Ubiquity's specifications sheet for the PowerBeam ac (Ubiquity Networks, 2014), the results from the Radio Mobile simulation can be used to predict the data rate that might be available on the link given our regulatory constraints, topography, and high sites.

The predicted receive (Rx) level of 70.4dBm means that the PowerBeam should be able to use 64QAM modulation. For 802.11ac this translates to a theoretical throughput of 292Mbps. Of course, local radio noise will inevitably reduce this somewhat, and license-exempt bands are often congested.

Once installed, the measurable sustained throughput was closer to 200Mbps using 16QAM modulation.

4.3. Last miles

4.3.1. Duna Public Library

The last mile from the Joza Youth Hub to Duna Public Library consists of a pair of Ubiquity NanoStation M5 wireless bridges. Both are mounted to the gable walls of the respective buildings. They are approximately 30 metres apart.

Traffic from Duna is carried over the wireless backhaul between the JYH and AMM, and from there reaches the University's network core via Gigabit copper cabling (the high site at AMM is located one floor above a datacentre housing a core router). The copper cabling is likely part of the reason for the problem identified in section 5.3.6 below.

4.3.2. Grahamstown Public Library

The last mile for Grahamstown Public Library consists of a pair of Ubiquity NanoStation M5 wireless bridges between the Library and an adjacent building (approximately 10m). From there network traffic is carried over Gigabit fibre optic cable back to Rhodes' Struben datacentre which houses a second core router.

4.4. Wireless hotspots

The wireless access points providing eduroam coverage within the libraries form part of Rhodes' enterprise wireless solution. They are Ruckus ZoneFlex 7372 access points tunnelling back to ZoneDirector WLAN controllers located in the University datacentres on campus. This allows us to manage them as part of the campus wireless network, and they benefit from the existing authentication infrastructure.

In addition to eduroam coverage, the access points also carry a well-known local commercial wireless hotspot provider on a separate SSID. This allows library patrons who are not affiliated to any university to gain wireless access to the Internet using the same infrastructure. Unfortunately this is currently a paid-for service, but Rhodes has negotiated with the hotspot provider to provide free access to resources such as Wikipedia and Project Gutenberg. (This is done as a *quid pro quo* for carrying the hotspot provider's traffic over the University's infrastructure.)

5. Take-up and utilisation

Cognisant that decisions about the future viability of this project would need to be made, it was necessary to ensure that there was comprehensive monitoring and graphing of all access points in the libraries.

5.1. Grahamstown Public Library

At Grahamstown Public Library, there are three access points, all of which see low numbers of connections during library opening hours. One of these is shown in Figure 3 below.

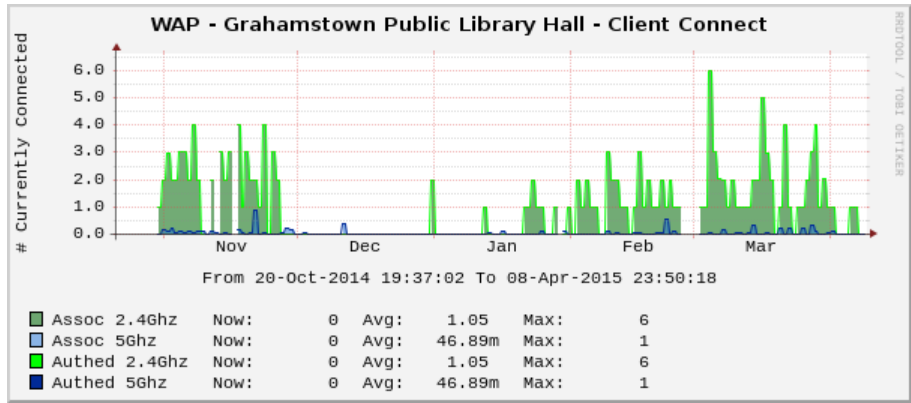


Figure 3- Grahamstown Library utilisation

The lower utilisation over December and early January can be explained by South African university vacations, and by the fact that municipal libraries were closed between Christmas and New Year.

5.2. Duna Public Library

Unfortunately the take up at Duna is somewhat poorer, in part for the reasons explained in 5.3.6 below. The library is a single open space, so there is only one access point which is shown in Figure 4.

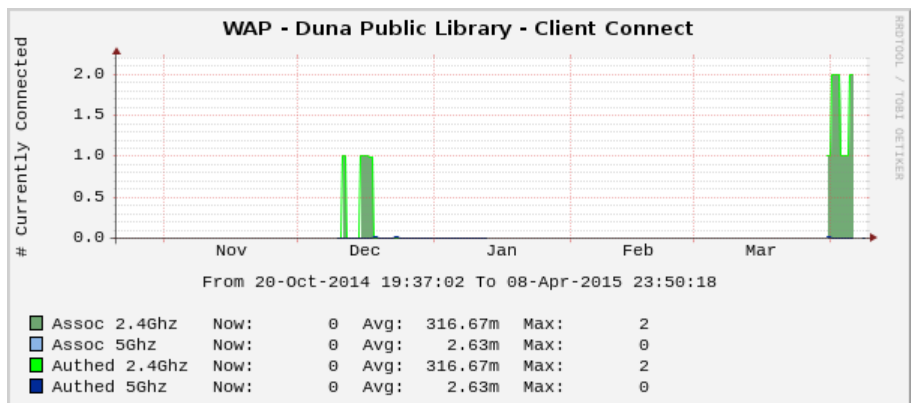


Figure 4- Duna Public Library utilisation

Despite the problems with connectivity to Duna, this is still a disappointing result considering that township connectivity was the primary motivation for undertaking this project. On the face of it, it would seem that the project was a waste of time and money. However, unpacking the low utilisation shows that there might be other factors at play.

5.3. Possible reasons for poor take-up

Informal surveys and discussions with some of the stakeholders identified a number of possible reasons for the low utilisation. Understanding these reasons helps determine what interventions might be necessary to address them.

5.3.1. Difficulty communicating

Having deployed eduroam Wi-Fi coverage into two public libraries, we were faced with the challenge of letting students know it was available. Both libraries have clear signage at the entrances and in strategic locations within the building. However this only helps people who are already in the libraries; it does not reach students who might not ordinarily visit a public library.

In the case of Rhodes students, an announcement was made to a student-wide mailing list. This received positive feedback from a number of students. However, it is not easily possible to reach students from other South African universities in this way.

The use of advertising in popular media such as the local newspaper was also considered, but there was some concern that this would not reach the target audience. In addition, the limited budget for deployment made it difficult to do this. Whilst this approach has not been used to date, it may be reconsidered in future.

5.3.2. Student access to eduroam

When considering this deployment, we expected that the majority of utilisation would come from Rhodes' own students as well as those attending one of two other universities: the University of South Africa (UNISA), and Nelson Mandela Bay Metropolitan University (NMMU). Both UNISA and NMMU both provide distance education. In addition, NMMU's main campus is in Port Elizabeth – only 130 kilometres away, making it an attractive choice for part-time students. Preliminary investigations suggested that both were eduroam identity providers.

The reality turned out to be different – UNISA's identity provider is in a trial phase, and only provides very limited assertions; NMMU does not assert the identities of their undergraduate students (who are the likely beneficiaries of this service).

As things stand, the vast majority of utilisation comes from Rhodes' own students with a handful of authentications from University of Cape Town students during their vacations.

5.3.3. Time of year

Despite best intentions, staffing and weather constraints meant that the libraries were only connected at the very end of the academic year. Unfortunately this meant that Rhodes' students had entered their end-of-year examination period, and this was followed by a long period of vacation shortly after deployment.

In some senses it is therefore premature to be looking at utilisation statistics – it would be better to wait until there is a full semester of data before making any decision that might jeopardise the project.

5.3.4. Library opening hours

Grahamstown's public libraries are not open after hours (Makana, 2013). Over weekends, they are only open on Saturday mornings. This limits their usefulness to students – Rhodes students are likely to be on the University's campus during library opening times, and students doing distance education at other universities might also be in full-time employment.

In addition, the public libraries are chronically short staffed with some of the branch libraries usually staffed by a single librarian. This means that when a librarian is sick or on leave, a branch may not open.

This turned out to be one of the major disadvantages of the “grassroots” approach mentioned in section 3.2 above – whilst the librarians themselves are sympathetic of the problem, they are not in a position to do anything about it. Addressing this would likely require higher-level strategic intervention from Makana municipality.

5.3.5. Public library staff

The municipal branch libraries do not have much in the way of their own ICT infrastructure, and access to it is limited. This means that some of the municipal librarians have low levels of information literacy, and do not routinely have access to wireless capable devices of their own.

Even if they do make use of wireless on their own devices, none of them can access to eduroam themselves. This means they have no first-hand experience, and limits the amount of assistance they can give library patrons.

One possible solution to this may be to provide the library staff with access to eduroam via Rhodes' identity provider. The governance issues around doing this are under investigation.

5.3.6. Lightning damage

About two months after we completed the installation at Duna Library, the Africa Media Matrix building received a direct lightning strike during a storm. Electrical storms are unusual in Grahamstown, and this particular one did significant damage to electronic devices in AMM. Amongst the casualties was the PowerBeam wireless bridge providing access to the Joza Youth Hub and its associated network switch.

Unfortunately, because these were consumer devices, they were not covered by any maintenance agreement. In addition, in an effort to reduce costs, no spares stock was ordered. This would typically be done for deployments on the University's campus. This meant replacements needed to be ordered and delivered.

In January when this happened, there was no stock of the PowerBeam ac bridges in South Africa. This led to considerable delays in obtaining a new bridge, and meant that the eduroam service at Duna was down for approximately six weeks.

The timing of this was terrible – just as the service was starting to attract student to Duna to use the service, it went away. Thus this single incident has greatly damaged the reputation of the service, and the University's relationship with the municipal library staff.

6. Lessons learnt (thus far)

The low-cost, community engagement nature of this project has meant that Rhodes' I&TS staff have got involved in activities that they would typically outsource. This has had the beneficial side effect of exposing these staff members to areas outside their traditional areas of responsibility and comfort zones – for instance, having to research and understand the local civil aviation regulations pertaining to masts. The practical lessons associated with the project are thus too numerous to mention.

The utilitarian benefits aside, several more fundamental lessons were learnt that are beneficial to anyone else wishing to embark on a similar exercise.

6.1. Anything involving volunteers takes longer than expected

When embarking on any project, it is common for stakeholders to ask some variant of “how long will it take?” Answers to that question are based on estimates, and it is usual to make assumptions about the behaviour of suppliers and contractors. For instance, when an order is placed with a supplier, a delivery time is negotiated and there's a reasonable expectation that every effort will be made to deliver on time.

However, projects that are dependent on volunteer time have to be more flexible – commitments are more easily broken, and things get rescheduled around the availability of volunteers. The impact of this cannot be underestimated, as small delays can easily compound (for example, a part that arrives the day after the end of term can mean that no progress is made until the beginning of the next).

The initial estimate that was given to the Municipal librarians and the University was that this project would take about six weeks to complete; in the end it took closer to six months.

6.2. Whilst grassroots gets things done, it only goes so far

The grassroots approach proved very successful in advancing the project at a time when it might otherwise be difficult. However, despite the best efforts and will of the municipal library staff, there are certain systemic issues that are beyond their control. Recognising the existence and extent of these limitations is an important part of managing expectations.

6.3. Include university library staff

It was initially assumed that academic libraries and public community libraries had little in common, and that the University library staff would have little to offer this project. This turned out to be a fallacy – Rhodes' library management have a good understanding of the constraints the municipal libraries operate under, and had some useful insights into how to approach them. They share a common passion, and have some training in common. As such this is likely true of other university librarians too.

In addition, the University's circulation and subject librarians deal with student connectivity issues on a daily basis. They have developed a pragmatic, common sense approach to resolving these. This makes them invaluable as trainers, and may help resolve some of the issues noted in section 5.3.5 above.

6.4. Whatever the budget constraints, make sure you have spares.

In an effort to reduce costs, a decision was made to forgo spares or maintenance contracts. For the most part this was a low-risk decision, as there were ways to replace or mitigate most known risks. For example, a faulty power-over-Ethernet switch could be replaced with any spare managed switch and an inline power injector.

However, to paraphrase the popular adage known as Murphy's Law, "the most likely part to break is the one you do not have spares for".

There was one possible failure that could not easily be mitigated – the point-to-point link between the JYH and AMM is by far the longest wireless link at Rhodes, and nowhere else on campus are there comparable wireless bridges. Thus it was perhaps unsurprising that of all the possible damage that might have occurred during a storm, this link was the only casualty.

As was mentioned in section 5.3.6 above, the reputational cost of this failure was more than the financial costs associated with either spares or replacements. Thus, with the benefit of hindsight, spares should have been purchased from the outset.

7. Future work

Despite the low take-up and setbacks, during the course of 2015 we intend deploying coverage into at least two of the three remaining public libraries. In addition, there is a desire to extend the project to two local community centres in Grahamstown East.

The main reasons for continuing with the project in its current form are:

- Whilst the number of Rhodes students utilising these links is low, the benefit to those students who do make use of them is significant.
- Rhodes would like to encourage the adoption and growth of eduroam in South Africa, and hopes that the availability of coverage will provide (particularly) UNISA students with some leverage to convince their university to assert student identities. In this regard, I&TS will also try to actively engage with UNISA's IT staff on this issue.

As noted in section 2.3 above, the project aligns with some broader strategic objectives.

- Some of the infrastructure already deployed and to be deployed will also help improve Internet access at local secondary schools.
- The University hopes to find a way to provide limited free wireless Internet access to other people in Grahamstown East, as a community engagement initiative. This would run on a different SSID, but would make use of the same infrastructure.

Thus the intention is to continue maintaining and expanding this deployment for at least the next year.

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