



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA



COSTED PLAN FOR CONNECTING SCHOOLS TO BROADBAND

Friday, 29 June 18

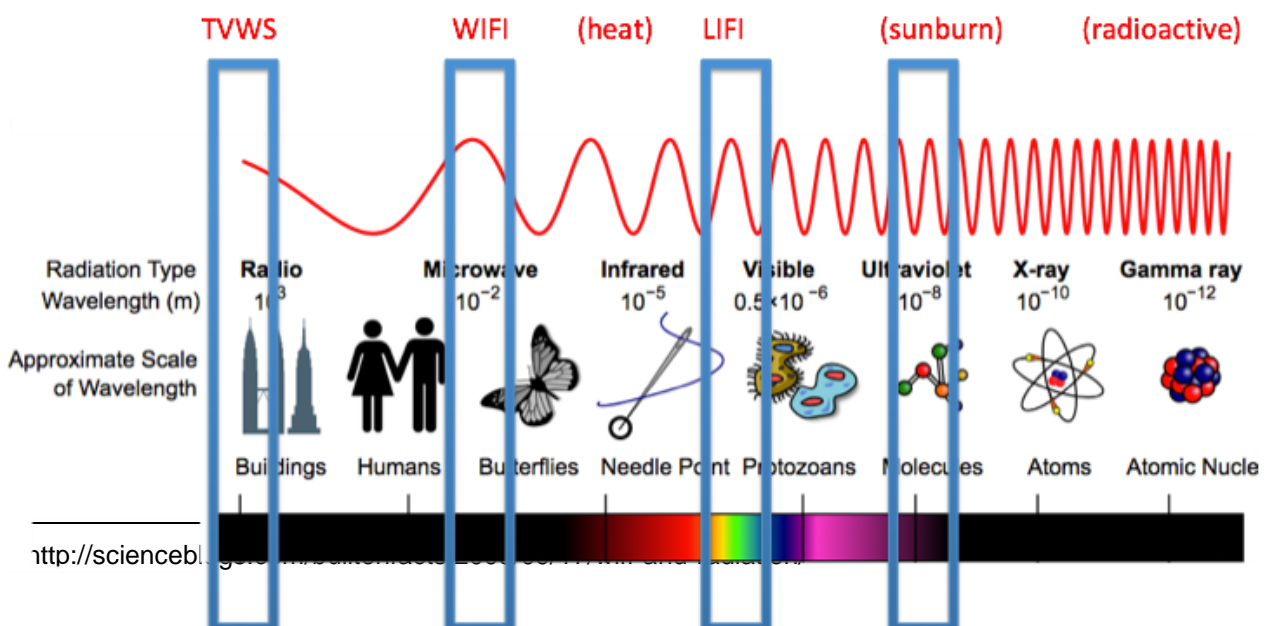
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Terminology

The following are terms required to understand this document. Other terms are defined in Appendix 1.

- **Point of presence (PoP):** a nearby source of broadband internet. In many cases, it will be an existing institution which has broadband, i.e. fibre.
- **Last Mile:** The link between a customer or user, and the nearest “point of presence”.
- **Backhaul:** The link between a “point of presence” to the area to be connected.
- **Microwave:** Connectivity provided over microwaves (light in the mm-cm wavelength region); used in microwave ovens and cellular telephones, and WiFi.¹ Effective range for microwave-based connectivity is around 50m-200m.
- **TV Whitespace (TVWS):** Connectivity provided in the TV spectrum (m-km range). Range: over 100km.
- **Fibre/Fibre optics:** cabling made of fibre glass which transmits internet connectivity signals using light. High-speed and immune to electrical interference.
- **Repeater:** A device which receives a signal and amplifies and transmits if further, to increase the range of the original signal.
- **Line-of-sight (LoS):** Where two devices responsible for connectivity have to have an unobstructed view of each other for the connectivity to work. Microwave requires LoS, TVWS and WiFi do not.
- **(Un)capped:** Limits on the amount of data downloadable without cost implications.
- **(Un)contended:** The extent to which the bandwidth is shared by multiple customers/users.



Executive Summary

This business case document describes the requirements of the Basic Education Sector (“Sector”) regarding connectivity. It proposes that the Department of Basic Education (DBE) performs a number of actions and partnerships, and finds funding, to roll out connectivity at a large scale, particularly for rural schools which are not in range of fibre optic cabling. It proposes a rollout plan to ensure delivery / rollout of the connectivity.

The business case first identifies the preparatory work needed in the context of the ICT strategy, specifically to first understand which schools need connectivity, where they are, what existing solutions they have, if any, and what their geographic context is:

1. Create a Database of the types of connectivity;
2. Provide analysis of the features;
3. Determine the Schools’ needs;
4. Determine Gaps; and
5. Determine Connectivity Deployment options.

Once this is done, a costing exercise will need to be performed which takes into account the nature of the

- (a) backhaul required,
- (b) last mile connectivity required (including the capital expenditure (CAPEX) on setting up infrastructure), and
- (c) monthly operating expenses (OPEX).

The business case argues for providing Backhaul, and specifically identifies the South African Research Network (SANReN), which is managed by the Council for Scientific and Industrial Research (CSIR), as one option to consider, giving some detail on the nature of SANReN and why it is an attractive option for backhaul. Alternative sources of backhaul, however, can be used, and indeed must be used in whichever scenario the source is most suitable, given the geographic context.

On the matter of last mile, we consider Microwave and TV Whitespaces (TVWS). The reasons are discussed under “options analysis” below.

Environmental Scan

Legislative context

The *White Paper on e-Education (2004)* calls for schools to be connected to broadband Internet so as to give learners and teachers access to online Learning and Teaching Support Materials (LTSM) as well as to enable our learners to be 21st century citizens having 21st century skills in the context of what is now called the Fourth Industrial Revolution.

The importance that the Department of Basic Education (DBE) places on e-Education is reflected through the *Action Plan to 2019: Towards the Realisation of Schooling 2030*, the Department's long term strategy to achieve quality education. The role of ICT in education cannot be overemphasized in our quest for quality teaching and learning for all our teachers and learners. The Action Plan highlights the need for teachers to be computer literate and to ensure that our learners have increasing access to a wide range of media, including computers that will enrich their education.

Business Process context

- The DBE is bound by the Public Finance Management Act which requires certain activities to be performed prior to any large-scale acquisition. This would entail, for example, putting out a Request for Proposals prior to initiating the project or identifying a rollout partner.

Economic context

- At present, the DBE does not have funding to support this initiative, and, due to the enormity of the amount of funding required, is unlikely to ever have such funding, without appealing to outside sources of funding.
- The economy experienced a downturn resulting in lower GDP growth and hence pressure on the fiscus to cut funds rather than increase allocations to departments.

Historical deployment context / Other initiatives

- At present, approximately 64-66% of the DBE's schools have some form of connectivity. The exact figure is yet to be confirmed, as the data sources are somewhat incomplete and have significant overlaps.

- The bulk of the DBE's schools are connected by ADSL or similar (approximately 11 000 schools), and at present 2078 are connected via fibre, microwave, or other technologies in provinces. In particular, the Western Cape has successfully rolled out fibre connectivity by pooling funds between provincial departments; their figure is 1278.
- The DBE relies heavily for new rollouts on the USAO.² At present, at the time of writing, 4366 schools were connected via the USAO, which also provides 24 tablets, two educator laptops, and a printer. The challenge with the USAO is that it has a sunset clause of two years; meaning that once it has been at a school for two years, legislation presently does not compel the MNOs to continue to support those schools or provide the mandated 20GB data per month.

Situational context / SWOT analysis

- The below analysis only applies to the current scenario.

	USAO, 3G/4G	Provincial initiatives	ADSL
Strengths:	<ul style="list-style-type: none"> • Easy to deploy • Ubiquitous 	<ul style="list-style-type: none"> • Better funded • Provide provincial uniformity 	<ul style="list-style-type: none"> • Existing • Working
Weaknesses:	<ul style="list-style-type: none"> • Low range / distance coverage • Expensive • Expiring/running out of data 	<ul style="list-style-type: none"> • No national uniformity • Richer provinces can provide sooner, furthering the digital divide 	<ul style="list-style-type: none"> • Slow • Copper theft
Opportunities:	<ul style="list-style-type: none"> • Quick solution to roll out • Willing partnerships with existing MNOs 	<ul style="list-style-type: none"> • Other provinces can investigate option to roll out similar solutions to Western Cape 	<ul style="list-style-type: none"> • Use existing infrastructure to deliver to non-connected schools
Threats:	<ul style="list-style-type: none"> • End of the USAO project • Costs 	<ul style="list-style-type: none"> • No national uniformity • Richer provinces can provide sooner, furthering the digital divide 	<ul style="list-style-type: none"> • Encourage failure to change in the sector; status quo unchanged

² USAO refers to Universal Services and Access Obligations, a license obligation imposed on Mobile Network Operators (MNOs) in terms of Government Gazette 37718

Stakeholder list

Acronyms are available in the appendix.

Stakeholders	Role
<ul style="list-style-type: none">• ICASA, DTPS, DoC, DPSA, SITA	<ul style="list-style-type: none">• Legislation and authorisation, mandate to provide connectivity or computing standards in the country
<ul style="list-style-type: none">• DBE, DHET, HEIs, schools, PEDs	<ul style="list-style-type: none">• Beneficiaries of connectivity, whose needs have to be met
<ul style="list-style-type: none">• DST, CSIR, SANReN, TENET	<ul style="list-style-type: none">• Potential stakeholder in providing broadband
<ul style="list-style-type: none">• Operators: Vodacom, MTN, Cell C, Neo-tel/Liquid Telecoms, Telkom, BBI/Sentech	<ul style="list-style-type: none">• Companies who may provide connectivity or who currently provide connectivity

Benefits for stakeholders in the Network Operator space

- Access to large numbers of users and their usage data
- Potentially “piggy backing” off the connectivity to deliver connectivity to paying customers

Desired Outcomes

Need Statement

- The bulk of the DBE's schools are connected by ADSL, which is presently too slow to use for teaching and learning. The remainder are connected by temporary solutions (USAO), or not at all (36%). Only a small percentage — approximately 8% — are currently connected to broadband. In order to realise the goals of White Paper 7 (2004), and the ICT enablement goals of the Action Plan, the DBE needs to provide connectivity to its schools, either directly or through suitable partnerships.

Vision Statement

- All public schools will be connected to Broadband Internet (over 10 Mbps) by 2020.

Impact, Outcome, Output and Performance Indicators

The following are envisaged as deliverables of the project.

- **Audit**
 - It is noted that the Council for Scientific and Industrial Research (CSIR) has performed an audit of this sort for NECT districts.
 - It is further noted that the National Education Infrastructure Management System (NEIMS) contains connectivity data for schools, which may be out of date.
 - It is therefore necessary to perform an audit of connectivity for the whole sector.
 - **An audit of the schools connectivity and the type of connectivity;**
 - **Create a Database** - or update the NEIMS database;
 - **Provide analysis** of the features, e.g. Bandwidth, LAN availability or LTE capabilities per school;
 - **Determine the Schools' needs**, per-policy guidelines; What type / size of school should get what or can spend what on connectivity;
 - **Determine Gaps;**
 - **Determine Connectivity Deployment options:**
 - BroadBand and drill further down between WIFI; TV White space / Other;
 - Mobile - USAO + Direct LTE subscriptions;

- ADSL - Continue use or Migrate to newer technology options.
- **Deployment and service supplier engagement:**
 - Costing
 - DTPS / BBI / Sentech?
 - USAASA / ICASA?
 - Mobile Network Operators (MNOs) ?
 - Other, e.g. SANReN, Telkom?³
- **Stakeholder Engagement**
 - Funding - Operational Cost for Connectivity
 - ICASA - Zero Rating
- **Roll-out Project Plan**
- **Cost to Achieve and Project Funding Approval**

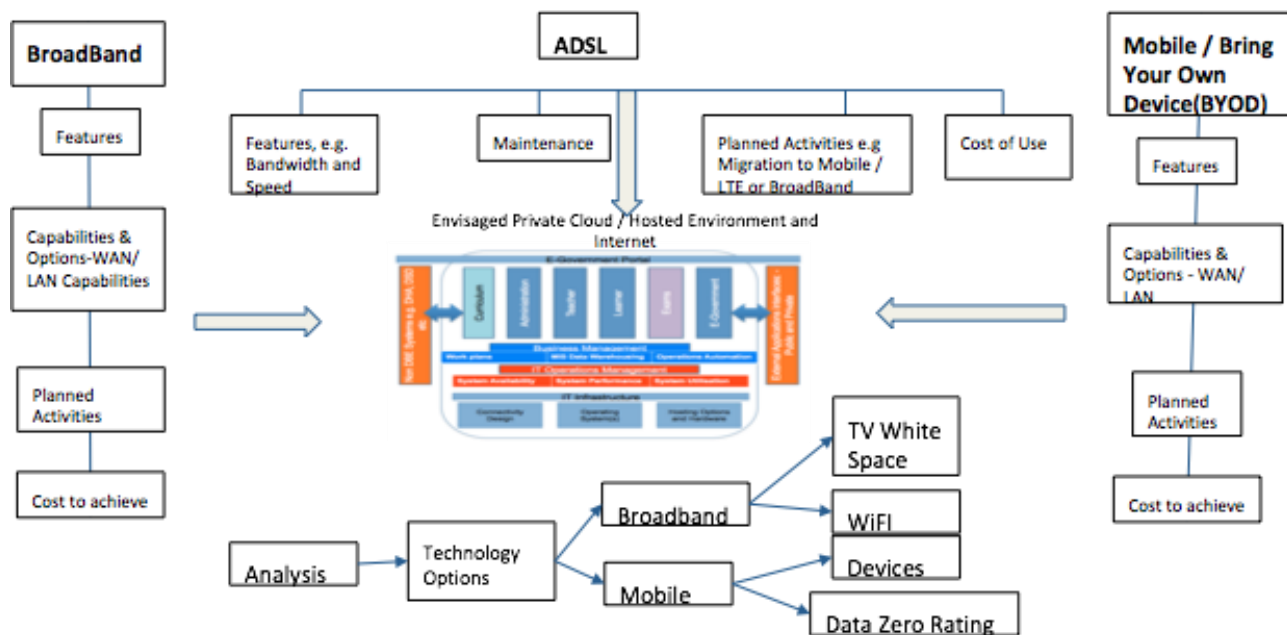
This document contains a draft rollout plan with general steps without definite dates; dates would depend on identified sponsors and funding sources.

Impact / Outcome / Output	Indicator	Baseline	Target
Preparation			
Create a Database of the types of connectivity	Complete database provided	NEIMS updated	As per indicator
Provide analysis of the features at schools	Database contains accurate information about schools' connectivity types	All schools known to have connectivity or not (no detail)	As per indicator
Determine the Schools' needs	Database of schools earmarked as needing upgrade	As per indicator	As per indicator
Determine Gaps	Database of schools, where they are, and what kind of connectivity they will need	Numbers of schools requiring upgrade	As per indicator

³ SANReN is the South African National Research Network, used by universities. More on SANReN is discussed later in this document under the Backhaul chapter which follows.

Impact / Outcome / Output	Indicator	Baseline	Target
Determine Connectivity Deployment solutions	<ul style="list-style-type: none"> Document the options for connectivity (this business case, done), and Determine on a per-school basis which solution to use 	Plan to deploy standard solution	Determine on a per-school basis which solution to use
Funding/Budgeting			
Costing	Detailed budget with a per-school, per-district and per-PED cost	Estimate based on numbers of schools	As per indicator
Identify funding source	Funding source identified and enlisted	Treasury requested for funds	All necessary funds obtained
Create tender	Create tender	As per indicator	As per indicator
Identify service provider	Service provider identified	As per indicator	As per indicator
Appoint service provider / successful bidder	Service provider appointed	As per indicator	As per indicator
Begin rollout			
1. Identify primary target districts including GIS mapping with telcos	Primary target districts identified including GIS mapping with telcos	As per indicator	As per indicator
2. Prioritise areas with no connectivity; build infrastructure	Schools without connectivity receive connectivity	Select districts receive connectivity	All schools receive new connectivity (except WC)
3. Test solution	Solution tested and working	As per indicator	As per indicator
4. Develop dashboard to track uptime/accessibility of solution	Dashboard deployed, shows activity / uptime of solution	Districts able to identify schools which are down	DBE is able to identify any school which is down
Rollout complete			
Maintenance and Refresh	DBE able to tell at any time which schools are online, which are down, and which need upgrades	DBE plans for regular upgrades	As per indicator

Strategic Alignment



Summary

The DBE ICT Strategy envisages a centralised service provision Enterprise Architecture (EA). Each potential solution — Broadband, ADSL, Bring Your Own Device (BYOD), and any other solution identified from analysis, has to deliver on a providing connectivity to the central EA.

Each solution must be investigated for:

- Appropriate features
- Appropriate capabilities and options
- Planned activities to roll out
- Cost to achieve the solution.

In this costed plan, we analyse the technology options and propose a choice of Microwave broadband or TV Whitespace broadband, for the Last Mile.

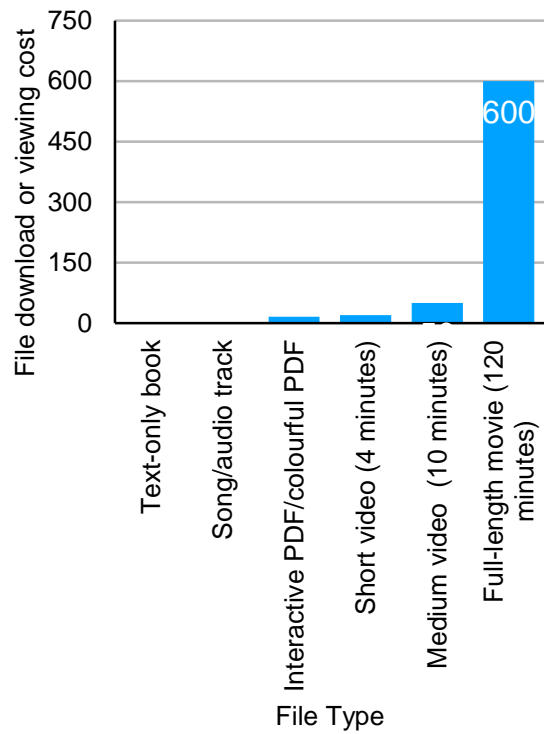
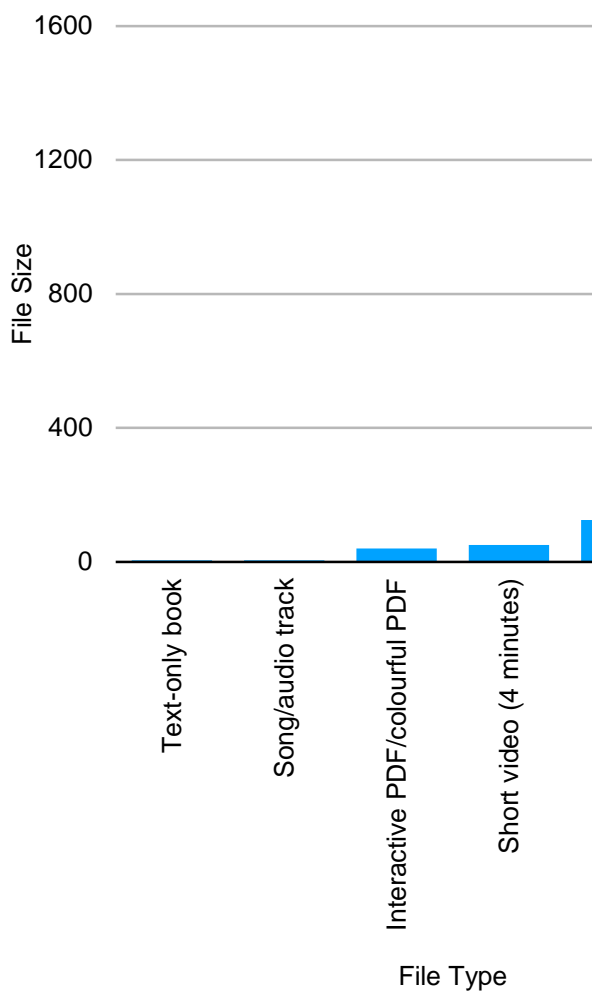
Options Analysis

Why not 3G/4G or Satellite?

The default solution to use in remote or rural areas is 3G or 4G connectivity. Whilst 4G does offer adequate speeds for use by a school (particularly a small rural school), the speed advertised does not always match expectations, particularly if a large number of people over an extended geographic region are using the same cellphone tower (contention). It therefore makes sense to use a different solution. One commonly-deployed solution is Satellite connectivity (VSAT — Very Small Aperture Terminal) — however it is too slow for reasonable educational use in most scenarios, peaking at a speed easily surpassed by other technologies (15 Mbps). Furthermore, both VSAT and 3G are quite expensive, and VSAT is affected by atmospheric conditions.

Consider the following table of costs for 3G:

Digital object	Data size in MB	Rand cost in cheap bundle (R 0.05)	Rand cost in expensive bundle (R 0.40)
Text-only book	4,5	0,23	1,8
Song/audio track	4,5	0,23	1,8
Interactive PDF/colourful PDF	40	2,00	16
Short video (4 minutes)	50	2,50	20
Medium video (10 minutes)	125	6,25	50
Full-length movie (120 minutes)	1500	75,00	600



RAND COST OF CELL DATA BUNDLE	BUNDLE DATA SIZE MB	COST PER MB IN RANDS	1 Song cost	1 Short Movie cost (approx 40 MB size)
12	30	0,40	1,80	16,00
29	100	0,29	1,31	11,60
59	250	0,24	1,06	9,44
99	500	0,20	0,89	7,92
149	1000	0,15	0,67	5,96
249	2000	0,12	0,56	4,98
299	3000	0,10	0,45	3,99
399	5000	0,08	0,36	3,19
599	10000	0,06	0,27	2,40
999	20000	0,05	0,22	2,00

Cellphone data cost is prohibitive from the point of view of the pricing of data bundles. For example, a learner might want to watch an educational video, but only have R 5 airtime. This airtime will be used up almost instantly in trying to watch a video, and, due to general ignorance of how data bundle sizes corresponds to rand price and file size, a learner would be surprised to suddenly be out of airtime and data. Larger data bundles, which are affordable only to the wealthy, cost less. So the pricing structure of mobile data ensures a widening of the digital divide.

The following costings were obtained informally for VSAT. As we can see, it is approximately as expensive as 3G/4G.

Uncapped	RANDS/MONTH
1Mbps	R915
2Mbps	R1750.000
4Mbps	R2365.000
10Mbps	R3075.000

It is for these reasons that we may need to advocate alternative technologies. In this costed plan we discuss **Microwave** and **TVWS**.

Summary

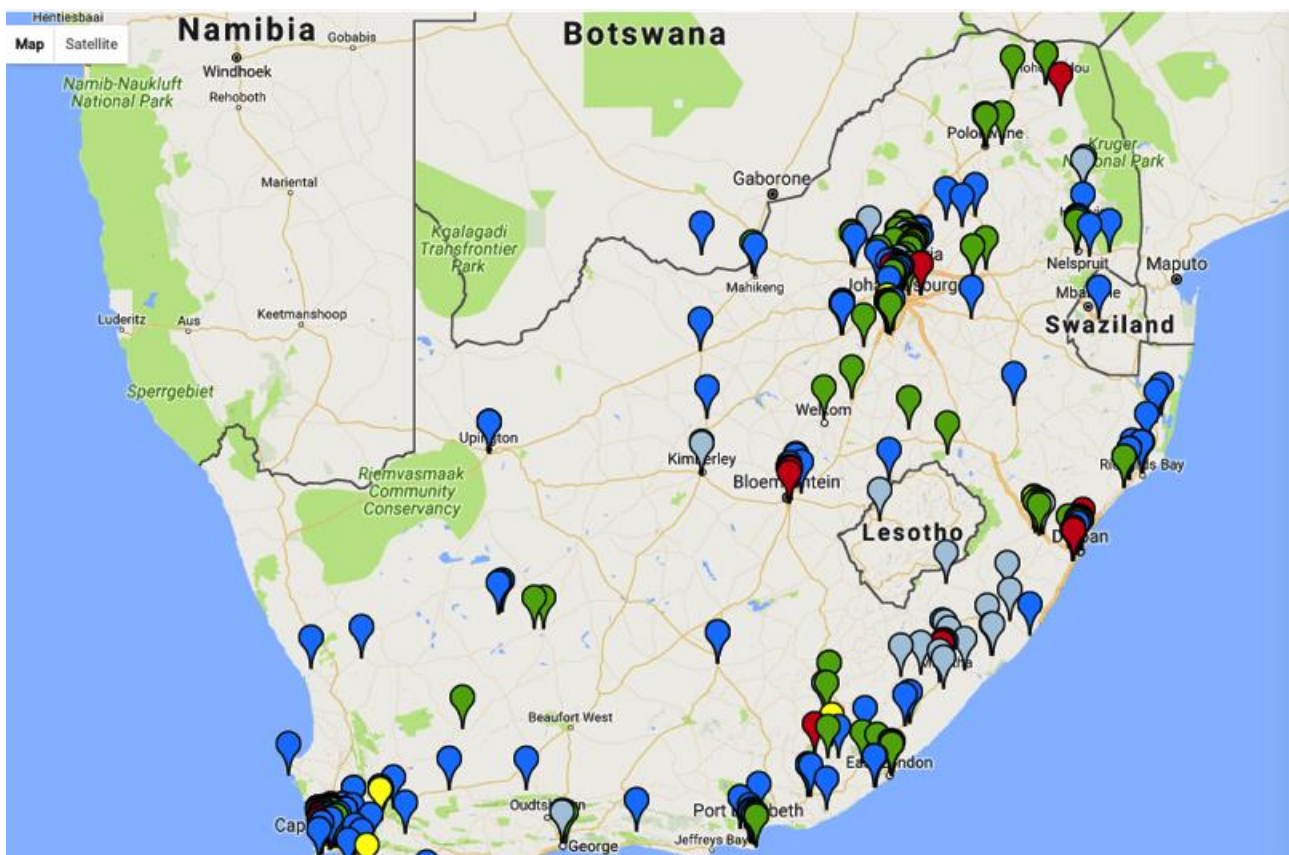
- For the last mile, we consider Microwave and TV Whitespaces (TVWS).
- 3G/4G and Satellite (VSAT) are not suitable solutions.
- Fibre optics in particular is excluded for most schools as the targeted schools are out of range.
- Microwave is more expensive and more suitable at short range, however, it is faster.
- TVWS can reach much further, and is cheaper to roll out, however it is a bit slower.
- Therefore, Microwave should be considered where a school is near a Point of Presence (PoP), whereas TVWS should be considered when the distance is great.

Proposal: Backhaul

Introduction

One of the key issues to be resolved for the Education Sector is the question of backhaul, that is, connectivity back to a large Internet Service Provider, e.g. in a city, to the nearest Point of Presence that schools can connect to, in groups. For this project, we propose that the most affordable, high-speed connectivity in an area be used, regardless of service provider; that is, we are proposing that we use whatever PoP is available in the vicinity without going to tender for PoP and backhaul, but rather to negotiate costing with each available PoP owner.

One of the projects proposed historically by the Department of Basic Education (DBE) has been to take advantage of the broadband backhaul used by universities, namely SANReN, the South African Research Network. This is a high-speed fibre network spanning most of the country and having lines and points of presence between most major cities and to all Higher Education Institutions (HEIs).

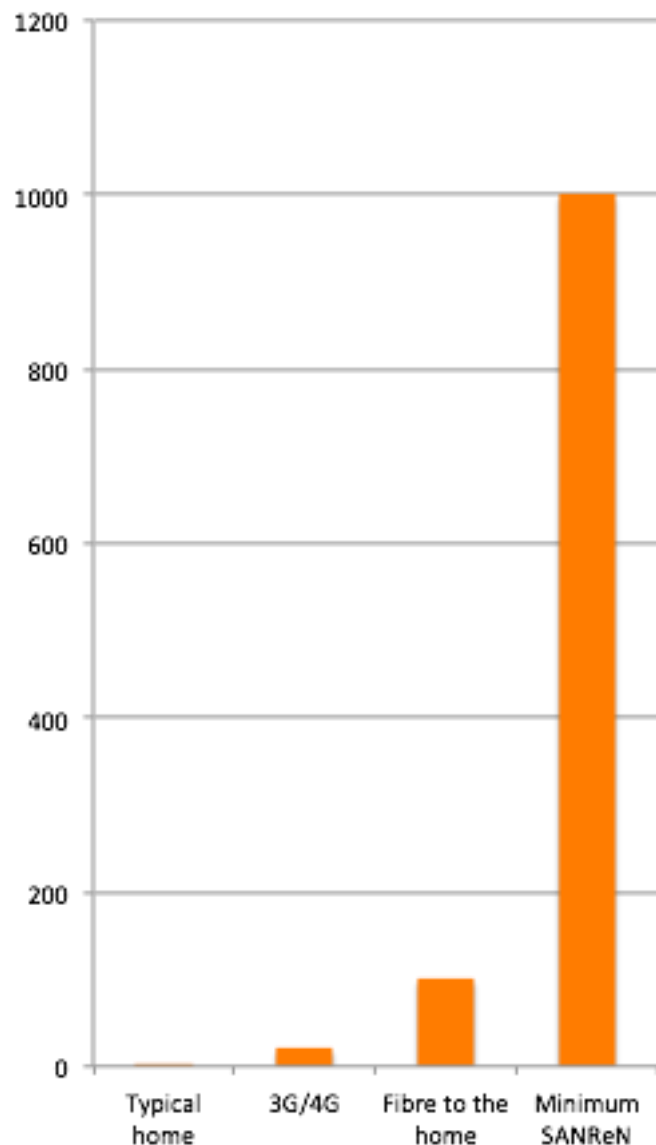


It is a physical network owned and/or leased by the CSIR's Meraka Institute's SANReN project under the aegis of Department of Science and Technology (DST). TENET, by contrast, is the Tertiary

Education Network. They provide Internet Services on SANReN (ISP services). SANReN buy or lease cables from fibre optic cabling providers such as Telkom, Neotel and Dark Fibre Africa (DFA).

Their policy is to connect a dedicated single line to each institution and to not share the line with other institutions to ensure maximum service levels (speed) and zero contention (competition for bandwidth). It is uncapped and unshaped. Their minimum connection speed that they provide is 1 Gb/s (one gigabit per second, 1000 Mbps). A typical suburban home connection is 4-20 Mbps. The connection speed is thus approximately 240 x faster than a home connection. Most universities get 20 Gigs (20 000 Mbps).

Internet service is provided on the network by TENET — the Tertiary Education Network (<http://www.tenet.ac.za>). The case for the SANReN collaboration was presented to the CSIR's Meraka Institute, which owns SANReN. The SANReN terms of use make it clear that any educational or research institution may in fact have access to their network.



- Speeds on SANReN start at 1000 megabits per second (1 Gigabit). A typical home in the suburbs is provided with 4-10, which is 100-200x slower.
- Most universities are provided with 20 gigabits/sec from SANReN.
- SANReN is uncapped, meaning they do not limit how much one can download.
- This chart compares a typical home connection, a 3G/4G connection, a maximum high-end home fibre connection to the minimum 1 Gig SANReN connection.
- It is envisaged that 10 schools would share a 1 Gig connection at the PoP.
- A secondary programme has been created called **SABEN** (South African Broadband Education Network), which will provide connectivity to Technical, Vocational Education and Training colleges (TVETs). SABEN will use SANReN for backhaul.

It is proposed that where feasible, DBE should plug into SABEN and/or SANReN. The Department of Science and Technology (DST) has been engaged and has indicated conditional support, relating to DBE funding and supporting SANReN/SABEN.

A number of schools are already connected to SANReN and their mandate to provide connectivity to educational institutions is clear. SANReN's speeds start at 1000 Mbps, which is 100x higher than that proposed by DTPS in their SA Connect initiative.

An important point about SANReN is that it **may only transmit educational content**; it is **not permitted** to use it for commercial use. This excludes commercial telecommunications providers (operators) from using SANReN for backhaul.

Brief History of the engagement:

- Memorandum of Understanding on collaboration was signed between DBE and CSIR (who owns SANReN) in 2013
- Meetings held with SANReN on 28 June, 13 July, 27 October 2016
- SANReN indicated that they're willing to connect schools but not individually, rather in batches ("networks") of 100 or so schools each getting 10 "gigs"
- **DHET approval.** At a meeting of Ministers held at Tuynhuys in Cape Town on 15 March 2017, the Hon. Minister Nzimande, MP, then of Department of Higher Education and Training (DHET), expressed support for the initiative.
- **DST approval.** The Hon. Minister Pandor, MP, then of DST, wrote to the DBE on 25 April 2017 in support of the initiative, subject to the terms outlined by SANReN below.
- Subsequently, SANReN were approached again on 19 May 2017 and they provided costing which is included below under **TENET**. The cost is significantly lower per month than equivalent services from commercial operators.
- The proposal to use TVETs as PoPs was presented to the education sector's Heads of Education Departments Committee (HEDCOM) in 2017, and concerns were raised by DHET at the meeting on the impact that schools' usages would have on quality of services for universities. DBE were advised to consider the matter of legal contracts between SANReN, TENET, and HEIs.
- The matter was not pursued further until a funding source can be identified and alternative backhaul solutions costed against SANReN.

Key advantages to the solution:

- Existing high-speed backhaul (no need to create new cabling)
- Highest speeds in the country
- Zero contention, uncapped, unshaped (features that SANReN impose on the network)
- Already designated for education
- Free peering with Google, Youtube and others to reduce costs
- DST have agreed in principle.

Conditions of Use: SANReN

1. There would be a need for assistance with funding the upgrading of the backbone (main network). At present, SANReN is host to approximately 200 institutions. Although schools would use less bandwidth, SANReN indicated that their upgrade cost was in the region of R 300 million. They request support with upgrading.
2. **Albany Schools** and **e-Schools Network** are on SANReN already. However, individual schools are not connected. SANReN recommends building similar networks of schools and connecting them as a batch.

Contact details:

e-Schools' Network (ESN): Karen Nicole; karen@esn.org.za

Albany Schools: Barry Irwin; b.irwin@ru.ac.za

3. Existing projects in Limpopo and the Western Cape were conducted with Microsoft using TV Whitespace signals for last mile connectivity (connecting the schools to the PoP).
4. Institutions may onwards-connect others as long as they meet the terms of agreement, e.g. no commercial content.
5. SANReN is uncapped and unshaped.
6. They have a very high-speed backbone (main) network of approximately 8000km between towns, and a further 3000km unused ('dark'), with connections to other major networks and the overseas SEACOM cable and the WAX (West Africa exchange).
7. They "peer" (connect) with many other large providers such as Google, YouTube and Facebook through caching (temporary storage of downloaded data) at TERACO in Kempton Park. This means that videos are not always coming from overseas, for example.
8. The cabling is built and/or leased at much lower rates from various providers. It was built because SA Connect was not in place.
9. SANReN/TENET currently have approximately 1 million users.
10. SANReN do not have support capacity and so each school network would need to be built by a service provider who took responsibility for it.
11. There would be a cost of setting up the "last mile" connectivity, and monthly hosting costs to TENET and SANReN.
12. SANReN and TENET's connection policy allows for the self-funded connection of eligible institutions to the SANReN backbone network, which has led to several TVET colleges funding TENET to connect themselves using this model.

Funding to cover TENET costs

TENET recovers costs from the beneficiaries of SANReN that it incurs by managing and operating the SANReN network, as well as providing capacity on selected links that have been implemented by TENET itself. Using assumptions above, the **total TENET costs will be as follows for a schools network of 100 schools:**

- Total local in-country bandwidth needed: 10 000 Mbps = 10Gbps
- Total international bandwidth needed on WACS: 100 Mbps
- Total monthly cost for local connectivity: R10 800
- Total monthly costs for international connectivity: R32 400
- Total monthly costs: R43 200 (excl VAT)

This entails a monthly cost for uncapped 100 Mbps fibre to each school of R 432/month excluding VAT. This is approximately **one third** of the cost of commercial fibre providers.

IMPORTANT: Note that these costs **exclude** funding contribution to the SANReN backbone upgrade effort, as well as the operations and maintenance (O&M) costs incurred by SANReN annually. Those costs are negotiable. The cost cited also excludes **last mile** connectivity needed to reach a SANReN PoP.

Funding to cover SANReN costs

Funding will be required to cover the following SANReN costs:

- **Contribution towards SANReN's capital investment to upgrade the current backbone:** SANReN is currently in the process of upgrading the existing national backbone from 10Gbps (10 000 Mbps) to 100Gbps (100 000 Mbps).
- **Contribution towards the recurring O&M cost incurred by SANReN for the existing national network links:** Currently SANReN incurs approximately R25m annual O&M costs for its existing national network links. It is expected that these costs will grow to at least R35m annually after the planned backbone upgrade. Depending on the proportional usage of these links by schools networks, a funding contribution for this O&M will be required. The contribution required can assumed to 2m annually.
- **Contribution towards the establishment of new SANReN PoPs, where required:** This will depend on the clustering approach used to establish schools networks, as well as SANReN's

current and planned PoP locations. The contribution might be R 2 million (CAPEX). This contribution is for establishing one new PoP.

- **Contribution towards upgrading backbone extension links to existing SANReN PoPs:**
Due to the additional load that schools networks will place on the SANReN network, there might be need to upgrade selected backbone extensions to existing SANReN PoPs (R 2 million in CAPEX and small component of OPEX). Note this can only be dealt with on a case by case basis. It could be vary depending on the number of backbone extensions links that must be up-graded. This budget estimate is for one link upgrade per 100 schools / district.

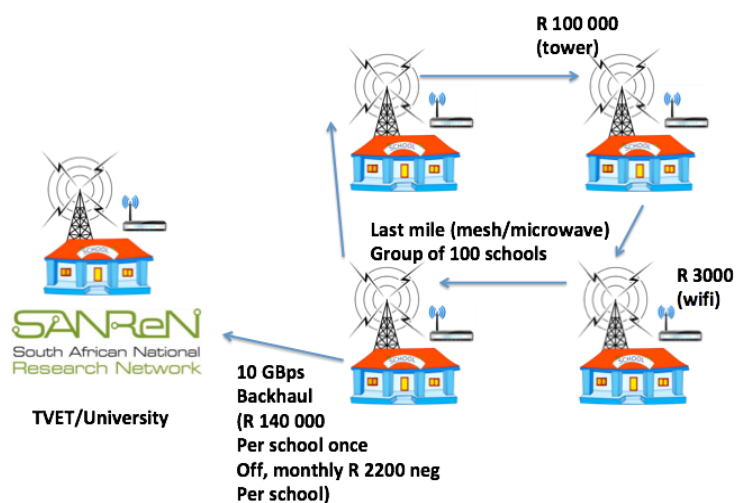
SANReN/TENET can provide the following:

1. Access to existing SANReN PoPs to connect schools networks backhaul links
2. Backbone bandwidth to carry schools network traffic locally and to international cable land- ing stations
3. International bandwidth to carry schools network traffic to Europe
4. Network engineering experts to provide guidance and help during the evaluation of the technical aspects of schools network proposals
5. Project and procurement management experts to help during the evaluation of the com- mercial aspects of schools network proposals
6. The full portfolio of SANReN services available to all beneficiaries (e.g. web and video con- ferencing services)
7. Access to all services provided by the SANReN via TENET peering arrangements with lo- cal and international service providers (e.g. Google)
8. TENET network support services (e.g. call centre) will be available for schools network management organisations.

Disclaimers

In order to proceed with the establish- ment of an arrangement to connect schools networks on to the SANReN network, approval is required from the following primary stakeholders:

- 1.DST
- 2.CSIR Executive
- 3.National Integrated Cyberinfrastructure System (NICIS) management team at the CSIR
- 4.TENET Board
- 5.TENET Executive

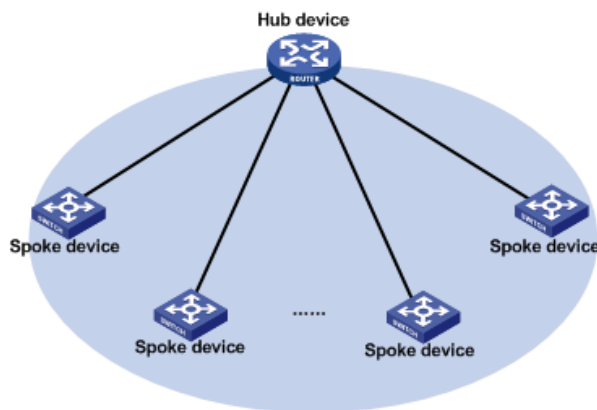


Costing Estimate: Microwave Last-mile

Introduction

Microwave connectivity involves the creation of a mesh or grid of networked towers using microwave electromagnetic radiation of the sort used by cellular telephone towers.

A hub-and-spoke model would likely be used, with a central school being the hub, connected via direct line-of-sight microwave beams to nearby schools. The central hub would then have a “back-haul” or high-speed connection to a nearby “Point of Presence”; whichever is available in the area.



Costing

The following cost estimates were derived from a costing exercise provided partially by CSIR and their partner vendors including SANReN. This costing was based on the assumption of using nearby TVET colleges. The approximate cost per school is R 100 000. The costing varies greatly depending on the number of “hops”, that is, how many times the signal has to hop from one tower to another, before reaching a PoP.

Assumptions

- Local/National (not international) bandwidth required per school: 100Mbps
- International bandwidth required per schools: 1 Mbps on WACS only, since most of the connectivity needs of the schools network will be catered for via the peering connections that TENET have in place with various international service providers (e.g. Google, Akamai, Microsoft, etc.) at Internet exchanges located inside South Africa. Assume no SEACOM connectivity is needed, as the schools network does not have need for international redundancy.

- Schools in rural areas have no fibre or ADSL lines available and have to use electromagnetic spectrum-based technologies such as “last mile”. This need entails that there is an unavoidable setup cost in providing connectivity to these schools.

Summary of costs for 100 schools via assumed SANReN backhaul

The below costing is on the assumption that TENET/SANReN will provide the Backhaul and ISP service:

	WiFi APs	Microwave links	TENET	SANReN creation of PoP	Totals
CAPEX (setup)	R300 000	R 10 m	R 0 . 0 0	R14m	R24.3m
OPEX per Month (ISP and support)	R4 000.00	R3 000.00	R49 248 (including VAT)	R166 600	R222 248

Average cost per school

- **CAPEX:** R 103 000 (hardware at school) + R 140 000 (PoP) = **R 243 000 setup costs per school** (once off per hardware refresh). Please note however that the cost of setting up the PoP link depends on factors such as whether a link already exists, e.g. at a TVET, and which funding source is envisaged.
- **OPEX** per month: R 70 (last mile) + R 493 (TENET fee) + R 1666 (SANReN fee) = R2229 / month / school. SANReN has indicated that contributions to OPEX are negotiable, e.g. R 416/month.

Second Quote

A second pricing was obtained to compare to the costing estimate from CSIR to obtain an average. As the reader can see on the next page, the cost for a **single mast solution** with **one** school connected is quite low - in the region of **R 22 000**. However, that assumes that there is **one hop**, or a direct line of sight, to the nearby PoP. If two hops are involved, the price goes up to **R 180 000 per**

school, and after **three hops**, **R 350 000 per school**. Assuming an **average** of **two** hops per school, the costing will be **R 1.6 billion rands** for the remaining **8919** schools (36%). If most schools are within range of one hop, the cost will be as low as **R 196 million**. However, if most schools are three hops away from a PoP, then the cost will be closer to R 3.1 billion rands.

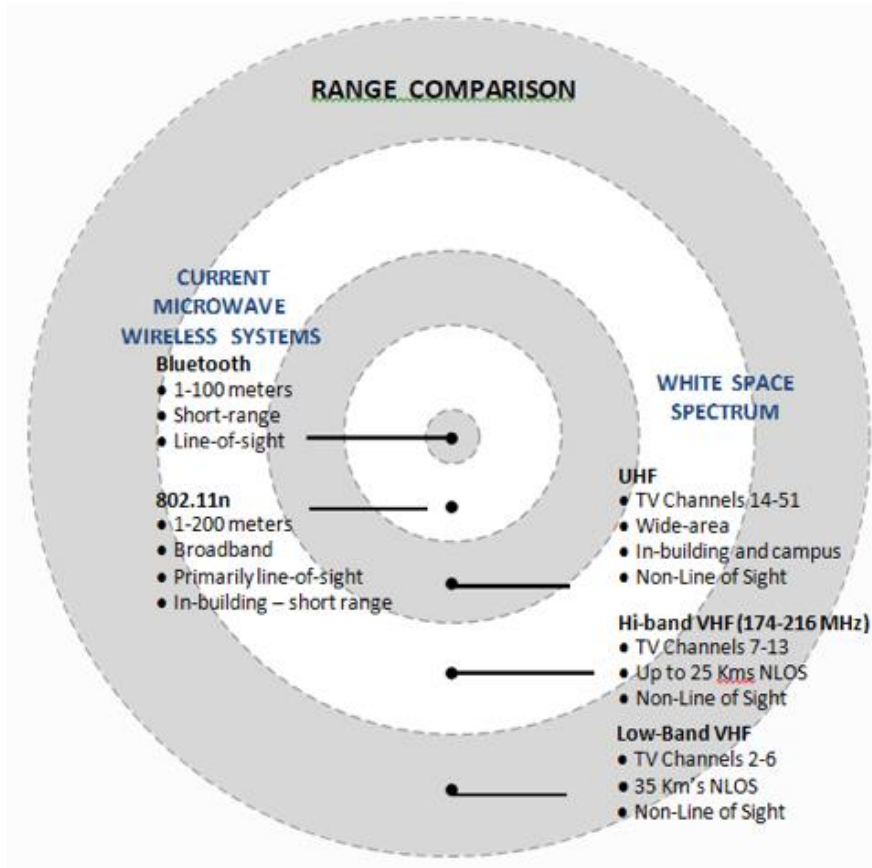
Total Number of Sites = 101	Single Hop Assumption	Double Hop Assumption	Triple Hop Assumption	12m Mast As-sumption for LOS	Wifi Ap's - 2 per site
Number of Sites per Solution	43	43	15	20	202
NRC Per Site	R 22 500,00	R 180 000,00	R 350 000,00	R 60 000,00	R 3 500,00
Monthlies per Month - MRC per Site	R 5 250,00	R 12 000,00	R 30 000,00		
Total NRC Per Solution	R 967 500,00	R 7 740 000,00	R 5 250 000,00	R 1 200 000,00	R 707 000,00
Total MRC Per Solution	R 225 750,00	R 516 000,00	R 450 000,00		
	Total	Per site			
Total NRC	R 15 864 500,00	R 157 074,26			
Total MRC	R 1 191 750,00	R 11 799,50			

- Single Hop = 1 x PTP link into backbone
- Double Hop = 2 x PTP link into backbone
- Triple Hop = 3 x PTP links into Backbone
- Prices exclude Backhaul from Tenet
- Prices Include Power at repeat sites based on licensed kit
- NRC = Once off install per site
- MRC = 36 month contractual term
- 12m mast - fully installed
- AP's fully installed based on 2 per site
- MRC includes Maintenance on kit
- MRC Costs include Spectrum / ICASA

Costing Estimate: TV White Space Last-mile

Introduction

TV White Space connectivity (TVWS) involves the creation of a mesh or grid of networked towers using television electromagnetic radiation. The advantage to TVWS technology is that it has great range — up to 130 km.



Meeting the relentless demand to expand and extend network connectivity into urban and rural environments is a continuing challenge, especially over long distances and difficult terrain. Utilising prime VHF and UHF TV band spectrum called “white space” provides a cost-effective approach to delivering backhaul and edge connectivity in challenging Non-Line Of Sight (NLOS) or treed paths.

A hub-and-spoke model would likely also be used, with a central school being the hub. However, as TVWS does not require LoS, this does not have to follow a strict geographical hub and spoke model as we see in the LoS microwave solution. The central hub would have a backhaul to a nearby PoP in the area.

What is White Space spectrum?

White Space technology uses:


- TV Channels in the 470 to 698 MHz range
- Channels are assigned by the CSIR under a testing license from ICASA
- Nearly 90% of South Africa has 30 MHz+ available

White space spectrum advantages

- Superior propagation characteristics over WiFi, microwave and cellular
- Goes further and penetrates deeper into buildings
- Superior penetration through vegetation and foliage
- Excellent NLoS abilities


Deployment configurations

VHF AND UHF FIXED ANTENNA OPTIONS




VHF Directional Antennas
174-220 MHz

VHF Directional
Gain: 10 dBi




UHF Directional Antennas
470-700 MHz


UHF Directional
Gain: 10.12 dBi




VHF Directional
Gain: 9.15 dBi



UHF Directional
Gain: 13.15 dBi



VHF Directional
Gain: 10.61 dBi



UHF Directional
Gain: 17.15 dBi

Optimum backhaul and broadband edge coverage and capacity performance is ultimately based on antenna performance.

We offers a wide selection of VHF and UHF antennas to meet specific requirements. In addition to the broadband directional antennas, sector and omni directional antennas are also available.

The systems allows mixing and matching of VHF and UHF to meet a wide range of requirements:

- Channel link aggregation for enhanced data through put and link reliability
- Rx (receive) diversity option which provides further throughput and link reliability
- Channel bonding allows traffic to be shared on two independent channels or even different bands (VHF and UHF)

Costing

The following cost estimates were derived from an informal costing exercise provided partially by CSIR and their partner vendors.

- A base station and the **first** school in a cluster will cost about **R 60 000**. That includes the base station, radio equipment at the school, Wi-Fi and caching server at the school.
- Approximately **R 27 000 per school** in a cluster other than the central hub school, including the above, if the feed off the same base station.
- Approximately 10 schools per base station with 15 Mbps per school (fewer schools = more speed)
- For backhaul we can use the base stations themselves to jump, or alternatively there might be fibre, microwave or we have access to satellite for extreme cases.
- The monthly fee will obviously depend on what backhaul one has to use and if the school requires a contended or uncontended service. We can assume about R1000 up to R6000 for uncontended backhaul. This excludes Internet break-out.

Costing Estimate for 36% of schools, based on current figures:

CAPEX

Item	Cost (item)	Total
1 x base station	55000	55000
20 x school equipment	20000	400000
effective per-school cost		22750
36% of schools	24775	8919
Cost for remaining schools	R	202 907 250

OPEX

Item	Cost (per month)	Total
Backhaul	1000	12000
Support	1000	12000
Land rental		0
OPEX per annum per school	R	24000

Item	Cost (per month)	Total
OPEX for 8919 schools per annum	R	214 056 000

Funds Sourcing

As per the recommendation of the ICT Advisory Council meeting of 8 June 2018, funds should be sourced by pooling available funds in various departments. Since schools typically will lie on the route between a Point of Presence and other governmental institutions such as clinics, police stations, and municipal offices, it is recommended that either

- a) National departments agree and collaborate to pool funds or;
- b) Provincial departments agree and collaborate to pool funds.

Once funds are gathered and pooled, the project can roll out to the extent that funds are available.

Rollout Plan

The following summary Rollout Plan assumes the availability of funding:

Activity	Approximate timeframe required	Responsibility
Identify funding source	2 months	DBE, NT
Pool funds	2 months	PEDs, DBE, NT, MECs
Create tender	1 month	DBE, NT
Identify service provider	1 month	DBE, NT
Appoint service provider / successful bidder	1 month	DBE, NT
Begin rollout		
1. Identify primary target districts including GIS mapping with telcos	1 month	DBE, CSIR, Telco / bidder
2. Prioritise areas with no connectivity; build infrastructure	6 months	Telco / bidder
3. Test solution	1 month	Telco / bidder
4. Develop dashboard to track uptime/accessibility of solution, so that when a site “goes down” it is known immediately	(solution exists, select one)	Telco / bidder
5. Deploy BI dashboard	1 month	Telco / bidder
6. Train DBE in accessing dashboard	1 month	Telco / bidder
Rollout complete		
Maintenance and Refresh	Ongoing	DBE, NT, Telco/bidder, PEDs

Appendix 1: Acronyms

AMESA	Association for Mathematics Education of South Africa
ANA	Annual National Assessments
ANSI	American National Standards Institute
AP	Access Point. A WiFi device.
APP	Annual Performance Plan
ASIDI	Accelerated Schools Infrastructure Delivery Initiative
ASS	Annual School Survey
ASSITEJ	International Association Theatre for Young People and Children
BAS	Basic Accounting System
BFR	Big Fast Result
BI	Business Intelligence
BO	Build, Operate
BOT	Build, Operate, Transfer
BYOD/T	Bring Your Own Device/Technology
CAD	Computer Aided Design
CAPS	Curriculum and Assessment Policy Statement
CAT	Computer Application Technology
CD	Compact disk
CEM	Council of Education Ministers
CEO	Chief Executive Officer
CMS	Content Management System
COBIT	Control Objectives for Information and Related Technology (COBIT): ICASA management framework.
COPs	Communities of Practice
CPD	Continuing Professional Development
CPTD	Continuing professional teacher development
CPU	Central Processing Unit
CR	Completion Rate
CSI	Corporate Social Investment
CSIR	Council for Scientific and Industrial Research
CSR	Corporate Social Responsibility

DAC	Department of Arts and Culture
DBE	Department of Basic Education
DD	Deputy Director
DDG	Deputy Director-General
DG	Director-General
DHA	Department of Home Affairs
DHET	Department of Higher Education and Training
DIET	District Institutes of Education and Training
Dir	Director/Directorate
DLP	Digital Light Processing
DoC	Department of Communications
DoH	Department of Health
DoT	Department of Transport
DPME	Department of Performance Monitoring and Evaluation
DPSA	Department of Public Service and Administration
DRC	District Resource Centre
DRDLR	Department of Rural Development and Land Reform
DRM	Digital Rights Management
DST	Department of Science and Technology
DTDC	District Teacher Development Centre
DTI	Department of Trade and Industry
DTPS	Department of Telecommunications and Postal Services
DTT	Digital Terrestrial Television
DVD	Digital Versatile Disk
e-Admin	Electronic Administration
e-ANA	Electronic Annual National Assessment
e-LTSM	Electronic Learning and Teaching Support Materials
ECA	Electronic Communications Act
ECD	Early Childhood Development
ECMA	European Computer Manufacturers Association
EFMS	Education Facility Management System
EGRA	Early Grade Reading Assessment

ELRC	Education Labour Relations Council
EMIS	Education Management Information System
EPMDS	Employee Performance Management and Development Systems
ePub	Electronic Publication, a type of container (XML + Zip). An e-Book.
ERP	Enterprise Resourcing Planning
ESR	Educator-School Ratio
ETDP	Education and Training Development Practises
FET	Further Education and Training
FOSS	Free and Open Source Software
Ft	Feet
GB	Gigabyte: 1 billion bytes
Gb	Gigabit: 1 billion bits (1 bit = one-eighth of a byte)
Gbps	Gigabits per second
GDE	Gauteng Department of Education
GER	Gross Enrolment Rate
GET	General Education and Training
GHS	General Household Survey
GITO	Government Information Technology Office
GTAC	Government Technical Advisory Centre
GUI	Graphical user interface
HDD	Hard disk drive
HDMI	High-Definition Multimedia Interface
HE	Higher Education
HEDCOM	Heads of Education Departments Committee
HEI	Higher Education Institution
HL	Home language
HO	Head Office
HoD	Head of Department
HR	Human Resources
HSPA	High Speed Packet Access
HSRC	Human Sciences Research Council
HTML	Hypertext mark-up language

ICASA	Independent Communications Authority of South Africa
ICT	Information and Communication Technology
IEB	Independent Examinations Board
IIAL	Incremental Introduction of African Languages
IP	Internet Protocol
IP5	Forum of the five largest intellectual property offices in the world
IQMS	Integrated Quality Management System
ISO	International Standardisation Organisation
ISP	Internet Service Provider
ISPA	South African Internet Service Providers Association
ISPFTED	Integrated Strategic Planning Framework for Teacher Education and Development
IT	Information Technology
KPI System	Key Performance Indicator System
LAN	Local Area Network
LCD	Liquid Crystal Display
LER	Learner-Educator Ratio
Linux	A free/open source operating system
LMS	Learning Management System
LTSEN	Learners with Special Education Needs
LSM	Learner Support Material
LSR	Learner-School Ratio
LTE	Long-Term Evolution
LTSM	Learning and Teaching Support Materials (e-LTSM: electronic LTSM)
LURITS	Learner Unit Record Information and Tracking System
M&E	Monitoring and Evaluation
Mbps	Megabits per second
Mb	Megabit (1 million bits)
MB	Megabyte (1 million bytes)
MCQ	Multiple Choice Questions/Questionnaire
MEC	Member of the Executive Council
MFP	Multi-function printer
MIOS	Minimum Interoperability Standards

MISS	Minimum Information Security Standards
MOOC	Massive Online Open Course
MoU	Memorandum of Understanding
MS	Microsoft
MSDF	Michael and Susan Dell foundation
MST	Mathematics, science and technology
MTEF	Medium Term Expenditure Framework
MTSF	Medium Term Strategic Framework
NACTU	National Council of Trade Unions
NAEP	National Assessment of Educational Progress
NSC	National Senior Certificate
NCS	National Curriculum Statement
NDP	National Development Plan
NECT	National Education Collaboration Trust
NEEDU	National Education Evaluation and Development Unit
NEIMS	National Education Infrastructure Management System
NEPAD	New Partnership for Africa's Development
NER	Nett Enrolment Rate
NGO	Non-governmental organisation
NICPD	National Institute for Curriculum Professional Development
NQF	National Qualifications Framework
NSC	National Senior Certificate
NSFAS	National Student Financial Aid Scheme
NSLA	National Strategy for Learner Attainment
NSNP	National School Nutrition Programme
NT	National Treasury
OA	Open Access
ODF	Open Document Format
OEM	Original Equipment Manufacturer
OER	Open Educational Resource(s)
OLED	Organic Light Emitting Diode
OS	Operating System

OSS	Open Source Software
PAIA	Protection of Information Act
PANSALB	Pan South African Language Board
PC	Personal Computer
PCI	Peripheral Component Interconnect
PD	Pure Data
PDF	Portable Document Format (Adobe Acrobat document)
PDP	Professional Development Portfolio
PED	Provincial Education Department
PERSAL	PERsonnel and SALary Information System
PFMA	Public Finance Management Act
PIRLS	Progress in Reading and Literacy Study
PLC	Programmable Logic Controller / Professional Learning Community
PLN	Professional Learning Network
PMO/PMU	Project Management Office / Unit
PoC	Proof of Concept
PoP	Point of Presence
PPN	Post-Provisioning Norms
PPP	Public-Private Partnership
PR	Promotion Rate
PSA	Public Service Act
PTD	Professional Teacher Development
PTDI	Provincial Teacher Development Institute
PTEDC	Provincial Teacher Education Development Committee
QA	Quality Assurance
QoS	Quality of Service; how traffic is prioritised
R&D	Research and Development
RAM	Random Access Memory
RFB	Request for Bid
RSA	Republic of South Africa
SA-SAMS	South African Schools Administration and Management System
SaaS	Software as a Service

SAASTA	South African Agency for Science and Technology Advancement
SACE	South African Council of Educators
SACMEQ	Southern and Eastern Africa Consortium for Monitoring Educational Quality
SADTU	South African Democratic Teacher Union
SAICA	South African Institute of Chartered Accountants
SAMR	Substitution, Augmentation, Modification, and Redefinition
SANReN	South African National Research and Education Network
SAQA	South African Qualifications Authority
SASA	South African Schools Act
SA-SAMS	South African School Administration and Management System
SETA	Sector Education and Training Authorities
SGB	School Governing Body
SIP	Strategic Infrastructure Projects
SITA	State Information Technology Agency
SLA	Service Level Agreement
SME/SMME	Small to Medium Enterprise, Small, Medium and Micro Enterprise
SMM	Senior Management Meeting
SMS	School Monitoring Survey / Short Messaging Service / Seat Management Services (RFT 285)
SMT	School Management Team
Stats SA	Statistics South Africa
TB	Terabyte
TCO	Total Cost of Ownership
TCP/IP	Transmission control protocol/internet protocol
TD	Teacher Development
TECH4RED	Technology for Rural Education
TENET	Tertiary Education and Research Network of South Africa
Thutong	National Education Portal
TIMSS	Trends in Mathematics and Science Studies
TLI	Teacher Laptop Initiative
ToR	Terms of Reference
TPACK	Technical, Pedagogical and Content Knowledge
TPD	Technical Procedure Development

TR	Transition Rate
UFSICTISE	University of the Free State ICT Innovation in School Education
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UPS	Uninterruptible Power Supply
URS	User Requirement Specification
USAASA	Universal Service and Access Agency of South Africa
USAF	Universal Services Access Fund
USAO/USO	Universal Service and Access Obligations
USB	Universal serial bus
VAT	Value-Added Tax
VLE/S	Virtual Learning Environment/Solution
VoIP	Voice over IP; Internet-based telephony
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal; satellite connectivity
WAN	Wide Area Network
WCED	Western Cape Education Department
WCG	Western Cape Government
WEF	World Economic Forum
WiFi	Wireless Fidelity, Wireless Internet

Appendix 2: Legislative Alignments

South African ICT Policy Environment		
Date and Publication	Document Full Title	Document Short Title, as referred to
1996, Act 108 of the Republic of South Africa	The Constitution of the Republic of South Africa	The Constitution
1996, Act 84 of the Republic of South Africa	South African Schools Act	Schools Act
2001, DBE	Strategy for Information Technology in Education	SITE
2001, National Treasury Republic of South Africa, April	Treasury Regulations for departments, constitutional institutions and public entities, Issued in terms of the Public Finance Management Act, 1999	Treasury Regulations
2004 (Government Gazette, 26734 of Aug. 2004)	White Paper on e-Education: Transforming Teaching and Learning through ICT	White Paper on e-Education (2004)
2005, 29 April, Memorandum by Hanlie Smit, Treasury	Minimum requirements for an Asset Register	Minimum requirements for an Asset Register
Treasury (no date cited)	Asset Management Learner's Guide	Asset Management Learner's Guide
Government Gazette Vol. 449 No. 38 of 7 November 2002	State Information Technology Agency Act as Amended	SITA Act
2006, DBE	Guidelines for the Use of Open Source Software in Schools of Feb 2006	FOSS Guidelines
August 2006, Department of Public Service & Administration	Policy on Free and Open Source Software Use for South African Government	FOSS Policy Document
September 2007, Department of Public Service & Administration	Minimum Interoperability Standards (MIOS) for Information Systems in Government	Government MIOS Policy
April 2008, SITA/Department of Public Service & Administration	Flight Plan: Free Open Source Software (FOSS) Deployment in the South African Government	SITA FOSS Flight Plan
2012/2013, DPSA, not yet public, derived from ISO 27002	Minimum Information Security Standards (MISS)	MISS
2008, Government Gazette, No. 31291 of 1 August 2008, DoC	Draft regulations on E-rate	E-rate Regulations
2009, Vol. 527, 8 May 2009, No. 32207	Employment of Educators Act, 1998: Teacher laptop initiative.	Original TLI Initiative
2010, Government Gazette 33059 of 1 April	Public Finance Management Act No. 1 of 1999 as amended	PFMA

South African ICT Policy Environment		
Date and Publication	Document Full Title	Document Short Title, as referred to
2011, DBE/DHET	Integrated Strategic Planning Framework for Teacher Education and Development in South Africa 2011–2025 Technical Report	ISPFTED
2015, DBE	Action Plan to 2019: Towards the Realisation of Schooling 2030	Action Plan
2012, DBE	The Guidelines Relating to Planning for Public School Infrastructure	School Planning Guidelines
2012, National Planning Commission, Presidency	National Development Plan – Vision for 2030: Chapter 9	NDP
2013, Government Gazette, No. 277/36359 of 10 April 2013, DoC/DBE	Outline of the ICT Policy Review Process	Government Gazette
Government Gazette, No. 582/37119, of 6 December 2013, DoC	South Africa Connect: Creating Opportunities, Ensuring Inclusion — South Africa's Broadband Policy	DoC Broadband Policy
Government Gazette, No. 37119, 6 December 2013	National Broadband Policy	NBP
Government Gazette, No. 37718, 4 June 2014	Electronic Communications Act's Universal Service Obligations for service providers	USO

1. The Action Plan to 2019: Towards the realisation of Schooling 2030

- *Goal 16.* Improve the professionalism, teaching skills, subject knowledge and computer literacy of teachers throughout their entire careers.
- *Goal 20.* Increase access amongst learners to a wide range of media, including computers, which enrich their education.
- *Goal 21.* Ensure that the basic annual management processes take place across all schools in the country in a way that contributes towards a functional school environment.
- *Goal 27.* Improve the frequency and quality of the monitoring and support services provided to schools by district offices, partly through better use of e-Education.
- *Goal 24.* Ensure that the physical infrastructure and environment of every school inspire learners to want to come to school and learn, and teachers to teach.
- *Goal 22.* Improve parent and community participation in the governance of schools, partly by improving access to important information via the e-Education strategy.

2. The White Paper 7 of 2004

- ICT professional development (White Paper, p25)
- e-Content Distribution (White Paper, p27) e.g. through national connectivity (White Paper, p29) and by having a DBE of Basic Education portal (White Paper, p28)
- Access to ICTs (White Paper, p22, p29)
- Community and Engagement (White Paper, p32) e.g. through Community-based SMMEs (White Paper, p33) so as to enhance equity (White Paper, p22) and capacity building (White Paper, p22)
- Research and Development (White Paper, p33)
- Assessment, Monitoring, Evaluation, Administration and Management (White Paper, p38,p29).

3. The NDP (15 August 2012)

- The NDP states that schools which lack infrastructure, such as ICTs, are to be prioritised for upgrades (NDP, p313), which is the given mandate of the DBE, including also:
- Broad-based access to education, training and skills development opportunities;
- Equity and redress of inherited inequities in provision and associated outcomes;
- Quality and effectiveness of education, training and skills development;
- Functional relevance of an electronic teaching and learning environment;
- Efficiency of provision, management and usage of elements of an electronic teaching and learning environment.
- Distance education using ICT, so as to expand learning opportunities for both teachers and learners (Action Plan Goal 16, also NDP, p295, p320). Learners are to have access to computer facilities at school (Action Plan Goal 20, NDP, p303) or educational material accessible via all devices, e.g. laptops, desktop computers, tablets and smartphones (Action Plan Goal 19, NDP, p304). Learners are to use laboratories or mobile devices to access e-LTSM, so as to help teachers better deliver learning and conduct assessments (NDP, p307);
- Teachers are trained, and given recognition for their work (NDP, p303);
- Learners should have the opportunity to learn in their home languages (NDP, p304).

4. MTSF alignment

[B]old and decisive steps to place the economy on a qualitatively different path that eliminates poverty, creates jobs and sustainable livelihoods, and substantially reduces inequality. (MTSF, p4)

The 2014-2019 electoral mandate focuses on the following priorities:

- Radical economic transformation, rapid economic growth and job creation
- Improving the quality of and expanding access to education and training (MTSF, p6)

An additional priority is to expand, modernise and increase the affordability and accessibility of information and communications infrastructure and electronic communication services, including

broadband and digital broadcasting. The work of all the state-owned information technology agencies will be aligned towards these objectives. (MTSF, p7)

Government will continue with the steps that have been initiated to improve the quality of education. This includes ... a focus on upgrading school infrastructure to meet the new norms and standards. (MTSF, p9)

Government has recently started to implement Operation Phakisa, based on the Malaysian “Big Fast Results” methodology... These will contain key indicators and targets from the MTSF. (MTSF, pp14-15)

Assurance that every learner has access to the required textbooks in every learning area and grade (MTSF, pp16-17)

An increase in broadband penetration from 33.7% in 2013 to 80% in 2019 ... including digital broadcasting. (MTSF, pp24-25)

The broadcast media, especially the national broadcaster, will air programmes that popularise narratives and visions of a non-sexist, non-racial, equal and democratic South Africa. (MTSF, p36)

Information technology (IT) is an important tool for improving service delivery. For example, IT can be used to make services more accessible, reduce the cost of accessing services, streamline administrative processes and improve turnaround times, and strengthen accountability and responsiveness. (MTSF, p33)