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Implementation Plan

Community Wireless Network

Nabweru Telecentre



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Version 1.0
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1. Introduction

This document provides an implementation plan (v. 1.0) for the Community Wireless Network of Nabweru Telecentre, Uganda.

The plan includes detailed specification of hardware needed for each of the partner sites of the network. Additionally, practical advices for each installation are provided. For each site, a *Comments* section highlights what important issues that require special attention.

2. Nabweru Telecentre (TC)

The Nabweru Telecentre will constitute the hub of the network and act as a Wireless ISP. Currently, the Telecentre is equipped with a wireless connection from Bushnet of **xxx** kbps for 250 USD per month. Due to high connectivity cost, the Internet connection has been down the last half a year or so.

The main source of power at the Telecentre is the national power grid. Load shedding are done every second day in the area. As a power backup, a single phase generator of 5 kVA is used. The generator consumes 10l diesel per 6 hours. Due to the high cost of operation, the generator is not run at all power cuts.

There is a small mast of approx. 10m on the compound of the Telecentre. It is owned and used by the radio station of the Telecentre. Oral permission has been given to use the mast for the wireless network.

As an alternative to the mast, since it is quite low and already occupied with equipment for the radio station, one of the surrounding building to the Telecentre could be used as the wireless hub. The Sub-county Office building, which is located only 40m from the Telecentre and is at least 5-6 m tall, could be suitable. A wall mounted pole could host the wireless equipment and reach the same height as the radio mast.

However, the budget specified in this document will be based on the assumption that the wireless equipment will be mounted in the mast on the compound of the Telecentre. If there is a reason to change the location, only minor changes to the implementation plan are needed.

Hardware specification

Location of radio	At the top of the mast
Mounting equipment	L-bracket with hose clamps
Radio unit	WPP54AG (Outdoor, Compex), RP-SMA female
Antenna	1 x Omni-directional, 12 dBi, N-female
RF cable	Connectors: RP-SMA male / N-male
	Length: 1 m
PVC Conduct	20 m
Network cable	20 m

Comments

- 1) Ensure access to the mast by contacting the radio station and set up a MoU.
- 2) Make sure that the wireless equipment will be hooked on to the generator.

3. Sub-county Office (SCO-1)

The (old) Sub-county Office will be connected to the Telecentre via Ethernet cabling. The distance between the both sites is less than 100m with no obstructions like other buildings or tarmac roads.

The Ethernet cable should be protected with a plastic conduct (PVC or similar) and be dug down to a depth of at least 50 cm assuming that the trench will not be trafficked by heavy loads.

When digging a trench of this scale, it is normal procedure to put more capacity than what is needed for the moment as the cable itself is relatively cheap compared to making another trench. Also, this practice is good in terms of redundancy. If one cable fails, you have two more chances. For these reasons, three Ethernet cables will be put in each conduct.

Each individual PCV pipe needs to be clued together with its surrounding pipes to avoid that water leaks in or that insects/animals enter the pipe. Rats and termites are common enemies to any type of cables. Additionally, water that leaks into the PCV tube can lead to that roots from trees and bushes enter and eventually break the pipe as they grow.

Hardware specification

Network cable	3 x 70 m
PCV conduct	50 m

Comments

- 1) It should be estimated which alternative (wireless vs Ethernet) is most cost efficient for this site. See section Way Forward for more information.

4. New Sub-county Office (SCO-2)

The New Sub-country Office is located just a few meters from the old sub-county office. The new building will be connected via Ethernet cable from the old building.

Hardware specification

Network cable	3 x 30 m
PCV conduct	10 m

5. Crown High School (CHS)

Crown High School is located 350m from the Telecentre with no line-of-sight (from the ground) due to thick vegetation. However, the school's building is at least 6m high. Mounting the wireless equipment on the roof, alternatively on the balcony on the second floor (4m) could be sufficient.

Hardware specification

Location of radio	Rooftop /balcony
Mounting equipment	Pole: 5 m
	Brackets: TBD
Radio unit	WP54G (Indoor, Compex), RP-SMA female
Antenna	Panel, 9 dBi, SMA-female (alternatively Panel, 12dBi, N-female)
RF cable	Connectors: RP-SMA male / SMA male
	Length: 7 m
Network cable	3 m
Surge protection	Yes

Comments

- 1) The exact location of the mast and how it should be mounted must be decided. The length of the radio cable will depend on the decision.

6. Nabweru Magistrate Court (NMC)

The Nabweru Magisterial Court is located 130m from the main hub of the network with a clear line of sight to the Telecentre.

The site will be connected by means of wireless technology using an (indoor) access point equipped with an external sectoral panel antenna (65 degrees).

Hardware specification

Location of radio	TBD
Mounting equipment	Pole: 2,5 m
	Brackets: Wall mounted
Radio unit	WP54G (indoor, Compex), RP-SMA female
Antenna	Panel, 9 dBi, SMA-female
RF cable	Connectors: RP-SMA male/ SMA-male
	Length: 5 m
Network cable	3 m
Surge protection	Yes

Comments

- 1) Decide exact location of installation and specify requirements of mounting brackets, RF cable length and pole.

7. Nabweru Parents School (NPS)

The Nabweru Parents School is located about 500m from the Telecentre. There is no line-of-sight between the Telecentre and the site due to thick vegetation and building blocks.

In order to connect this site to the wireless network, a small mast of 10-15m would be required.

Due to the fact that the school currently do not possess any computers and their interest in joining the wireless network is perceived as quite low, the Nabweru Parents School will not be included in the first implementation plan. If their situation changes during the project time, they can join the network at a later stage.

8. Network systems

The network will be built on two different network “systems”; a central hub and a set of wireless clients.

8.1 Central hub

The central hub of the network will be located at the Telecentre's compound. An omnidirectional antenna with a gain of 12 dBi will be mounted in the radio mast.

Transmitted power (T_x)	20 dBm
Antenna	Omnidirectional, 12 dBi
Height	10 m
RF cable	0,22 dB/m, 1 m
Receiving sensibility	-95 dBm
Total line loss	1 dB

Table 1: Technical specification of the central hub.

8.2 Wireless Client

The following sites will act as wireless clients: Crown High School and Nabweru Magisterial Court.

As mentioned earlier, the new and old Sub-county Offices will be connected via Ethernet cable, not by wireless.

Transmitted power (T_x)	19 dBm (IEEE 802.11g)
Antenna	Panel antenna, 9 dBi
Height	5 m
RF cable	0,52 dB/m, 1 m
Receiving sensibility	-95 dBm
Total line loss	4 dB

Table 2: Technical specification of a wireless client.

9. Network topology

An omni-directional antenna placed in the central tower at Nabweru Telecentre will provide toroidal coverage to its surrounding partners. Due to the short distance between the Telecentre and the two Sub-county Offices, they will be connected via Ethernet cable instead of wireless communication.

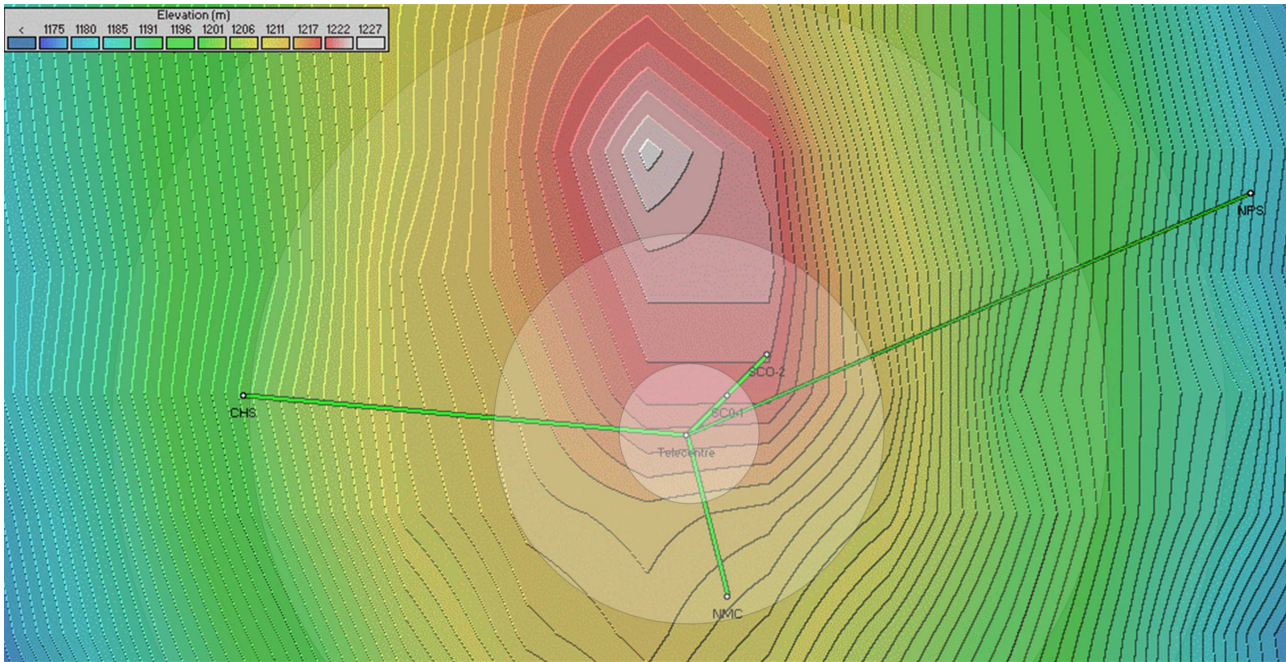


Image 1: Network topology of the Wireless network of Nabweru.

Site 1	Site 2	Distance [m]	Fresnel zone [5m]	Fresnel zone [10m]
Telecentre	SCO-1	40	6	
Telecentre	SCO-2	90	4,2	
Telecentre	Crown High School	340	0,7*	1,7
Telecentre	Nabweru Magisterial Court	130	3,8	
Telecentre	NPC	470	0,3*	0,7*

Table 3: The table shows the distance of each link in the network and the worst Fresnel zones for a client height of 5 respectively 10m.

* A clear Fresnel zone of at least 1.0 is required for a functional link. The sites with lower values than 1.0 will require a higher mast.

10. Hardware budget

Equipment	Specification	TC	SCO-1	SCO-2	CHS	NMC	Total
WPP54AG	Outdoor, Compex	1					1
WP54G	Indoor, Compex				1	1	2
RF cable, 1m	RP-SMA male/N-male	1					1
RF cable, 7m	RP-SMA male/SMA-male				1		1
RF cable, 5m	RP-SMA male/SMA-male					1	1
Antenna, omni, 12 dBi	N-female	1					1
Antenna, panel, 9 dBi	SMA female				1	1	2
Mounting pole	5m				1		1
Mounting pole	2,5m					1	1
Mounting pole	1m						
Brackets	L-brackets	1					
Brackets	hose clamps	4			1	1	6
Brackets	wall mount				1	1	2
Surge arrestor		1			1	1	3
UPS	400 VA	1	1	1	1	1	5
8-port switch	Compex			1	1	1	3
8-port switch	Other brand	1	1				2
Cat 5e cable [m]		20	210	90	3	3	326
PCV conduct [m]		30	50	10			90

Table 4: The table shows an estimated hardware budget for the Nabweru Wireless network. The fields marked in yellow specifies equipment that should be procured locally in Uganda. The grey fields shows equipment that will be procured in Sweden and shipped to Uganda.

11. Way Forward

Although a oral permission has been given to use the mast of the radio station, a written approval (MoU) must be stated.

Since there is some doubt whether the existing mast at the Telecentre will do the job, a test link could be set up between the mast and one of the wireless partners of the network. This activity would be suitable to carry out while the CWRC is awaiting the delivery of technical equipment from Sweden. The existing wireless equipment at CWRC would be sufficient for the task.

If it is found that the mast is a good location for the wireless hub, it should be investigated what kind of mounting equipment is needed for mounting the access point and the external omni directional antenna to the mast.

The Nabweru network includes two Ethernet cabled partners. Although Ethernet cable itself is cheap, the total cost of such an installation with protecting PVC pipes and digging of trenches will raise the cost substantially. We encourage the CWRC to make a comparison between connecting a site with standard wireless client equipment compared to connecting it with Ethernet cable. At what distance is the financial break point when it is cheaper to do wireless than Ethernet cable?