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Implementation Plan

Community Wireless Network

Nabweru Telecentre



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Version 1.1
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1. Introduction

This document provides an implementation plan (v. 1.1) 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.

Change log version 1.1

- The sub-county offices will be connected via wireless instead of Ethernet due to the obstacle of a major road between the sites and the fact that maintenance work in ongoing in the area.

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 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

System unit	Central hub
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
Network cable	30 m (outdoor)

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 is located only 50m away from the Telecentre with clear line of sight. Although Ethernet cable would be a feasible option, the site will be connected by means of a wireless client. Due to an obstacle in form of a major road between the sites and the fact that maintenance work is ongoing in the area, using wireless communication will be more suitable in this case.

Hardware specification

System unit	Wireless outdoor client
Location of radio	TBD
Mounting equipment	Pole: 5 m
	Brackets: TBD
Radio unit	WPP54AG-6C (Outdoor, Compex)
Antenna	Internal, 8.5 dBi
Network cable	20 m (outdoor)

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

The New Sub-county 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

System unit	Ethernet client
Network cable	3 x 30 m (indoor)
PCV conduits	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

System unit	Wireless indoor client
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 (indoor)

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

System unit	Wireless indoor client
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 (indoor)

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 three different network “systems”:

1. Central Hub
2. Wireless Indoor Client
3. Wireless Outdoor Client
4. Ethernet Client

8.1 Central hub

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

A surge arrestor will be placed between the antenna and the RF cable to protect the radio from indirect lightning strikes.

Unit	WPP54AG (Compex)
Antenna	Omni directional, 12 dBi
Transmitted power (Tx)	20 dBm (IEEE 802.11g)
Receiving sensibility	-92 dBm @ 6 Mbps
Max. total line loss	1 dB
Height	5 m
Surge arrestor	Yes

Table 1: Technical specification of the central hub.

8.2 Wireless Indoor Client

The wireless Indoor Client will use a radio with an external sectoral antenna of 9 dBi. The antenna will be equipped with a surge arrestor to protect the radio from indirect lightning strikes.

Unit	WP54G (Compex)
Antenna	9 dBi, sectoral 65° (external)
Transmitted power (Tx)	19 dBm (IEEE 802.11g)
Receiving sensibility	-95 dBm
RF cable	0,52 dB/m, 1 m
Max. total line loss	4,5 dB
Height	5 m
Surge arrestor	Yes (SMA-male, SMA-female)

Table 2: Technical specification of the Wireless Indoor Client.

8.3 Wireless Outdoor Client

The wireless outdoor client will use a radio with an internal sectoral antenna of 8.5 dBi.

Unit	WPP54AG-6C (Compex)
Antenna	8.5 dBi, sectoral 65° (internal)
Transmitted power (T _x)	19 dBm (IEEE 802.11g)
Receiving sensibility	-95 dBm
Height	5 m
Surge arrestor	No

Table 3: Technical specification of the Wireless Outdoor Client.

8.4 Ethernet client

The Ethernet cable should be dig down in trenches and be protected with PCV conduits. For redundancy purposes, three Ethernet cables should be places in each PCV conduits.

Ethernet	Cat5e
Protection	PVC conduits

Table 4: Technical specification of the Ethernet client unit.

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 both Sub-county Offices, they will be interconnected via Ethernet cable instead of wireless communication.

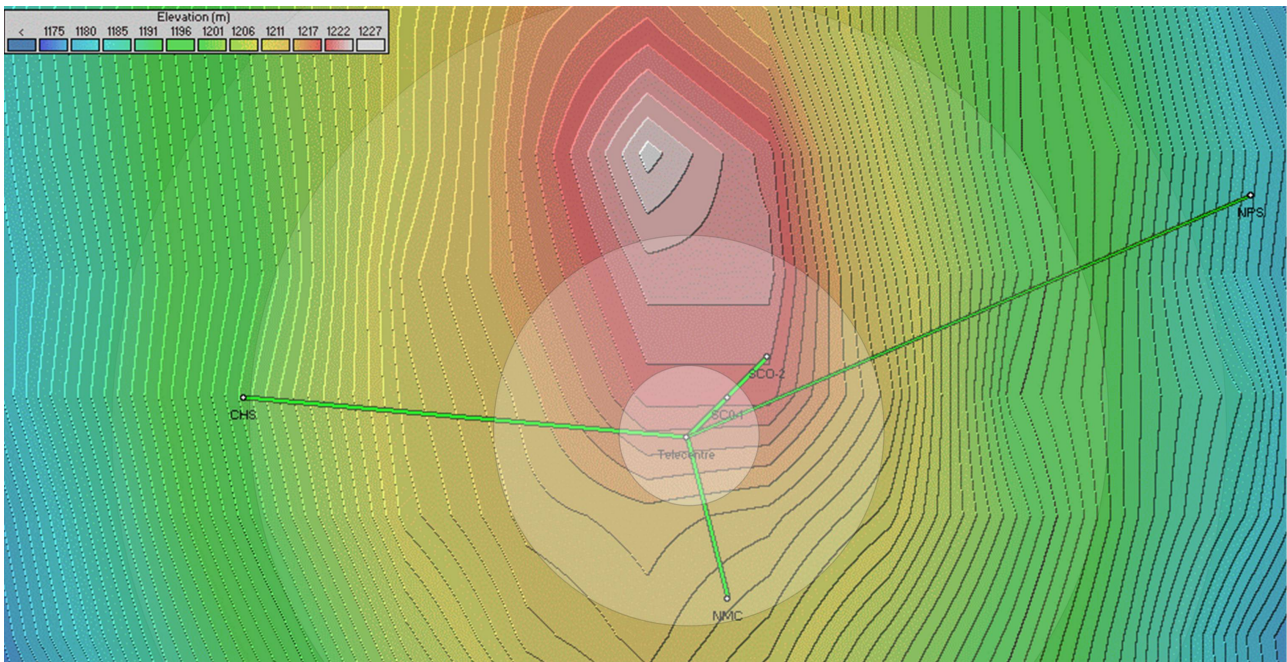


Image 1: Network topology of the Wireless network of Nabweru.

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

Table 4: 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.

** NPC is not included in the budget.

10. Hardware budget

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.

Equipment	Specification	TC	SCO-1	SCO-2	CHS	NMC	Total	Price
AirPoint NEXUS PRO TOTAL	Outdoor, SmartBridges							
WPP54AG 8.5 dBi	Outdoor, Compex		1				1	305
WPP54AG, no antenna	Outdoor, Compex	1					1	283
WP54G	Indoor, Compex				1	1	2	196
RF cable, 1m	N-male N-male							
RF cable, 1m	RP-SMA male/N-male	1					1	30
RF cable, 7m	RP-SMA male/SMA-male				1		1	50
RF cable, 5m	RP-SMA male/SMA-male					1	1	40
Antenna, omni, 12 dBi	N-female	1					1	125
Antenna, panel, 9 dBi	SMA female				1	1	2	102
Surge arrestor (panel 9dBi)	SMA-male SMA-female				1	1	2	30
Surge arrestor (omni 12 dBi)	N-male N-female	1					1	15
8-port switch	Compex			1	1	1	3	81
8-port switch	Other brand	1	1				2	179
Mounting pole	5m		1		1		2	60
Mounting pole	2,5m					1	1	15
Mounting pole	1m							
Brackets	L-brackets	1	1				2	20
Brackets	hose clamps	4	2		1	1	8	4
Brackets	wall mount		1		1	1	3	30
UPS	400 VA	1	1	1	1	1	5	1,100
Cat 5e indoors [m]				90	3	3	96	80
Cat 5e outdoors [m]		30	20				50	75
PCV conduct [m]				10			10	25

Total: 2,845

Table 5: The table shows an estimated hardware budget for the Nabweru Wireless network.

11. The 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.