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Implementation Plan

Community Wireless Network

CPAR Telecentre, Lira



Source: Okwany Robinson, CWRC

Version 1.0
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1. Introduction

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

The plan includes a 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 *Comment* section highlights what important issues that require special attention.

2. CPAR Telecentre

The CPAR Telecentre will constitute the hub of the network. Currently, the Telecentre is equipped with a wireless connection from Bushnet providing 64 kbps for 250 USD per month.

The Telecentre mail source of energy is the national grid. For power backup, a solar system has been installed.

There is a 20m tall mast raised on the compound of the Telecentre. The mast, which actually is just a smooth metallic pole, is difficult to access. On the compound of the Telecentre exists also a water tower. This structure would be suitable to host the wireless equipment as it is tall and easy accessible.

The wireless hub will be equipped with an outdoor access point (Compex) that supports PoE (Power over Ethernet). An external omni-directional antenna will be connected to the access point which will provide coverage to its surrounding partners.

Hardware specification

System unit	Central hub
Location of radio	In the top of the water tank behind the CPAR Telecentre
Mounting equipment	Pole: 5 m
Radio unit	WPP54AG (Outdoor, Compex), RP-SMA female
Antenna	Omni-directional, 12 dBi, N-female
RF cable	Connectors: RP-SMA male / N-male
	Length: 1 m
PVC Conduct	15 m
Network cable	50 m

Comments

- 1) Find appropriate structure to mount the access point and the omni antenna in the water tank.

3. NUSAF District offices

The NUSAF District offices is located less than 100m from the Telecentre with clear line of sight to the water tank. NUSAF is already connected to the Telecentre via Ethernet cable but due to bad isolation of the cable, it has suffered damage from hungry termites.

Since the site is just in the limit of what Ethernet cabling can reach, we suggest that wireless technology should be used instead of Ethernet.

The site will be equipped with an indoor access point with an external sectoral panel antenna (9,dBi, 65 degrees).

Hardware specification

System unit	Wireless indoor client
Location of radio	In the room next to the Accountant's office
Mounting equipment	Pole: 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: 7 m
Network cable	3 m

4. CCE (Makerere Institute of Adult and Continuing education)

CCE is located approximately 60 m from the Telecentre with clear line of sight to the water tank. Due to its proximity to the Telecentre and the fact that there are no obstructions like other buildings or tarmac roads between the buildings, it will be connected by means of Ethernet cable.

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

System unit	Ethernet client
Network cable	3 x 100 m
PCV conduct	70 m

5. NAADS Office

The NAADS office is located approx. 90 m from the Telecentre. The line-of-sight is obstructed with a thick fence of vegetation.

Due to its proximity to the Telecentre (90m) and CCE (30m), the site can easily be connected with Ethernet cable. It is suggested to dig another cable from CCE which already will be connected to the Telecentre via Ethernet.

Hardware specification

System unit	Ethernet client
Network cable	3 x 50 m
PCV conduct	30 m

6. Network systems

The wireless network will be built on three different network systems units:

1. Central hub
2. Wireless indoor client
3. Ethernet client

6.1 Central hub

The central hub of the network will be at the water tank at the CPAR Telecentre. It will be equipped with an omni directional antenna with a gain of 12 dBi.

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

Unit	WPP54AG (Compex)
Antenna	Omni directional, 12 dBi
Transmitted power (T _x)	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.

6.2 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 lightening strikes.

Unit	WP54G (Compex)
Antenna	9 dBi, sectoral 65° (external)
Transmitted power (T _x)	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 indoor wireless client unit.

6.3 Ethernet client

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

Ethernet	Cat5e
Protection	PVC conduct

Table 3: Technical specification of the Ethernet client unit.

7. Network topology

At the moment, the network only has three clients, 1 wireless and 2 cabled. Installing a omni directional antenna in the central hub will facilitate the process of connecting more partners in a later stage as coverage will be provided in all directions.

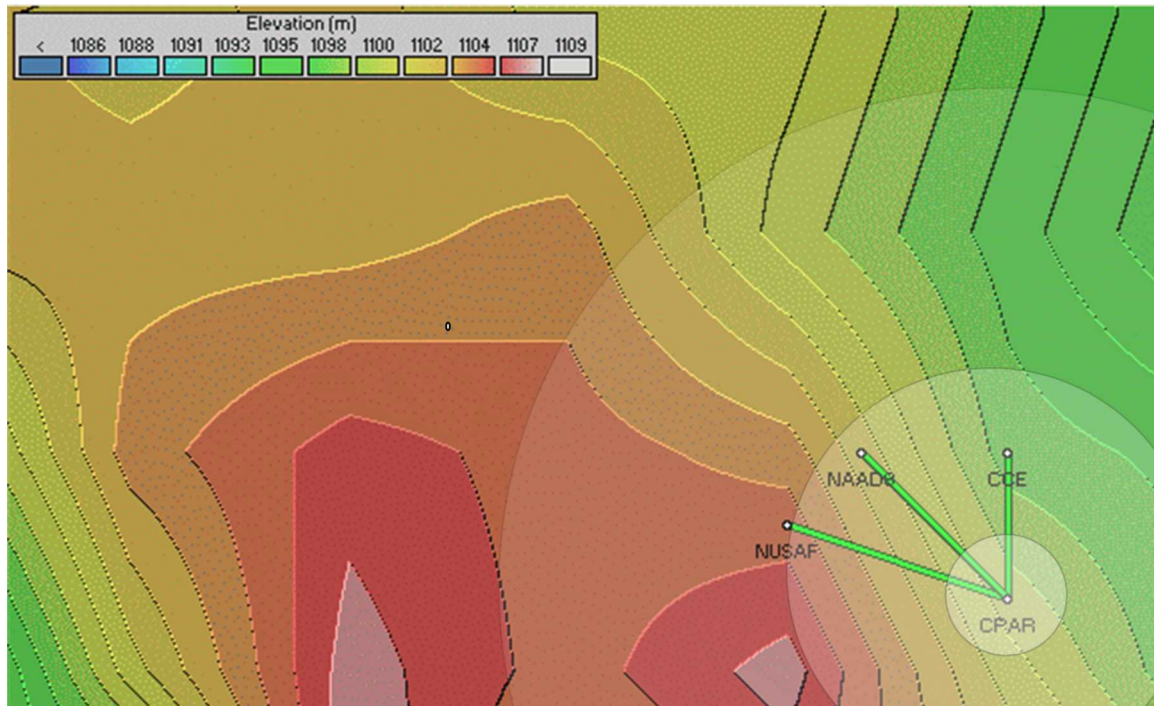


Image 1: Network topology of the Wireless network of CPAR Lira. An omni-directional antenna placed in the water tank at the Telecentre will provide toroidal coverage to its surrounding partners.

Site 1	Site 2	Distance [m]	Fresnel zone [5m]	Fresnel zone [10m]	System unit
CPAR	NUSAF	100	0,9*	1,4	CLIENT-IN
CPAR	CCE	60	1,2	1,8	ETHERNET
CPAR	NAADS	90	1,0	1,5	ETHERNET

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.

8. Hardware Budget

The table below shows an estimated hardware budget for the CPAR Lira 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.

Equipment	Specification	CPAR	NUSAF	CCE	NAADS	Total
WPP54AG 8.5 dBi	Outdoor, Compex					
WPP54AG, no antenna	Outdoor, Compex	1				1
WP54G	Indoor, Compex		1			1
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					
Antenna, omni, 12 dBi	N-female	1				1
Antenna, panel, 9 dBi	SMA female		1			1
Mounting pole	5m	1	1			2
Mounting pole	2,5m					
Mounting pole	1m					
Brackets	L-brackets					
Brackets	hose clamps	4	4			8
Brackets	wall mount		1			1
Surge arrestor (panel 9dBi)	SMA-male SMA-female		1			1
Surge arrestor (omni 12 dBi)	N-male SMA-female	1				1
UPS	400 VA	1	1	1	1	4
8-port switch	Compex		1		1	2
8-port switch	Other brand	1		1		2
Cat 5e cable [m]		30	3	300	150	483
PCV conduct [m]		12		70	30	112

Table 5: Hardware budget for the CPAR Lira Wireless Network.

9. The way forward

Most of the work related to the network in Lira is digging down Ethernet cable in a proper way. This work can be initiated while the CWRC are awaiting the delivery of technical equipment from Sweden.

Furthermore, it should be investigated what kind of mounting equipment is needed to mount the wireless equipment in the water tank of the Telecentre.