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Site Survey and Implementation Plan

Community Wireless Network
CPAR Telecentre, Lira



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1. Introduction

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

Change log version 1.1

- The parter CCE will be connected to the central hub via wireless communication instead of Ethernet cable. The decision of using wireless was based on the fact that CCE's premises should be seen as "semi-permanent" facilities which are likely to change location in a near future.

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
Surge protection	Yes
Network cable	50 m (outdoor)

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 (indoor)

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

CCE is located approximately 95 m from the Telecentre with clear line of sight to the water tank. Despite its proximity to the Telecentre and a non obstructive path to the Telecentre, it will be connected by means of wireless communication since their premises are of “semi-permanent” character and it is likely that they will change location in a near future.

Hardware specification

System unit	Wireless outdoor client
Location of radio	TBD
Mounting equipment	Pole: 2,5 m
	Brackets: Wall mounted
Radio unit	WPP54AG-6C (Outdoor, Compex), RP-SMA female
Antenna	Internal, 8.5dBi
Network cable	20 m (outdoor)

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 (40m), 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 wireless communication.

Hardware specification

System unit	Ethernet client
Network cable	4 x 50 m
PCV conduits	40 m

6. Network systems

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

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

6.4 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 placed in each PCV conduits.

Ethernet	Cat5e
Protection	PVC conduits

Table 4: Technical specification of the Ethernet client unit.

7. Network topology

At the moment, the network only has three clients, 2 wireless and 1 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.

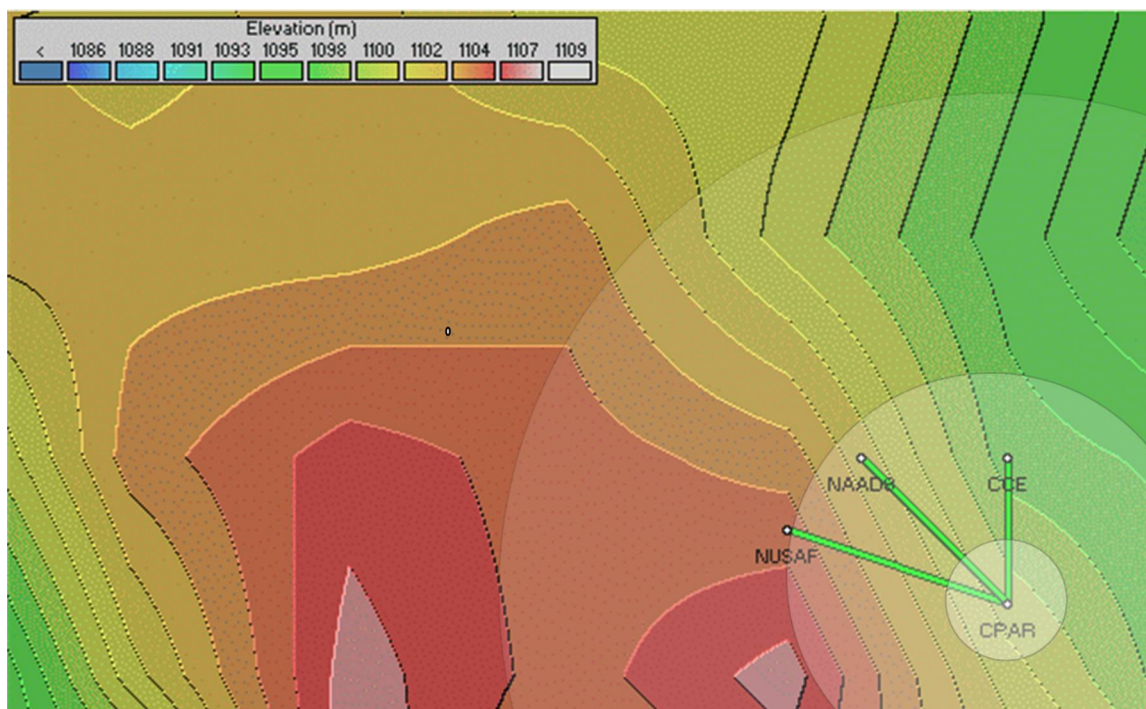


Image 1: Network topology of the Wireless network of CPAR Lira. An omni-directional antenna placed in the water tank at the Telecentre will provide toroidal coverage to its surrounding partners.

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	CLIENT-OUT
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	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	98
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						
Antenna, omni, 12 dBi	N-female	1				1	125
Antenna, panel, 9 dBi	SMA female		1			1	51
Surge arrestor (panel 9dBi)	SMA-male SMA-female		1			1	15
Surge arrestor (omni 12 dBi)	N-male N-female	1				1	15
8-port switch	Compex		1		1	2	54
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						
Brackets	hose clamps	4	4	2		10	5
Brackets	wall mount		1	1		2	20
UPS	400 VA	1	1	1	1	4	880
Cat 5e indoor [m]			3		200	203	168
Cat 5e outdoor [m]		30		20		50	75
PCV conduct [m]					40	40	100

TOTAL: 2,529

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

9. The way forward

The work related to dig down Ethernet cable to connect the NAADS office can be initiated while the CWRC are awaiting the delivery of the 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.