

ITRAINONLINE MMTK
Case Study: Budgeting and Planning
Wireless Network, Fantsuam Foundation, Nigeria
Developed by: IT +46

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1. Introduction

This case study is based on a “real life” situation. It describes a proposed network topology and hardware budget for a planned wireless backhaul network in rural Nigeria.

Fantsuam Foundation, an NGO located in Kafanchan, Nigeria, has currently a VSAT subscription that they are using for their daily NGO activities and Internet café. Due to the extreme high costs of the VSAT connection, Fantsuam Foundation wishes to establish a wireless network that can connect potential clients in Kafanchan and its surroundings to their VSAT gateway. In this way, Fantsuam Foundation can operate as a Wireless ISP and together with the clients share the cost of the international bandwidth.

The VSAT gateway is located at the premises of Fantsuam Foundation. In order to try to keep the local traffic local, Fantsuam Foundation wants to implement a set of basic network services in the network operating centre, such as a local mail server and web caching. To be able to work as a WISP and provide a certain Quality of Service and be able to handle billing smoothly, a bandwidth manager will be implemented and a billing system.

Furthermore, a VoIP system will be installed and all connected clients will be equipped with a VoIP phone. In this way, Fantsuam Foundation will be able to offer telephony over IP to the people of Kafanchan, an area that is still not covered with fix telephony lines.

The topology presented in this document includes 13 potential clients in Kafanchan. After discussing the technical details of the network, the hardware budget for the network is presented.

2. Geographical Area

In order to better understand the proposed network topology, we start by giving the necessary information of the different areas where the partners are located.

The centre of the city of Kafanchan is situated 1.5 km west of Fantsuam Foundation premises (where the VSAT gateway is situated). The central area of Kafanchan is approximately 4 km² (2x2 km).

Although the city of Kafanchan is fairly flat, it is surrounded by a very hilly terrain. There are several hills that affects this network topology including the high Kagoro Hills.

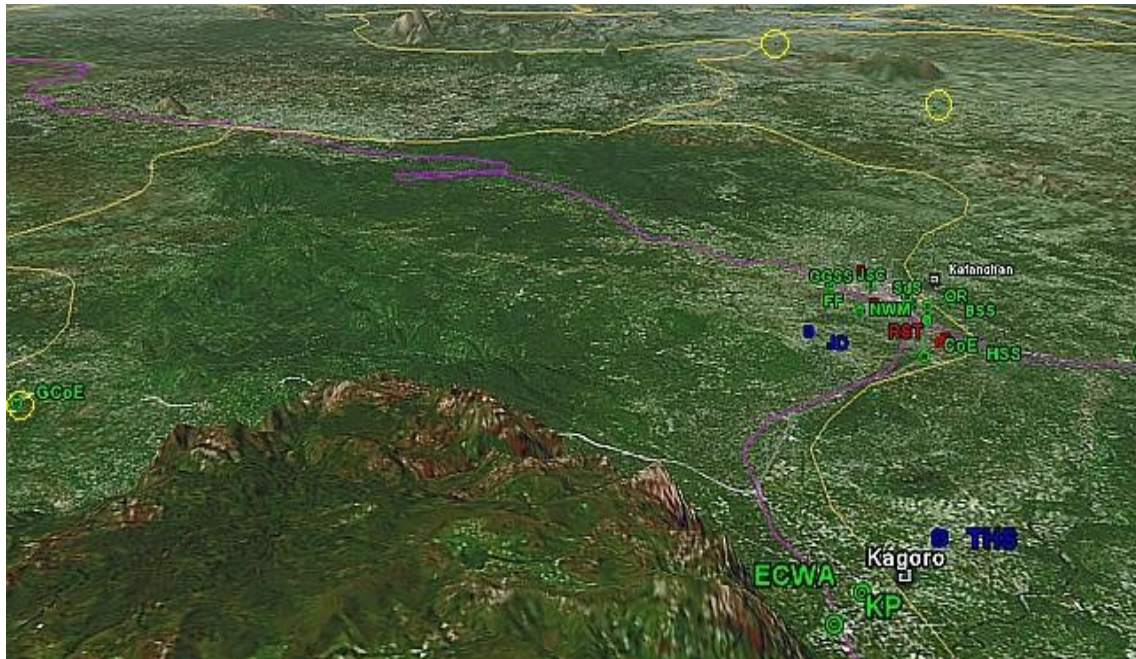


Image 1: The Kagoro hills and Kafanchan (flat).

3. Network Description

The network is divided into to geographical areas:

1. Central Kafanchan (magenta circle)
2. Kagoro Hills (orange circle)

The central Kafanchan (1) includes 11 clients that need to be connected while Kagoro Hills includes 2 clients. The clients are represented as green dots in image 2.

The VSAT connection is situated in the premises of Fantsuam Foundataion (FF) marked in Image 2 with a red dot.

The central parts of Kafanchan are covered by tree different service areas

1. SECT1: Covers the central part of Kafanchan
2. SECT2, Covers the northern "suburbs" of Kafanchan
3. OMNI-1, Covers sites that are outside of SECT1 and SECT2 coverage area.

The Kagoro hills has one service area, OMNI-2.

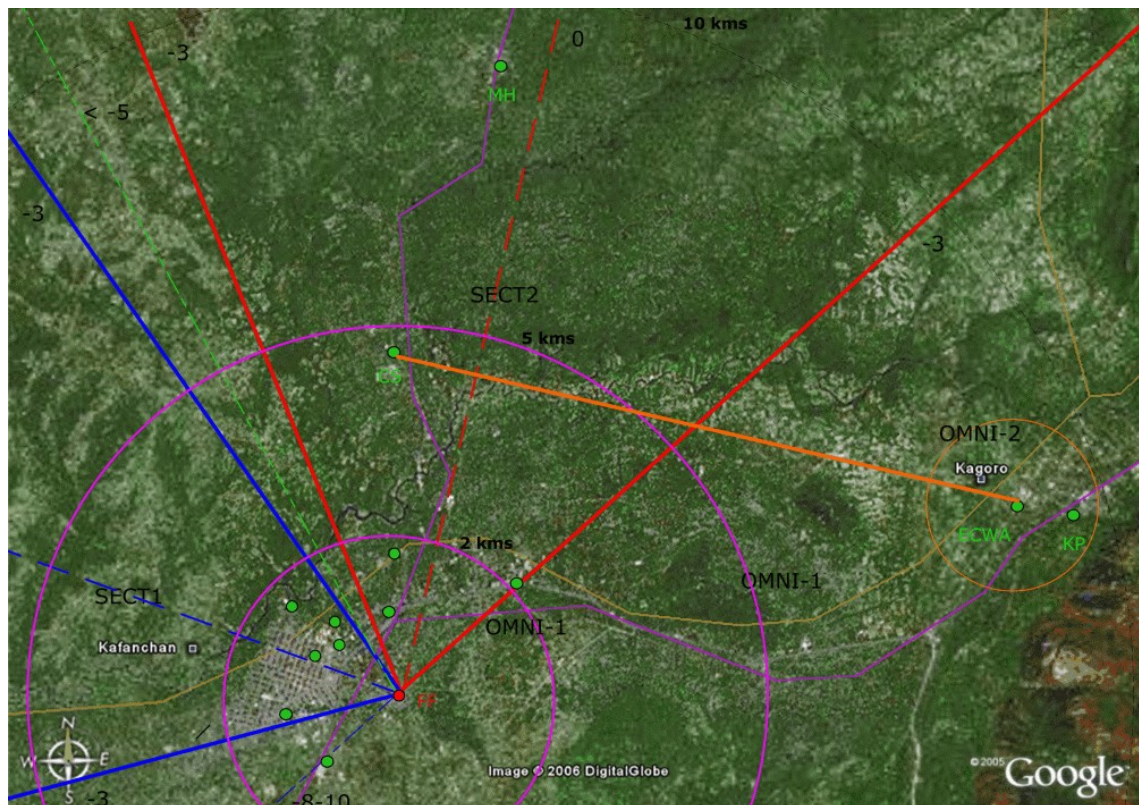


Image 2: Network description showing the four service areas
1) SECT1 (blue), 2) SECT2 (red), 3) OMNI-1 (magenta), 4) OMNO-2 (orange)

The following section describes in detail the proposed backhaul network for the 13 partners' sites.

Network Operation Centre (NOC)

The Network Operation Centre (NOC) is situated on the premises of Fantsuam Foundation. The proposed basic network topology is a star-topology from Fantsuam Foundations' VSAT gateway. A PtP link will be added to the star topology to reach a set of nodes in the Kagoro hills.

To be able to serve as the central site of a star topology, a 150 ft (45 meter) central tower needs to be established close to the VSAT equipment on Fantsuam Foundations premises.

The Network Operation Centre (NOC) of the Wireless ISP will also be responsible of running four common services:

1. Data: Mail and Web caching
Local mail server able to work after long offline periods.
Web Caching of frequent web requests
2. Voice: VoIP PBX
Local Voice over IP exchange and Voice Mail.
3. Traffic: Bandwidth management
Internal and External Bandwidth Management
4. Security: AAA (Authorisation, Authentication and Accounting)
Access Control and Billing System

The image below shows the equipment needed in the NOC to run the services described above.

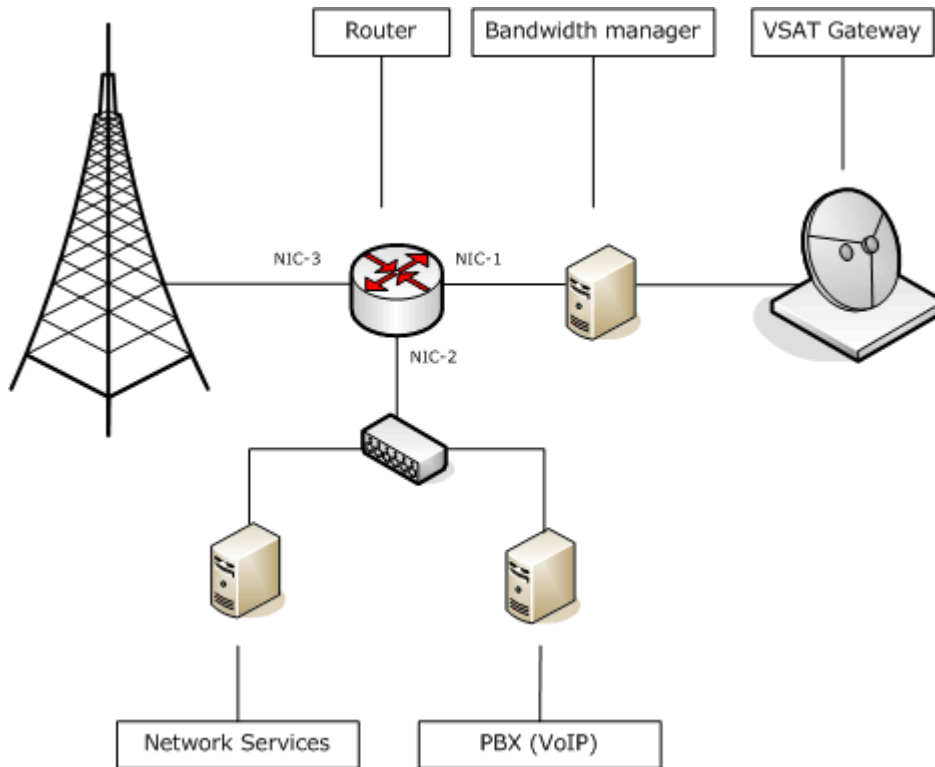


Image 3: NOC Services and central tower

3.1 Tower and Service Area

The central tower will host a total of three wireless rugged outdoor units:

1. SECT1 (Channel 1)
2. SECT2 (Channel 5)
3. OMNI-1 (Channel 10)

Both SECT1 and SECT2 provide an horizontal service area of 70° using a vertically polarized panel antenna of 14 dBi gain. Placed carefully both antennas can jointly serve 180°.

The third non-overlapping radio channel available in 2.4 Ghz is assigned to OMNI-1. The OMNI-1 hosts an 6 dBi omnidirectional antenna with a service area of 360°.

3.1.1 City of Kafanchan (SECT1)

SECT1 provides coverage to the city of Kafanchan (west). Five sites will be connected to SECT1 serving as the Kafanchan wireless backhaul infrastructure. Each of the sites will be a client of the network and a point of presence (POP) for the network expansion. Each of the sites will receive a guaranteed 1/3 T1 (8 channels of 64 Kbps) over the wireless media (Intranet).

The suggested sites are: CoN, OR, JSC, SdS and BSS.

3.1.2 Northern Sites (SECT2)

SECT2 provides coverage to the North and North East backhaul sites. Five sites will be connected to SECT2 serving as backhaul infrastructure to the North Area. Each of the sites will be a client of the network and a point of presence for the network expansion to the North. Each of the sites will receive a guaranteed 1/3 T1 (8 channels of 64 Kbps) over the wireless media (Intranet).

The suggested sites are: CoE, HSS, NWM, MH and CS.

One of the sites (CS) in this sub network will serve as a intermediary (routing) node for the East sites in Kagoro. CS becomes a “repeating” node and hence a new point of failure for the nodes in Kagoro Hills.

3.1.3 OMNI-1

OMNI-1 provides coverage to the sites that can not connect via any Point of Presence (POP) in SECT 1 and SECT2. Initially only one site is expected in this service area: GGSS

3.2 NOC Hardware

The image below describes the equipment of the central tower that is needed to provide the service areas that were described above.

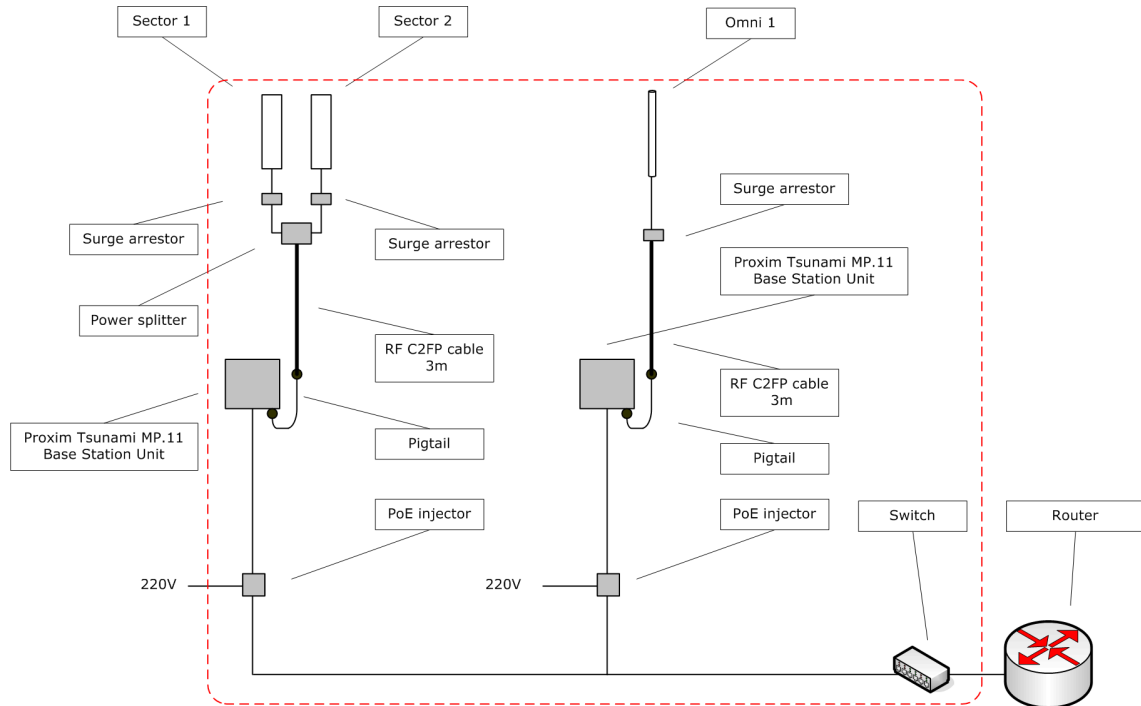


Image 4: Central Tower Equipment for service areas SECT1, SECT2 and OMNI-1

4. Network Map

The image below show the complete set of links that is needed to connect the central tower to the 13 identified links. The network is composed of 13 radio links using a total of 17 radios.

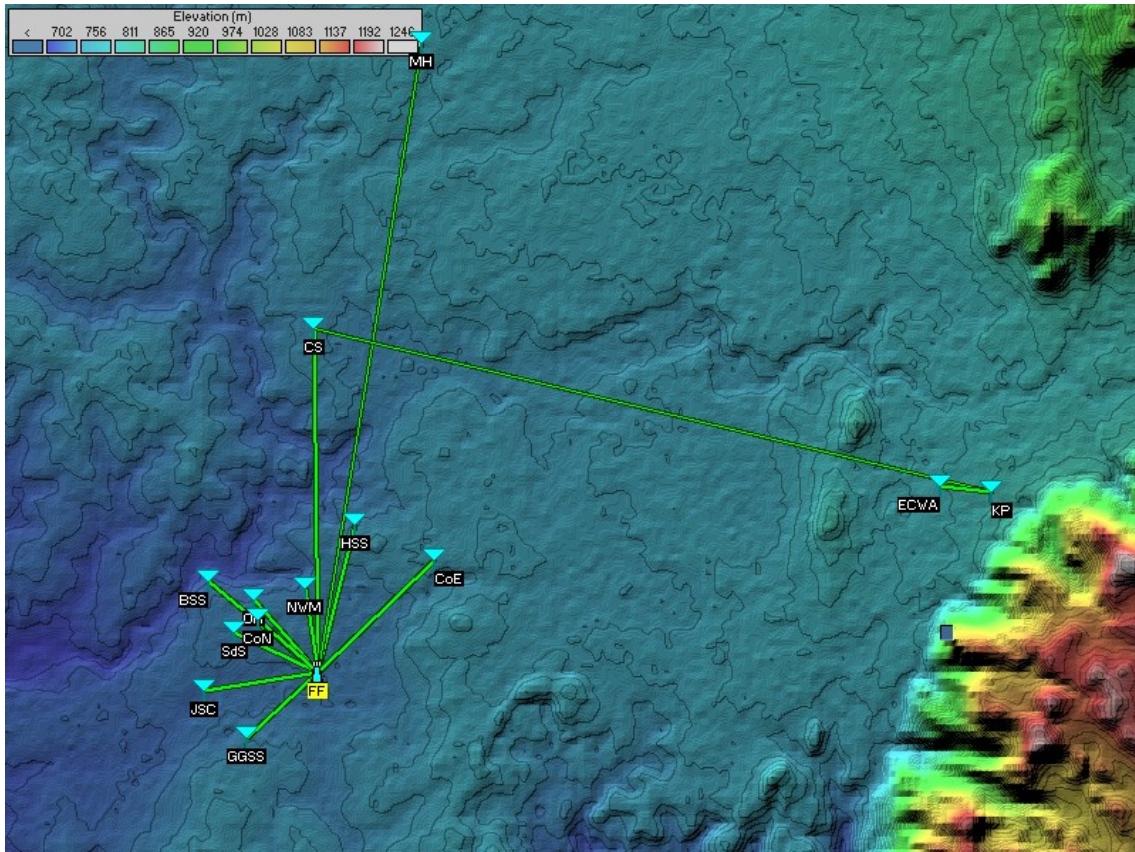


Image 6: Network Topology based on 13 radio links.

5. Equipment

SECT1 and SECT2 are served by two Proxim Tsunami MP11 2411¹ outdoor units (BSU). The units support a proprietary polling technique known as Advanced Wireless Outdoor Routing Protocol (WORP) that uses all the features existing in IEEE 802.11 plus a set of add ons to enable link level QoS.

Although the technology does not interoperate with other vendors, it is the most cost-effective way to build a wireless backhaul infrastructure for a wireless ISP (WISP) if Quality of Service is required in the radio channel.

Each of the clients connected to SECT1 and SECT2 uses an indoor Tsunami MP11 residential subscriber unit (RSU). A cabinet in each of the clients sites needs to be procured to protect the indoor equipment.

The dedicated point-to-point link equipment between CS and KP in the East (Kagoro) does not require support for “dynamic polling”. This link can be implemented by means of conventional outdoor wireless equipment as the Complex Outdoor Unit WPP54G or similar.

1 Tsumani MP11 Technical Spec. http://www.proxim.com/products/bwa/multipoint/mp11/mp11a/MP11_techspec_TS2-1005.pdf

6. Hardware Budget

A detailed budget can be found in *Appendix 1*. The budget includes all hardware directly related to the implementation such as access points, antennas, cables and tower.

The budget does *not* include tools that can be useful during the site survey and the implementation phase such as climbing equipment, GPS and walkie-talkies.

The budget consists of the following eight items:

<i>Item</i>	<i>Budget Item</i>	<i>Description</i>
1	NOC	Tower (hardware, transport, installation and fees (1 year)) SECT1 and SECT2 hardware OMNI-2 hardware NOC basic services
2	SECT1	5 polling clients
3	SECT2	5 polling clients
4	OMNI-1	1 non-polling client
5	PtP	Non-polling, 10 km
6	OMNI-2	1 non-polling client
7	VoIP	1 PBX 13 VoIP phones (1 per client)
8	Transport	Stockholm-Abuja (air freight) Insurance, 4,5% of total value

Table 1: A description of the budget breakdown.

ITEM	TOTAL (USD)	%
HARDWARE AND TRANSPORT		
1. NOC	15,550	42%
2. SECT1	4,625	13%
3. SECT2	4,825	13%
4. OMNI	695	2%
5. PtP	1,860	5%
6. KP-ECWA	1,670	5%
7. VoIP	2,560	7%
8. Transport	5,000	14%
TOTAL	36,785	100%

Table 2: Hardware budget in summary [USD].

7. APPENDIX 1: DETAILED HARDWARE BUDGET

Note that all prices are in USD.

1. NETWORK OPERATION CENTER	Comment	UNIT	PRICE	TOTAL
TOWER				
LICENSE (initial fee + 1 year)		1	2300	2300
TOWER		1	5000	5000
SECTOR 1 + 2 (POLLING)				
OUTDOOR RUGGED ACCESS POINT MP.11		2	2000	4000
PANEL ANTENNA VP470/24 14 dBi		2	300	600
MOUNT PANEL ANTENNA VP470/24		2	100	200
SURGE ARRESTOR		2	100	200
POWER DIVIDER 2 WAYS		1	100	100
RF CABLE	3M	2	30	60
OMNI-1 IEEE 802.11 OUTDOOR				
OUTDOOR RUGGED ACCESS POINT (COMPLEX)		1	350	350
OMNI DIRECTIONAL ANTENNA		1	110	110
MOUNT OMNI ANTENNA		1	25	25
SURGE ARRESTOR		1	100	100
RF CABLE	3M	1	30	30
NOC				
BANDWIDTH MANAGER		1	1000	1000
CAT5E CABLE	100M	1	75	75
SERVICES (mail, proxy/cache, web etc.)		1	1000	1000
SWTCH 8 PORTS		1	100	100
UPDATE ROUTER		1	300	300
SUBTOTAL				15550
2. SECT1 CLIENTS (5 polling)				
RSU KIT [JSC, SdS, OR, CoN, BSS]	VP165	5	450	2250
MOUNT VP165 ANTENNA/EXTRAS		5	25	125
GALVANIZED MAST - POLE	6M	5	25	125
INDOOR CABINETS		5	100	500
UPS APC APC Back-UPS 650VA 400W		5	200	1000
SWTCH PSS2216		5	50	250
CAT5E CABLE		5	75	375
SUBTOTAL				4625

3. SECT2 CLIENTS (5 polling)				
RSU KIT [NWM, HSS, CoE]	VP165	3	450	1350
RSU KIT [MH, CS]	SP45/24	2	550	1100
MOUNT ANTENNA/EXTRAS		5	25	125
GALVANIZED MAST - POLE	6M	5	25	125
INDOOR CABINETS		5	100	500
UPS APC APC Back-UPS 650VA 400W		5	200	1000
SWTCH PSS2216		5	50	250
CAT5E CABLE		5	75	375
SUBTOTAL				4825

4. OMNI-1 (1 non-polling client)				
PANEL ANTENNA VP165		1	50	50
RF CABLE	8M	1	40	40
PIGTAIL		1	30	30
INDOOR ACCESS POINT [GGSS]		1	100	100
MOUNT ANTENNA/EXTRAS		1	25	25
GALVANIZED MAST - POLE	6M	1	25	25
INDOOR CABINETS		1	100	100
UPS APC APC Back-UPS 650VA 400W		1	200	200
SWTCH PSS2216		1	50	50
CAT5E CABLE	100M	1	75	75
SUBTOTAL				695

5. PtP LINK CS - KP (non-polling 10 km)				
PARABOLIC ANTENNA SP60/24		2	200	400
OUTDOOR RUGGED ACCESS POINT (COMPLEX)	3M	2	350	700
LIGHTING PROTECTION (IN TOWER)		2	0	0
SURGE ARRESTOR		2	100	200
RF CABLE		2	30	60
MOUNT ANTENNA/EXTRAS	6M	2	25	50
GALVANIZED MAST - POLE		2	25	50
UPS APC APC Back-UPS 650VA 400W		2	200	400
SUBTOTAL				1860

6. OMNI-2 (1 non-polling Client)				
PANEL ANTENNA VP165		1	50	50
OMNI DIRECTIONAL ANTENNA		1	110	110
RF CABLE	8M	2	40	80
PIGTAIL		1	30	30
OUTDOOR RUGGED ACCESS POINT (COMPLEX)		1	350	350
MOUNT ANTENNA/EXTRAS		2	25	50
GALVANIZED MAST - POLE	6M	2	25	50
INDOOR ACCESS POINT		1	100	100
INDOOR CABINETS		2	100	200
UPS APC APC Back-UPS 650VA 400W		2	200	400
CAT5E CABLE	100M	2	75	150
SWTCH PSS2216		2	50	100
SUBTOTAL				1670

7. VoIP COMPONENTS				
VoIP PBX		1	1000	1000
VoIP PHONE		13	120	1560
SUBTOTAL				2560

8. TRANSPORT				
STOCKHOLM- ABUJA (max 338 Kg 2 m3)		1	3800	3800
INSURANCE, 4,5% of total value		1	1200	1200
IMPORT TAX				0
SUBTOTAL				5000

BUDGET EQUIPMENT AND TRANSPORT		UNITS	PRICE	TOTAL
LICENSE (initial fee + 1 year)	*	1	2300	2300
TOWER	*	1	5000	5000
CAT5E CABLE, 100m	*	14	75	1050
GALVANIZED MAST – POLE, 6m	*	15	25	375
INDOOR CABINETS	*	13	100	1300
UPS APC APC Back-UPS 650VA 400W	*	15	200	3000
MOUNT ANTENNA/EXTRAS		16	25	400
MOUNT PANEL ANTENNA VP470/24		2	100	200
BANDWIDTH MANAGER		1	1000	1000
INDOOR ACCESS POINT		2	100	200
OMNI DIRECTIONAL ANTENNA		2	110	220
OUTDOOR RUGGED ACCESS POINT (COMPLEX)		4	350	1400
OUTDOOR RUGGED ACCESS POINT MP.11 (TSUNAMI)		2	2000	4000
PANEL ANTENNA VP165		2	50	100
PANEL ANTENNA VP470/24 14 dBi		2	300	600
PARABOLIC ANTENNA SP60/24		2	200	400
PIGTAIL		2	30	60
POWER DIVIDER 2 WAYS		1	100	100
RF CABLE SMA-SMA, 8m		3	40	120
RF CABLE -C2FCP, 3m		5	30	150
RSU KIT (indoor AP, antenna, 8m cable) SP45/24		2	550	1100
RSU KIT (indoor AP, antenna, 8m cable), VP165		8	450	3600
SERVICES (mail, proxy/cache, web etc.)		1	1000	1000
SURGE ARRESTOR		5	100	500
SWTCH 8 PORTS		1	100	100
SWTCH PSS2216		13	50	650
UPDATE ROUTER		1	300	300
VoIP PHONE		13	120	1560
VoIP PBX		1	1000	1000
TRANSPORT		1	5000	5000
SUBTOTAL				36,785

LOCAL PROCUREMENT

13,025

EXTERNAL PROCUREMENT

23,760

* To be procured locally