Satellites

Overview

This concept provides satellite connections to several "Centers of Excellence", or forward-thinking universities, in Nigeria, while at the same time providing dial-in or drive-in access to everyone within the NUC system.

This plan has been instigated by Dr. Mamman Aminu Ibrahim, the Deputy Director for Research at the Nigerian University's Commission (NUC) and the Chairman of the Nigerian Universities Network (NUNet). It has been designed and expanded upon by Mr. Cliff Missen, a Fulbright Scholar from the University of Iowa who has taught networking in Nigerian universities, various members of the NUC staff, the vice-chancellors and NUNet chairmen of several Nigerian universities, and technical consultants in Nigeria and the U.S.A.

This plan demonstrates how satellite Internet connectivity can be used throughout Nigeria and prepares Nigerian technicians for a future that looks increasingly to be satellite based.

The overall notion is to provide reliable connectivity in a few universities around the country, to build redundant links between these centers, and to provide a mechanism for those at other universities to access the Internet via these "Centers of Excellence". This plan is envisaged as the first step towards full connectivity for all Nigerian universities. It is designed to provide the widest access for all institutions while a core group develops the requisite skills to foster further expansion.

Consistent with Nigeria's aspirations and the NUC's Action Plan, fully-connected Nigerian University Network will:

1. end the intellectual isolation of Nigerian students, teachers, and researchers
2. expand Internet access to higher education at minimal capital costs
3. improve standards education and currency of knowledge
4. optimize utilization of Nigeria’s academic resources regardless of their physical location
5. encourage local and worldwide academic and research collaborations

This project will also serve as a demonstration to other academic and public institutions across sub-Saharan Africa of how these satellite technologies can be best deployed to serve their communication needs.

- **Why Satellites?**
- **The Plan for Satellite Connectivity**
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  - Setting up mirror Web sites to reduce bandwidth consumption
- **Implementing Internet Connectivity & Broadening Participation**
  - Building redundancy (telephones, etc.)
  - Providing for spare parts
  - Providing regional dial-up access
  - Regional high-speed Internet access centers

- **Capacity Building**
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- **Cost Estimates**

Why Satellites?

Throughout the world, in both the public and private sectors, long-distance data communications are becoming increasingly satellite based. With the numbers of satellites multiplying dramatically and the explosive growth of Internet communications, the costs continue to drop while the hardware and software become more robust as well as easier to implement and support. Satellite vendors in the U.S. already service tens of thousands of businesses and households with high-speed satellite Internet connections and this number is expected to grow exponentially in the near future.

In Nigeria in particular, the emphasis on using satellite connectivity stems from the wish to avoid many of the infrastructure and service problems in dealing with NITEL, the Nigerian telecommunications monopoly, as well as frustrations with other key services which remain outside of the universities' sphere of control.

Across the board, Nigerian institutions of higher education struggle with inadequate telecommunications infrastructure. In fact, there are some Nigerian universities without a single functioning telephone, while others struggle to keep their few working phone lines alive. There is a great need for improvement in the Nigerian telecommunications sector and no doubt improvements will be made in the coming years. Yet it would be foolhardy to assume that fast and reliable service will be available any time soon.

Satellite connectivity has the inherent benefit of allowing the universities to be autonomous and independent: they can choose to install reliable power generation facilities to support their installations; they can determine when, how, and at what capacity they will connect to the Internet; and they can interact with a satellite independent of the larger Nigerian telecommunications infrastructure. In essence, the universities can choose how much they want to spend to insure the level of reliability they desire independent of any outside agencies.

NITEL is currently developing a two-megabit fiber ring that will eventually include five access points around Nigeria. (Which is already one-year behind schedule.) Yet, even as this is potentially made functional in the next year, most universities still face the "final mile" conundrum. At this point there simply are no reliable copper services between the NITEL access points and the universities.

This proposed satellite communications system will act as a redundant layer alongside the traditional hardwired systems envisioned by NITEL and others. In the long run, it would be wise to install both satellite and ground-based connectivity at Nigerian universities to provide for greater redundancy should one system fail.

NITEL's only connection to the Internet is via a satellite. This satellite connectivity means that Nigeria must pay "rent" to the non-Nigerian satellite owners for every piece of data sent outside of Nigeria. Currently, there are proposals that call for Nigerian universities to connect to NITEL via satellite and then have NITEL send and receive data to the wider Internet (from whence 98% of the traffic is bound to come in the first few years) via its own satellite. Such a scheme would have Nigerians paying satellite "rent" twice for each packet of data: once to send the packet to NITEL, and again to send it to the wider Internet.

In reality, most satellite services offered by NITEL and its contractors are three to four times more costly than their international counterparts -- even though they use the same satellite and ground station equipment. Those who are currently attached to satellite systems provided by NITEL and its contractors report that they experience ridiculously low bandwidth.

This Nigerian Universities Satellite proposal would call for universities to be connected to the original Internet service provider through a direct connection, halving the satellite "rent" and essentially providing Nigeria with 50% more Internet bandwidth.

Bandwidth is a major concern for Nigerian universities. Unlike most corporate Internet needs, academic Internet use is bandwidth-intensive. Research and collaboration via the Internet calls for sifting through thousands of documents and working with large-size media of all kinds.

The Nigerian university system represents a very large community. The NUC's membership hovers around 270 higher educational institutions. In universities alone, the potential user-base is now greater than 500,000.

There's little doubt that Nigerian universities will very soon require more bandwidth than is currently offered by NITEL. Being forced to compete with NITEL's other customers for NITEL's limited bandwidth could leave Nigerian universities in the position of paying a very high price for very little progress.

The Plan for Satellite Connectivity

The current plan would have six to twelve satellite ground stations installed at universities around Nigeria. One of these would be installed in Abuja at the Nigerian Universities Commission's headquarters and the rest distributed to universities in all the regions of Nigeria.

The NUC-based satellite ground station would give the NUC planners, trainers, and decision makers ready access to the Internet. The NUC's technicians, who will be responsible for supporting the outlying universities, will be able to develop day-to-day experience with the equipment and the technology. And academics from around the country can use the Internet connection in the NUC's thirty-station computer lab. Abuja is a central location with good transportation access and facilities.

The other satellite ground stations will be fanned out to those universities that the NUC has identified as Centers of Excellence. At this point the list includes: the University of Jos, Amadu Bello University, the University of Ibadan, BUK in Kano, Owerri, and Calabar. OAU at Ile-Ife

is viewed as being a Center of Excellence but already operates a satellite dish. They may be invited to participate in the rest of this program but won't require the initial infrastructure investment.

Setting up mirror Web sites to reduce bandwidth consumption

The satellite ground station equipment installed at each satellite center will have a total potential capacity of up to two megabits on either the C or KU bands. Originally, each institution will be configured for a 64 K uplink (outgoing) and one-megabit downlink (incoming). However, the one-megabit downlink will be shared between all participating universities. This provides and inexpensive way for the Nigerian Universities Commission the ability to increase the overall amount of bandwidth coming into the Nigerian University systems and dramatically increased throughputs for all the participating parties.

The way the shared bandwidth works is this: the Nigerian Universities Commission will contract with their satellite vendor for one megabit of broadcasting capacity. All member ground stations will share this bandwidth, so if eight ground stations are receiving data simultaneously, they will experience throughput of 128K or better. But if only one institution is receiving data, it can receive it at a full megabit. So, at minimum each institution will experience a 64K uplink and a 128K downlink.

One of the first technical challenges for us is to see if it is possible to have common things like USENET news groups intercepted and cached on every machine in the system in order to conserve overall bandwidth by eliminating duplicate broadcasts.

Since the ground station equipment will have a two-megabit capacity, the participating organizations can individually or collectively work with the satellite provider to upgrade or downgrade their connection as necessary.

Implementing Internet Connectivity and Broadening Participation

Building Redundancy

With each university utilizing identical equipment -- and with the Nigerian Universities Commission storing a redundant set of spares in the capital city -- doing training, conducting maintenance, and providing staffing redundancy should prove to be markedly easier -- leading to more cost-effective installation and reliable operations.

Redundancy at a connectivity level will be accomplished by adding dial-up equipment at each of the connected universities. In the case of equipment failure at one university, that university will be able to use their telephone line to dial into one of the other satellite-connected universities. Each institution will have a NUC-sponsored telephone line dedicated for this purpose.

Broadening Participation

All satellite centers, including the NUC in Abuja, will host up to four dial-in connections that will allow other NUC organizations and institutions to dial-in and access the Internet. Thus, in addition to the satellite and router equipment for each connected institution, the system will include one PC configured to act as a proxy server, a pop e-mail server, and a remote access server. This machine, though purchased by the participating university, will be dedicated to serving the NUNet system, and thus be configured and maintained by the NUC staff and not used for any other purposes.

As envisioned, this system will provide high-speed Internet access to every computerist attached to the local area network at each of the participating institutions. As well, with all six participating institutions providing one or more dial-in connections, numerous individuals at other NUC organizations can also participate and share in this Internet connectivity. Finally, the NUC will provide for each participating organization one or more workstations to be attached to the local area network and set aside for visitors from other NUC institutions to use on a reservation basis. (These would be used by the host university when not scheduled for a guest.)

This will give individual researchers at the remaining unconnected institutions the capacity to choose either dial-in or drive-in access to the Internet.

Those researchers wanting low-cost high-speed access might choose to travel to the nearest satellite station, whereas those wanting intermittent and convenient Internet access might choose the dial-in option.

Training of Satellite Installers

Vendor technicians, accompanied by NUC and outside partners, will train 20 technicians drawn from the NUC and the member universities. This training will begin with trainees being supplied advance material and quizzes on CD-ROM. After a week of on-site training in Abuja, the trainees will install two relatively close satellite sites accompanied by the vendor's technicians. Vendor's technicians will be contracted to provide on-line support for the remaining installations.

University and NUC installers will be trained in:

- installation of satellite ground stations and routers
- monitoring and maintenance of the satellite equipment
- installation and maintenance of dial up equipment (modems and digiboards)
- interfacing with satellite vendor's technical support staff as well as other NUC and university technicians

Trainees will receive an interim certificate after assisting in the installation of two ground stations. They will receive a full certificate after they have acted as one of three lead installers in the installation of a ground station. The certificate must be maintained (renewed) by attending an annual refresher course. New complete training courses will be mounted by the NUC whenever the pool of trained installers falls below a set minimum.

Training Materials

- One set of the primary tools for installing and calibrating satellite. (To be kept at NUC for use by all participants.)
- A set of necessary tools to each participating university
- Manuals, diagrams, and CD-ROM documentation for installers

Administration and Management
of Access Facilities and Technology

The NUC will provide a person to act as the clearinghouse for technology maintenance and facilities scheduling. This person will be responsible for keeping spare parts on hand, dispatching technicians, and reserving stations at regional access points.

Project Cost Estimates

	Naira	USD
Satellite Equipment and Connection Fees	83,608,000	836,080
Expansion and Redundancy	5,634,000	56,340
Capacity Building	1,633,800	16,338
TOTALS:	N90,875,800	$908,758

Satellite Connection Expenses (est.)
Satellite Costs (assuming Lyman Bros.)
Set-Up and First Year Expenses

Common Components/ Charges		Sites			
Installation	12000	**8**	$ 96,000		
Shipping	6500	8	$ 52,000		
Support	2400	8	$ 19,200		
Connect Fees	45420	8	$ 363,360		
		Subtotal:	$ 530,560		
				TOTAL	**Naira**
EQUIPMENT OPTION 1 (up to 1mbit total bandwidth)					
Equipment	29600	8	$ 236,800	**$ 767,360**	76,736,000
EQUIPMENT OPTION 2 (up					

to 2mbit total bandwidth)					
Equipment	38190	8	$ 305,520	**$ 836,080**	83,608,000
Reoccurring Expenses			Naira		
Connect Fees	45420	8	$ 363,360		
Support	2400	8	$ 19,200		
			$ 382,560		$ 38,256,000
Mirrored Web Site					Naira
Setup Fees	120	1	$ 120		
Registration	70	1	$ 70		
Monthly Fees	26	12	$ 312		
			$ 502		$ 50,200

Expansion and Redundancy Costs

Redundancy

Assuming	8	Centers		Naira	Subtotals
	8	modems	15000	120,000	
	8	phone lines install	21000	168,000	
	8	phone usage	60000	480,000	
					6,144,000

Regional Access Dial-in

16	modems	15000	240,000	
16	phone lines install	21000	336,000	
16	phone usage	60000	960,000	
8	Digiboard	40000	320,000	
				14,848,000

Regional High-Speed Internet Access

16	network ports	10000	160,000	
16	workstations	140000	2,240,000	
				19,200,000

Spare Parts

6	Modems	15000	90,000	
6	Digiboards	40000	240,000	
2	workstations	140000	280,000	
				4,880,000
	TOTAL:		5,634,000	

Reoccurring Expenses

	Phone usage	120000	120,000

Capacity Building Cost Estimates

Capacity Building

			Naira
Training and Installation of First Two Sites			
1	Primary Installation Tools for Satellite	120000	120,000
20	Sets Maintenance Tools	6000	120,000
20	Sets Training Materials	5000	100,000
18	Roundtrip travel to Abuja	10000	180,000
18	Night Allowance/Per Diem	30000	540,000
18	Local Transportation	500	9,000
25	Transport to Second Site	5000	125,000
1	Lunch/Refreshments for week	75000	75,000
	Sub total:		1,269,000
Installation of Subsequent Sites			
2	Travel for trainees	5000	10,000
2	Travel for NUC supervisors	5000	10,000
4	Two days night Allowance/Per Diem	10000	40,000
4	Local Transportation	200	800
	Sub total:		60,800
	For six sites		364,800
	GRAND TOTAL:		**1,633,800**

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