Satellites

Vision

To provide our partner universities with the knowledge of low-cost innovative data transmission solutions in order to maximize value and avoid the mistakes of first time buyers.

Satellite Communication in Nigeria

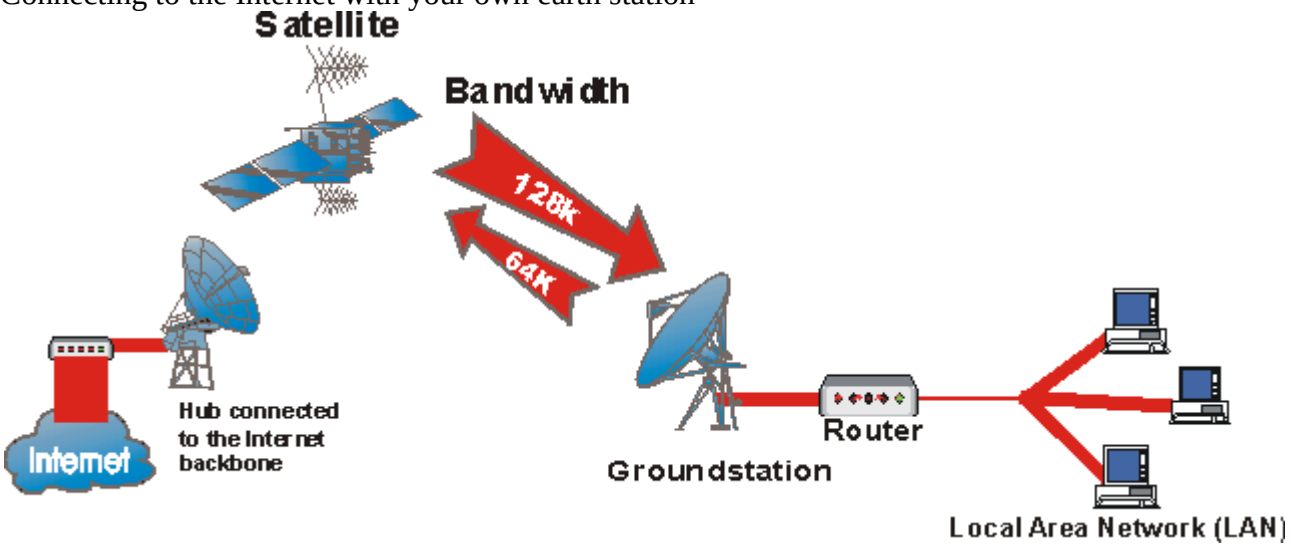
Though there are many ways of connecting to the Internet, like copper wires, microwave, fiber optics, etc., the **backbone**. (Generally when we mention the term "Internet backfastest channel is fiber optics. However, employing fiber optics requires an existing connection to the **Internet** bone", we are referring to the main pipes along which data is transferred; the central data transmission lines. The backbone is not operated by any one company or government, though both operate individual components of the Internet backbone.)

Because the Internet backbone doesn't pass through most countries in Africa, organizations and institutions within these countries who want to have access to the Internet generally must do so via satellites. Either they own the ground station or they connect via phone lines through Internet Service Providers (ISPs.) These ground stations receive from and transmit data to the Internet via a hub provided by the Satellite Service Providers. Because there is no Internet backbone passing through Nigeria at the moment, Internet users only have access to the Internet via satellites and not through fibers, copper wires, telephones etc.

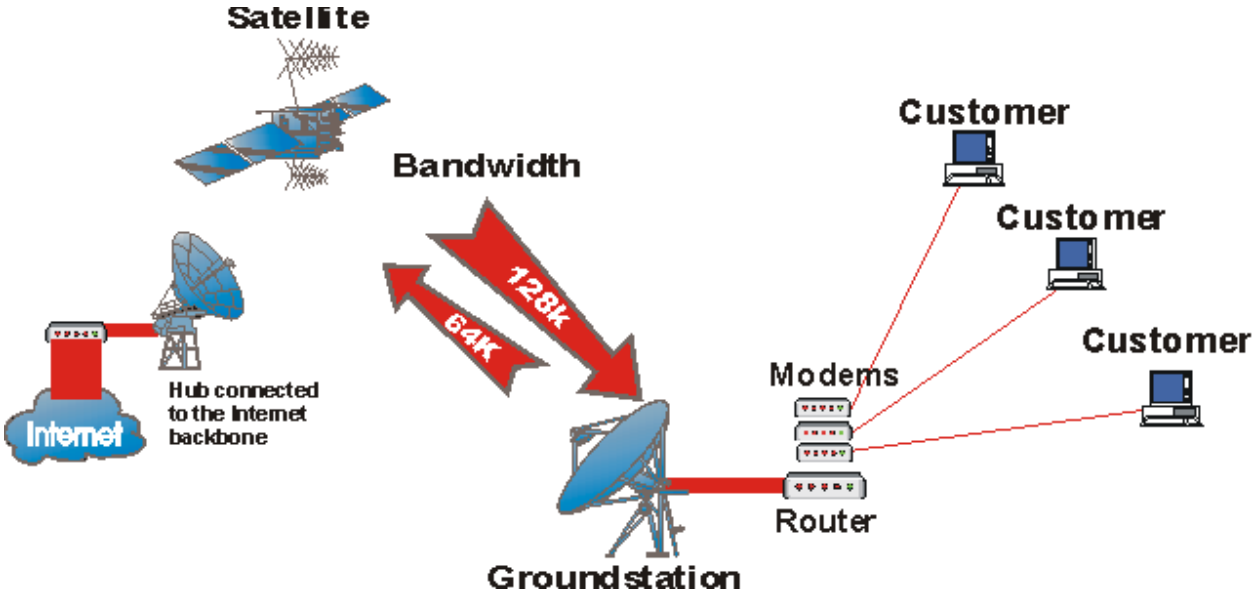
In Nigeria, individuals or companies who want access to the Internet typically do so via ISP's, which provide them with access to space on a satellite from which the ISP itself has acquired space (bandwidth).

The basic Satellite connection can be provided for individuals directly or to a network of computers:

Connecting to the Internet with your own earth station



Connecting to the Internet via an Internet Service Provider



Understanding How Communication via Satellite Works

Why Satellites?

Satellite Proposal for Nigerian Universities? – see www.widernet.org/sites/default/files/Satellites.pdf

Satellite Information for Technicians

The **Internet** is represented by a cloud since once Internet traffic hits the backbone, it can take numerous and various pathways to get from one device to another Internet backbone

The Internet is a global collection of networks, both big and small. These networks connect together in many different ways to form the single entity that we know as the Internet. In fact, the very name comes from this idea of interconnected networks. Since its beginning in 1969, the Internet has grown from four host computer systems to tens of millions. However, just because nobody owns the Internet, it doesn't mean it is not monitored and maintained in different ways. The Internet Society, a non-profit group established in 1992, oversees the formation of the policies and protocols that define how we use and interact with the Internet

The term internet backbone is often used to describe the main network connections composing the internet. Generally when we mention the term, we are referring to the main pipes along which data is transferred: a larger transmission line that carries data gathered from smaller lines that interconnect with each other. It is a set of paths that local or regional networks connect to for long-distance interconnection. These connection points are known as network nodes or telecommunication data switching exchanges (DSEs). Most large communications companies have their own dedicated backbones connecting between various regions.

However, Internet backbone can also be described as a group of communications networks managed by several commercial companies that provide the major high-speed links to the internet; the central data transmission lines. The backbone is not operated by any one company or government though companies operate components of the Internet backbone). ISPs are either connected directly to these backbones or to a larger regional ISP that is connected to one. The backbones themselves are interconnected at various access points called "NAPs". NAPS (Network Access Point) is a junction point where major Internet service providers interconnect with each other. A connection at one or more of these NAPs means "connected to the Internet."

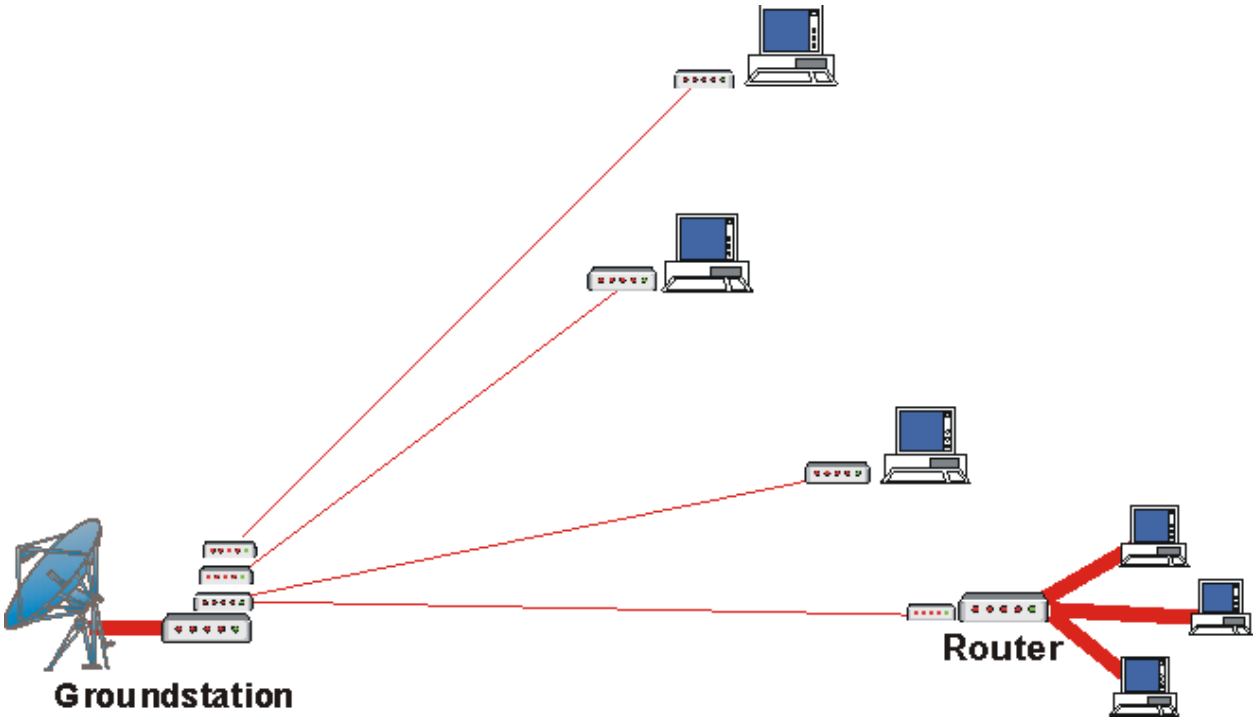
For more on Internet backbone, check out the following How Stuff Works Web sites...
› Introduction to How Internet Infrastructure Works - http://www.howstuffworks.com/internet-infrastructure.htm
› A Hierarchy of Networks - http://www.howstuffworks.com/internet-infrastructure1.htm
› Bridging The Divide - http://www.howstuffworks.com/internet-infrastructure2.htm
› Protocol of the Internet - http://www.howstuffworks.com/internet-infrastructure3.htm
› What's In A Name? - http://www.howstuffworks.com/internet-infrastructure4.htm
› Web Servers - http://www.howstuffworks.com/internet-infrastructure5.htm
› Lots More Information - http://www.howstuffworks.com/internet-infrastructure6.htm

A **hub i**s a collection of communications equipment designed to receive signals from (and usually transmit signals to) satellites. It is also called a *downlink station.*

Today information is normally sent as digital signals from a ground station to a satellite. At the satellite, the signals are received, amplified, and as a rule converted into another frequency before they are sent back to another ground station. The transmission of the signals takes place by means of parabolic aerials and microwaves with wavelengths from 1 - 20 cm.

An Internet Service Provider (ISP) is an Organization that provides one or more basic internet services such as Internet access, web site hosting, or DNS support for domains . ISP's provide information to their customers (internet users) directly via phone lines and to networks via routers as depicted below.

In this case our ISP not only provides internet access to its individual customers but through a hub at the organization or company, it can provide services to a network of computers. The whole picture of how internet access via an ISP works is as depicted below



A **satellite** is a specialized wireless receiver/transmitter — essentially a radio- frequency repeater that is launched by a rocket and placed in orbit around the earth. A satellite is basically any object that revolves around a planet in a circular or elliptical path. The moon is Earth's original, natural satellite, and there are many manmade (artificial) satellites, usually closer to Earth. The path a satellite follows is an orbit. In the orbit, the farthest point from Earth is the apogee, and the nearest point is the perigee. Artificial satellites generally are not mass-produced. Most of them are custom built to perform their intended functions. Although anything that is in orbit around Earth is technically a satellite, the term "satellite" is typically used to describe a useful object placed in orbit purposely to perform some specific mission or task.

A **satellite** is a specialized wireless receiver/transmitter — essentially a radio-frequency repeater — that is launched by a rocket and placed in orbit around the earth.

Satellites transmit data to and from ground stations and hubs connected to the internet backbone. The ground equipment needed to contact the satellite consists of a IBM-PC compatible computer, a Terminal Node Controller (TNC), a satellite radio, and antennas. There are hundreds of satellites currently in operation. They are used for such diverse purposes as weather forecasting, television broadcast, amateur radio communications, Internet communications, and the Global Positioning System.

The first artificial satellite, launched by Russia (then known as the Soviet Union) in the late 1950s, was about the size of a basketball. It did nothing but transmit a simple Morse code signal over and over. In contrast, modern satellites can receive and re-transmit thousands of signals simultaneously, from simple digital data to the most complex television programming. There are three types of communications satellite systems. They are categorized according to the type of orbit they follow. A geostationary satellite orbits the earth directly over the equator, approximately 22,000 miles up. At this altitude, one complete trip around the earth (relative to the sun) takes 24 hours. Thus, the satellite remains over the same spot on the earth's surface at all

times, and stays fixed in the sky from any point on the surface from which it can be "seen." So-called weather satellites are usually of this type. You can view images from some of these satellites on the Internet via the Purdue Weather Processor. A single geostationary satellite can "see" approximately 40 percent of the earth's surface. Three such satellites, spaced at equal intervals (120 angular degrees apart), can provide coverage of the entire civilized world. A geostationary satellite can be accessed using a dish antenna aimed at the spot in the sky where the satellite hovers.

A low-earth-orbit (LEO) satellite system employs a large fleet of "birds," each in a circular orbit at a constant altitude of a few hundred miles. The orbits take the satellites over, or nearly over, the geographic poles. Each revolution takes approximately 90 minutes to a few hours. The fleet is arranged in such a way that, from any point on the surface at any time, at least one satellite is on a line of sight. The entire system operates in a manner similar to the way a cellular telephone functions (http://searchnetworking.techtarget.com/sDefinition/0,,sid7_gci211763,00.html). The main difference is that the transponders, or wireless receiver/transmitters, are moving rather than fixed, and are in space rather than on the earth. A well-designed LEO system makes it possible for anyone to access the Internet via wireless from any point on the planet, using an antenna no more sophisticated than old-fashioned television "rabbit ears."

Some satellites revolve around the earth in elliptical orbits. The path a satellite follows is an orbit. These satellites move rapidly when they are near perigee (the nearest point to the earth on the orbit, or their lowest altitude) and move slowly when they are near apogee, (the farthest point from Earth or their highest altitude).

Such "birds" are used by amateur radio operators, and by some commercial and government services. They require directional antennas whose orientation must be constantly adjusted to follow the satellite's path across the sky.

Take a look at the following Web sites for more on satellites and how they work.

How is a Satellite Launched into an Orbit? - http://www.howstuffworks.com/satellite2.htm
Orbital Velocity and Altitude - http://www.howstuffworks.com/satellite3.htm
What is a Satellite Launch Window? - http://www.howstuffworks.com/satellite4.htm
What is Inside a Typical Satellite? - http://www.howstuffworks.com/satellite5.htm
What Are the Types of Satellite Orbits? - http://www.howstuffworks.com/satellite6.htm
Satellite Altitudes - http://www.howstuffworks.com/satellite7.htm
How Much Do Satellites Cost? - http://www.howstuffworks.com/satellite8.htm
How Can I See an Overhead Satellite? - http://www.howstuffworks.com/satellite9.htm
What is AMSAT? - http://www.howstuffworks.com/satellite10.htm
What Causes Space Junk? - http://www.howstuffworks.com/satellite11.htm
Lots More Information! - http://www.howstuffworks.com/satellite12.htm

For more information on Satellites check out these websites:

Basics about Satellites
http://www.missouri.edu/~ascwww/satellite/

USOE Satellite Primer
http://www.usoe.k12.ut.us/curr/ednet/sat_prim.htm

An introduction to satellite communications
http://www.satellitesandyou.com/concepts.shtml

USOE Satellite Primer
http://www.usoe.k12.ut.us/curr/ednet/sat_prim.htm

All About Satellites - NASA Mike
http://coolspace.gsfc.nasa.gov/nasamike/essays/satellites/satellit.htm

Satellite Communications East
http://www.satcomeast.com/classroom/index.html

Satellites Reach the Rest of the World
http://www.isp-planet.com/research/satellite.html
by Alex Goldman

Introduction to Satellite Communications
http://www.satellitesandyou.com/elearn/elearn_demo1.htm

Satellite Internet - What is It ? A Primer / Editorial by Thomas "Bouncer" Blakely
CCNA, CCDA.http://www.speedguide.net/editorials/satellite.shtml

Satellite Communications East: Public Questions and Comments
http://www.satcomeast.com/cgi-bin/publicboard/index.html

Quality of Service (QOS) Issues of Satellite Links
http://www.museum.tv/archives/etv/S/htmlS/satellite/satellite.htm

Satellite Data Communications
http://www.interlinx.qc.ca/leehogle/satellite.html#elements

Satellite Technology - The Next 5 Years
http://www.hughes-escorts.com/solution_resource/vsatprimer/index.htm
http://www.hughes-escorts.com/solution_resource/vsatprimer/satelliteTech.htm

Geostationary telecommunication satellites
http://www.tbs-satellite.com/tse/online/mis_telecom_geo.html

All About Satellites
http://www.latrobe.edu.au/crcss/satellites.html

Geostationary, LEO, MEO, HEO Orbits
http://www.geo-orbit.org/sizepgs/geodef.html

Satellite antennas
http://www.funke.nl/satellit.html

What are transponders?
http://www.hughespace.com/uplink.html

Small Satellites
http://www.ee.surrey.ac.uk/SSC/SSHP

Satellite Technology Catalog
http://www.shelburnefilms.com/satelit0.htm#Install%20Manual

Satellite Communications
http://telecom.about.com/cs/satellite/

The Satellite Site
http://www.thetech.org/hyper/satellite/

Know Satellites
http://www.ibuybroadband.com/ibb2/know-satellite.asp

What Is a Satellite? (Satellite Technology for Young People)
http://www.hughespace.com/sat101.html

Low Earth Orbiting Satellites and Internet-Based Messaging Services
http://www.isoc.org/isoc/whatis/conferences/inet/96/proceedings/g1/g1_1.htm

E-Sat
http://www.esatcom.net/Library-basic.htm

How It Works: Satellite Internet Access
http://www.pcworld.com/howto/article/0,aid,17617,00.asp

History of Data Communications Satellites
http://www.interlinx.qc.ca/leehogle/satellite.html#elements

Communications Satellites: Making the Global Village Possible
http://www.hq.nasa.gov/office/pao/History/satcomhistory.html

Satellites Communications Paper
http://www.vu.union.edu/~queirolf/ESSAYS/Satellite%20Communications.pdf

To find out more about satellite service providers, check out:
http://www.business2.com/webguide/0,1660,4239,FF.html

Bandwidth refers to the amount of digital information that is transferred from one point to another.

Bandwidth refers to the amount of digital information that is transferred from one point to another. It is the transmission capacity of an electronic line such as a communications network, computer bus or computer channel. It is expressed in bits per second, bytes per second or in Hertz (cycles per second).

Whenever someone visits your Web site, the files which compose your site (graphics and HTML) are downloaded by their Web browser. Imagine that the home page (index) of your Web presence contains two images of 5,000 bytes each (5k) and another 5,000 bytes of text. If your web hosting firm allows 1 GB (gigabyte) of data transfer per month, your main page index could be viewed over 66,000 times for the allowed 1,000 megabytes of data transfer bandwidth.

Our statistics show that less than 5% of all Web sites will generate greater bandwidth usage than 1 GB monthly. However, normally, the cost of transmitting data is much higher than that of receiving. Thus most organizations tend to have more incoming bandwidth (128 kilobytes) than outgoing (64 kilobytes)

Bandwidth is a somewhat confusing and a commonly misunderstood term because in the past it has been used in many different ways. Bandwidth primarily means a measure of data transfer speeds or as a measure of space available for data to occupy. What does that have to do with you? When it comes to the Internet, bandwidth relates to the amount of information that is moved in a specific amount of time. The amount of bandwidth that is transmitted affects many aspects of online communication and conferencing such as web telephony, file sharing, videoconferencing, and webcams. We hear of the word broadband well, broadband comes from the words “broad bandwidth” and is used to describe a high-speed connection to the Internet. A broadband connection lets you instantly connect to the Internet or your corporate network at speeds many times faster than a dial-up connection.

In today's world when high connections are not only important but are gradually becoming a necessity what effect does it have on the realm of Internet technology? As the use of high speed access increases so will the need for Internet Bandwidth, because of this cables that are used to carry Internet packets are growing larger and faster as companies and individuals strive to keep up with the increasing rate of Internet use and the flow of information. Video and audio files alone use a tremendous amount of bandwidth and the problem with slow or lost data is the culprit when it comes to poor video and audio quality, therefore not giving you the results that you desire.

It is not uncommon for an Internet Service Provider (ISP) to place bandwidth restrictions on a Web page that is hosted by them. The ISP allows users to download a certain number of bits per month and when that bandwidth limit is exceeded the ISP charges the owner of that site for the additional bits that were absorbed. This is why it is not uncommon to hear of camgirls who have very popular sites being charged for additional bandwidth that was used by their viewers. The cost of the extra bandwidth doesn't make camming a cheap hobby for those girls and eventually they are forced to charge, implement affiliate links to draw in supplemental income, or eventually give up their webcam hobby.

If you have been using the Internet for a significant amount of time you have probably heard the rumor that the Internet is going to eventually run out of bandwidth. Is there any truth to this? In order to dispels this rumor you must understand a bit about the infrastructure behind the Internet. The Internet has been built on a scalable system, allowing more capacity to be added when needed. A problem that is not so easy to correct is that the routers which is a device that connects a number of local-area networks (LANs) are being bottlenecked by bandwidth. They are still operational in the megabit range, but it's not uncommon for them to be bogged by the increasing demand to reach gigabits. As the face of the Web continues to change the need hard-pressed need for more bandwidth will be ever-increasing to meet the needs of today's world. Bandwidth will be used to encompass high-tech videoconferencing, telephony, virtual reality, web cams and more.

Together broadband and bandwidth will not only change the way businesses operate but it will also change the way the average online user lives.

For more about bandwidth and related topics, check out:

Bandwidth and Latency
http://compnetworking.about.com/library/weekly/aa021902a.htm?iam=howstuffworks_SKD&terms=what+is+bandwidth

Beginner's Guide to Hosting
http://www.helpwithhosting.com/beginners_guide/bandwidth.html

Computer World
http://www.computerworld.com/cwi/story/0,1199,NAV47-74-212-466_STO51713,00.html

Everything You Need to Know About Broadband
http://www.ibuybroadband.com/ibb2/knowledge.asp

Overview of High-Speed Internet Technologies
http://www.trueband.net/hsi/overview.asp

Bandwidth
http://www.projectcool.com/developer/gzone/basics/01-basics/bandwidth.html

Bandwidth Basics - A Comparison of Connection Speeds

http://www.wesonline.com/techsystems/bandwidth.htm

E-mail Attachments & Bandwidth - Know The Netiquette
by Patricia Rideout, Your Virtual Professional Secretary

http://bzone.co.nz/knowledge_zone/0,,1920-931828,00.html

BROADBAND 101 The Unofficial Dictionary
http://www.sbc.com/Products_Services/DSL/BB101_dictionary.doc

Battle of the bandwidths
http://www.telecomsadvice.org.uk/features/bandwidth.htm

Broadband Satellites
http://www.satelliteonthenet.co.uk/white/bband.html

Information on broadband satellites , LEOS, Networking topologies etc
http://proshikanet.com/corporate_clients.htm

Broadband IP
http://www.gilat.com/Solutions_BroadBandIP.asp

More on other related topics:

DATA BROADCAST – One way service
http://www.redwingsat.com/DataSheets/data_broadcast.htm

RECEIVE ONLY Broadband Satellite Internet Service:
http://www.sharcstar.com/receive.htm

Internet Broadband Access
http://www.business2.com/webguide/0,,3692,00.html

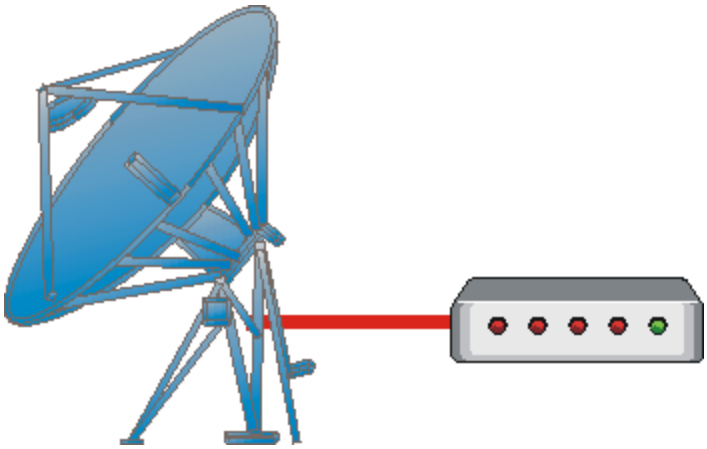
DATA BROADCAST
http://www.vulcancom.net/VSAT.htm

TWO-WAY Broadband Satellite Internet Bandwidth Service:
http://www.sharcstar.com/2way.htm

Internet broadband access: Satellite hardware
http://www.business2.com/webguide/0,1660,4240,FF.html

By **Ground station** we are referring to the VSAT(Very Small Aperture terminal) and its router which receive from and transmit data to satellites.

Ground Station: By Ground station we are referring to the VSAT(Very Small Aperture terminal) and its router which receive from and transmit data to satellites. As explained earlier, this could be owned by an ISP from which an internet user or network of users could gain access via phone lines and modems or could be owned by an institution or organization itself.



A VSAT consists of two parts, a transceiver (a device that both transmits and receives analog or digital signals) which is placed outdoors in direct line of sight to the satellite and a device that is placed indoors to interface the transceiver with the individual communications device, such as a personal computer. The transceiver receives or sends a signal to a satellite transponder in the sky. The satellite sends and receives signals from a ground station computer that acts as a hub for the system. Each end user is interconnected with the hub station via the satellite, forming a star topology The hub controls the entire operation of the network. For one end user to communicate with another, each transmission has to first go to the hub station that then retransmits it via the satellite to the other end user's VSAT. VSAT can handle up to 56 Kbps.

For more information about satellite dishes, check out:

Satellite Basics

http://www.spacenet.com/tools/satellite_basics/

What is a VSAT?

http://www.gvf.org/vsat_industry/index.htm
http://www.afsat.com/services.htm

VSat Technology
http://www.telesindo.com/vsat-overview.htm

Information on VSATs

http://www.qpcomm.com/vsat_info.html

Frequently asked questions… What would you like to know about VSAT systems?

http://www.comsys.co.uk/vsatinfo.htm#VSAT_FAQ

VSAT?
http://www.donegal-holdings.com/vsat.htm
basic info about vsat and benefits of using it

Some more related issues

C and Ku Satellite Bands
http://www.isp-planet.com/fixed_wireless/technology/2001/band_bol.html

Cband and the advantages of its use
http://www.tripled.com/features/bigdish.htm

Ku Band vs CBand
http://www.kfcf.org/rainfade.htm

http://www.prss.org/ug/resources/gloss_el.htm
appendix with definition for Ku band

Mc Rel Terminology
http://www.mcrel.org/products/tech/satellite/terminology.asp

About KU Band
http://www.celeritek.com/pdf/kuband.pdf

PRSS APPENDIX
http://www.prss.org/ug/resources/gloss_cd.htm

A **Router** is a device that forwards data packets from one local area network (LAN) or wide area network (WAN) to another or from a network to another connection Like in our diagram: a ground station. We're all used to seeing the various parts of the Internet that come into our homes and offices -- the Web pages, e-mail messages and downloaded files that make the Internet a dynamic and valuable medium. But none of these parts would ever make it to your computer without a piece of the Internet that you've probably never seen. In fact, most people have never stood "face to machine" with the technology most responsible for allowing the Internet to exist at all: **the router.**

Routers are specialized devices that send your messages and those of every other Internet user speeding to their destinations along thousands of pathways. They forward data packets from one local area network (LAN) or wide area network (WAN) to another or from a network to another connection, like in our diagram: a ground station.

On the Internet, a router is a device or, in some cases, software in a computer, that determines the next network point to which a packet should be forwarded toward its destination. The router is connected to at least two points and decides which way to send each information packet based on its current understanding of the state of the points it is connected to. A router is normally situated at any gateway (where one network meets another). A router is often included as part of a network.

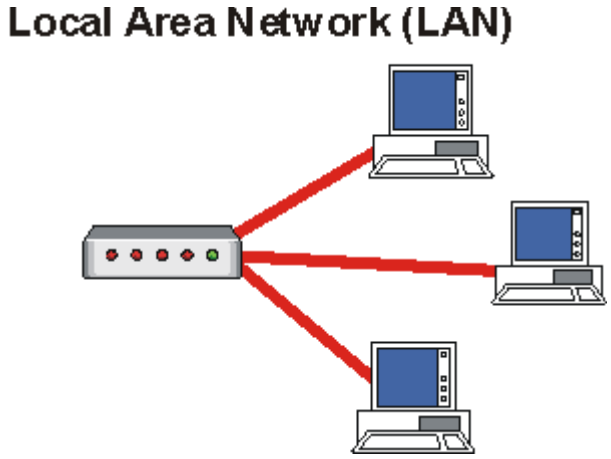
Router may create or maintain a table of the available routes and their conditions and use this information along with distance and cost algorithms to determine the best route for a given packet. Typically, a packet may travel through a number of network points with routers before arriving at its destination. Routers are used to balance traffic within workgroups and to filter traffic for security purposes and policy management. Routers are also used at the edge of the network to connect remote offices.

For more on this check out How stuff works for:

› Introduction to How Routers Work - http://www.howstuffworks.com/router.htm
› Routers Keep The Messages Moving - http://www.howstuffworks.com/router1.htm
› Taking Packets from One Place to Another - http://www.howstuffworks.com/router2.htm

› How Routers Know Where to Send Data - http://www.howstuffworks.com/router3.htm
› Routers Understand the Protocols - http://www.howstuffworks.com/router4.htm
› Tracing a Message - http://www.howstuffworks.com/router5.htm
› Backbone of the Internet - http://www.howstuffworks.com/router6.htm
› Lots More Information! - http://www.howstuffworks.com/router7.htm

A Local Area Network (LAN) is a group of computers and associated devices that share a common communications line and typically share the resources of a single processor or server within a small geographic area (for example, within an office building). Usually, the server has applications and data storage that are shared in common by multiple computer users.



Every computer that is connected to the Internet is part of a network, even the one in your home. For example, you may use a modem and dial a local number to connect to an Internet Service Provider (ISP). At work, you may be part of a local area network (LAN), but you most likely still connect to the Internet using an ISP that your company has contracted with. When you connect to your ISP, you become part of their network. The ISP may then connect to a larger network and become part of their network. The Internet is simply a network of networks. However, while a local area network may serve as few as two or three users , it could also serve thousands of users.

Generally, we can classify network technologies as belonging to one of two basic groups. Local area network (LAN) technologies connect many devices that are relatively close to each other, usually in the same building. The library terminals that display book information would connect over a local area network. Wide area network (WAN) technologies connect a smaller number of devices that can be many kilometers apart. For example, if two libraries at the opposite ends of a city wanted to share their book catalog information, they would most likely make use of a wide area network technology, which could be a dedicated line leased from the local telephone company, intended solely to carry their data.

In comparison to WANs, LANs are faster and more reliable, but improvements in technology continue to blur the line of demarcation. Fiber optic cables have allowed LAN technologies to connect devices tens of kilometers apart, while at the same time greatly improving the speed and reliability of WANs.

A basic scenario of internet access for individual customers or internet users in Nigeria via satellite

So How does Satellite Communication via Satellites work?

Integrators are companies which bring together all sorts of satellite technology components and sell them as a package., ie in most cases, they don't own any satellite nor hub but rather just buy space from a Satellite Service Provider (who has connection to the internet backbone) and sell it in portions to others

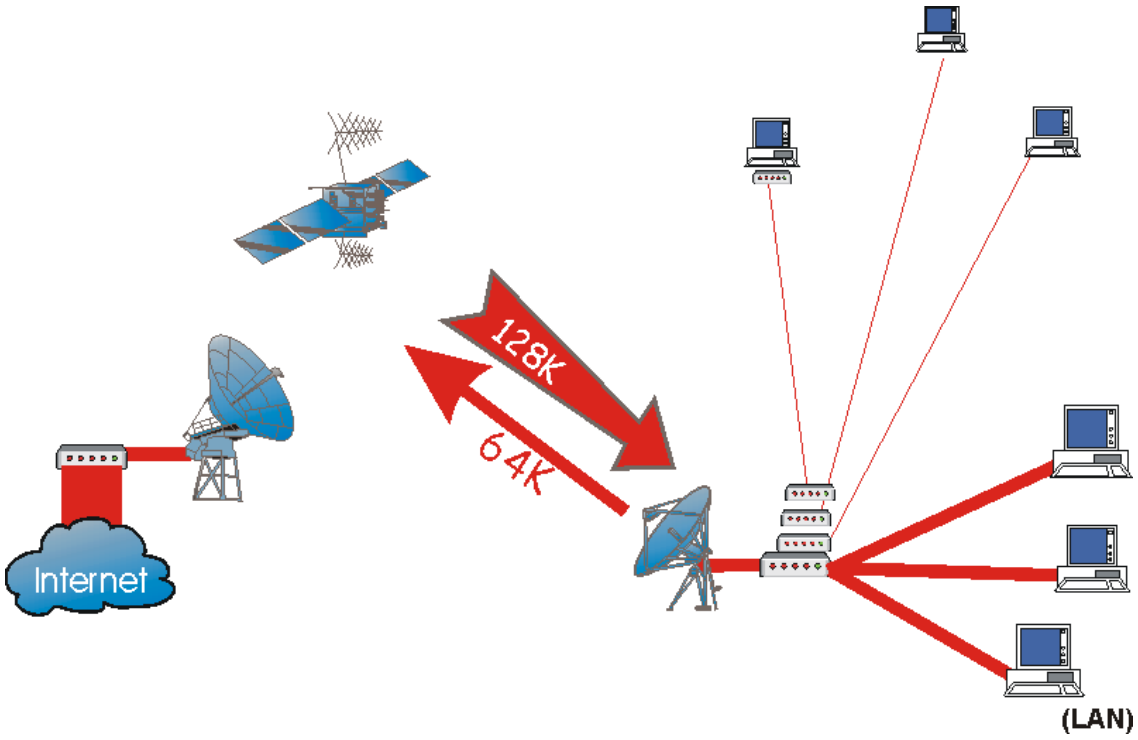
The way a basic Satellite internet connection works

When a customer (internet user) requests for some information, say a webpage, the request passes through its phone line and modem to the VSAT terminal (ground station). From here it passes through the satellite dish (which is the VSAT) to the satellite which requests for this information from the internet via the hub connected to the Internet back bone. Once the information has been gotten from the internet. it then passes back via the same sequence back to the customer. Connections to the Internet via the internet backbone are usually very fast. Thus most Satellite Service Providers site their hubs within close proximity to the internet backbone. What these companies do is to have a hub connected to the internet from which ISP's can buy space on and supply their customers (internet users) through a ground station (if they don't already have one) connected to their computers directly through modems or via a router in the case of a network.

The Nigerian Scenario

What happens in Nigeria is that individuals or companies who want to have access to the internet do so via ISP's which provide them with access to space on a satellite from which the ISP itself has acquired space.

A basic scenario of internet access in Nigeria via a satellite can be depicted as follows



This depicts a ground station that has 128k of digital information coming in and 64K going out. Because of the high cost of transmitting data, most companies have more incoming signals than outgoing ones.

Presently, there are very few ISP's in Nigeria Like Nitel and Skannet which actually have hubs connected to the internet backbone. However, there are numerous options available to internet users wanting internet access and many ways in which satellite technologies can be manipulated to provide them this service. Given the desire for maximal utility and efficiency, internet users must look critically at issues such as; the nature of services that will be rendered, the reliability, the cost, the amount of bandwidth that will be available to them, the speed of the connection etc.

Some Options Available to Nigerian Universities and Companies Desiring Internet Access

Option 1

Given the existence of Nitel, a university or company can just decide to pay Nitel for some of their bandwidth and via either a telephone line, some cables or a wireless connection, hook up to the internet this way. Similarly another option available to internet users is the acquisiton of bandwidth from another company or organization that has a satellite dish whose capacity is not

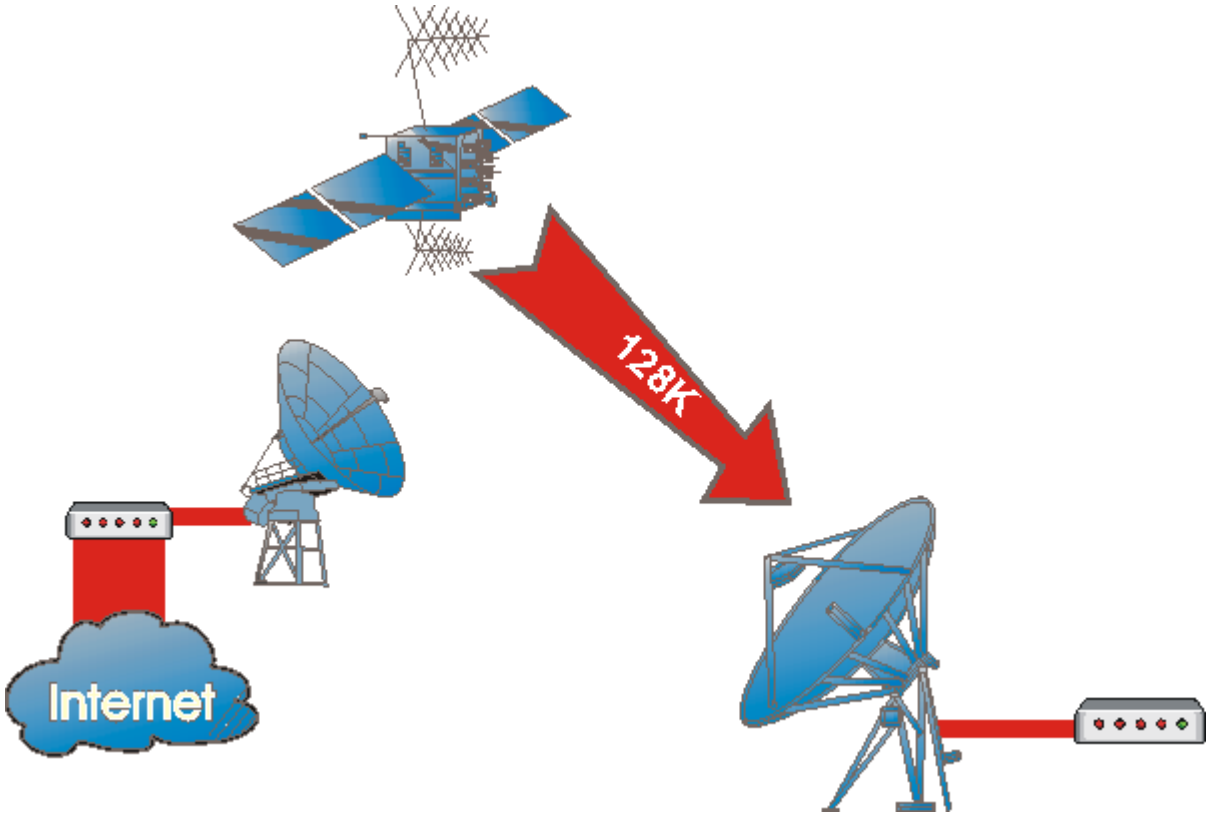
being fully utilized. For example, in the case of the University of Jos with a VSAT connection of 128K but which is capable of about 2MB, it is possible for an organization to pay the University to acquire more bandwidth from its Integrator (BT) and sell a portion of it to them. Once a company or organization has a satellite it is possible for it to spread out its services to others through selling out parts of its own bandwidth.

Option 2

Basically Other than renting space of another company the other general possibility is the aquistion of a satellite. This in itself can also be manipulated into different scenarios

Option 2A:

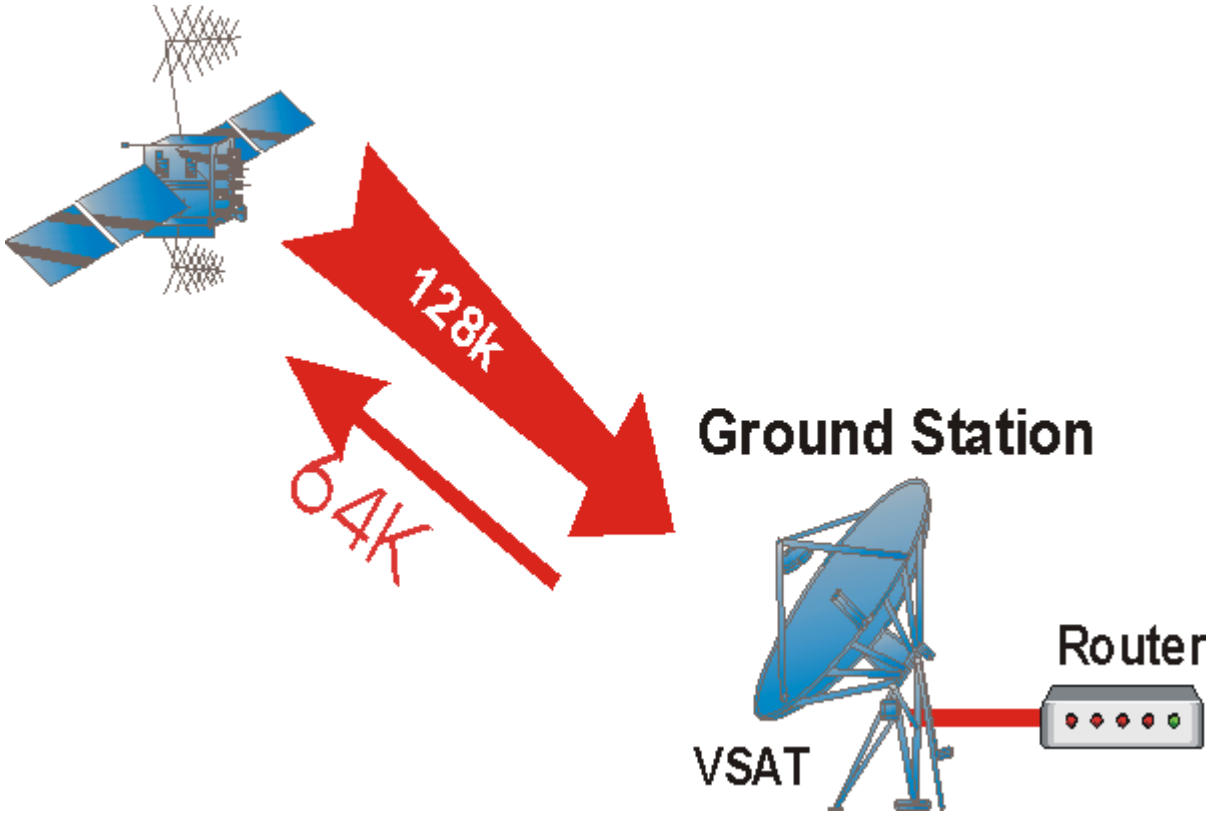
A basic option available to an internet user could be to make use of a receive only satellite system (which only receives signals but doesn't transmit)



In this case the satellite only receives data from the internet via the satellite but doesn't transmit any data to it. Thus in this case the internet user can

Option 2B:

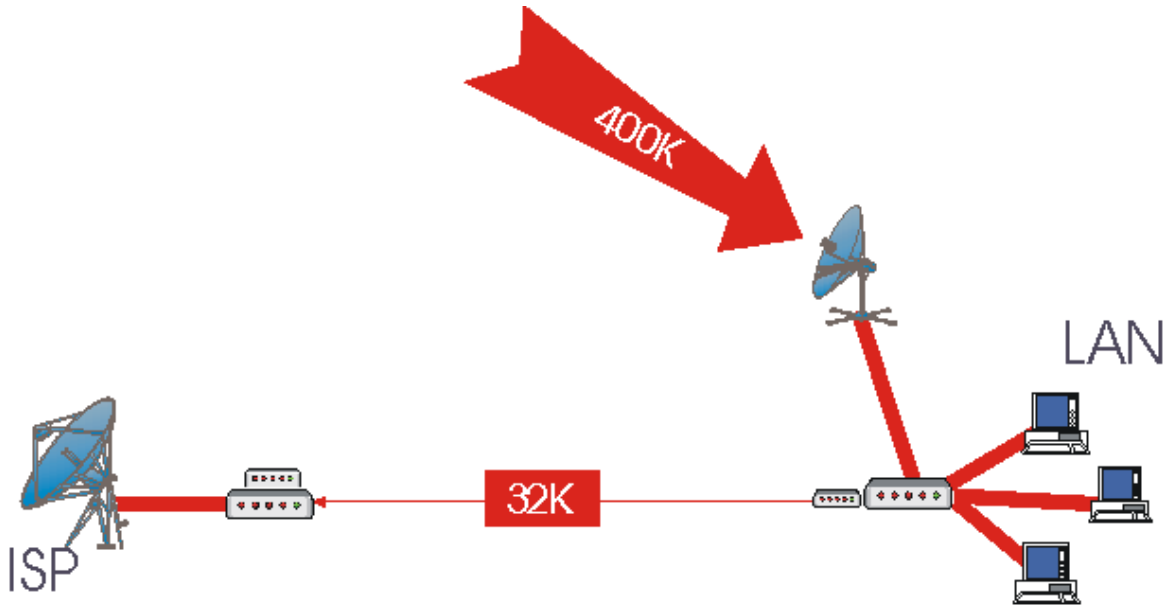
Another option could comprise of a basic 2 way satellite system



This consists of a ground station and a router and some space on a hub connected to the internet back bone.

From the diagram, you may have noticed the difference in the amount of incoming and outgoing data. We can see that the incoming data is much more than the outgoing. As explained earlier, this is normally because of the high cost of transmitting data via satellites. Thus, another option to increase amount of bandwidth accessible to an internet user presents itself:

Option 2C: This is a hybrid system which combines the use of a VSAT and ISP connection



This option involves the use of a low cost receive only satellite satellite system on one hand and a connection to an ISP via a modem connection. In this case the internet user can increase the amount of his incoming bandwidth via the VSAT and still have some means (a 32K link) for outgoing signals.

These are just 3 possible options which can still be further manipulated to give us many more possibilities. However, the key issue to be addressed is the efficiency both in terms of cost effectiveness and reliability.

For more on satellite communication in Developing Countries, check out

An Introduction to using Wireless Technologies in Africa
http://www.idrc.ca/acacia/studies/ir-jens4.htm
IDRC Study
August 31st 1996
Mike Jensen (mikej@wn.apc.org)

The Wireless Toolbox
A Guide To Using Low-Cost Radio Communication Systems for Telecommunication in

Developing Countries - An African Perspective IDRC publication January 1999
http://www.idrc.ca/acacia/03866/wireless/
Satellite Communications for Africa
By JC Bell
http://www.redwingsat.com/DataSheets/PDFs/SA0801a.PDF

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.

Satellite Information for Technicians

Internet broadband access: Satellite hardware	http://www.business2.com/webguide/0,1660,4240,FF.html
Satellite Service Providers	http://www.business2.com/webguide/0,1660,4239,FF.html
Internet Broadband Access	http://www.business2.com/webguide/0,,3692,00.html
Satellite Data Communications	http://www.interlinx.qc.ca/leehogle/satellite.html#elements
Satellite Technology - The Next 5 Years	http://www.hughes-escorts.com/solution_resource/vsatprimer/index.htm http://www.hughes-escorts.com/solution_resource/vsatprimer/satelliteTech.htm
Geostationary telecommunication satellites	http://www.tbs-satellite.com/tse/online/mis_telecom_geo.html
All About Satellites	http://www.latrobe.edu.au/crcss/satellites.html
Geostationary, LEO, MEO, HEO Orbits	http://www.geo-orbit.org/sizepgs/geodef.html
Satellite antennas	http://www.funke.nl/satellit.html
What are transponders?	http://www.hughespace.com/uplink.html
Small Satellites	http://www.ee.surrey.ac.uk/SSC/SSHP
Satellite Technology Catalog	http://www.shelburnefilms.com/satelit0.htm#Install%20Manual