

UNDERSTANDING THE DNS INDUSTRY AND LOCAL HOSTING

.ng Media Collage

26th July, 2019



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HISTORY OF TELEPHONE

International Morse Code

1. The length of a dot is one unit.
2. A dash is three units.
3. The space between parts of the same letter is one unit.
4. The space between letters is three units.
5. The space between words is seven units.

A	• —	U	• • —
B	— • • •	V	• • • —
C	— • • — •	W	• — — —
D	— • • •	X	— • • —
E	•	Y	• • — —
F	• • — •	Z	— — • •
G	— — • •		
H	• • • •		
I	• •		
J	• — — — —		
K	— • • —	1	• — — — —
L	• — • •	2	• • — — —
M	— —	3	• • • — —
N	— •	4	• • • • —
O	— — —	5	• • • • •
P	• — — — —	6	• — • • •
Q	— — • • —	7	— • • • •
R	• — • •	8	— — • • • •
S	• • •	9	— — — • • •
T	—	0	— — — — —

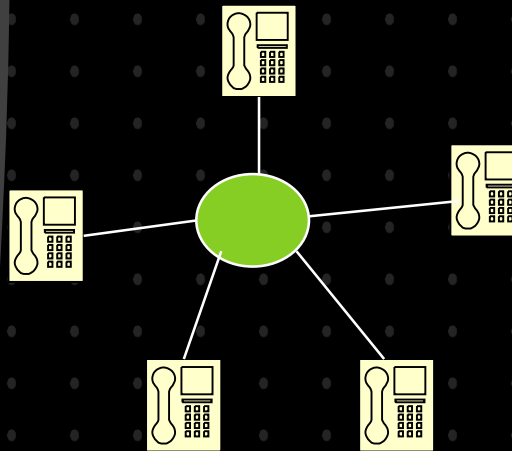
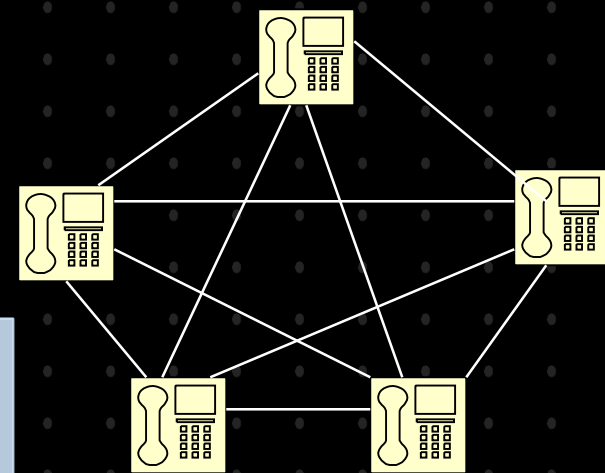
- ▶ Letter and messenger
 - ▶ Information carried by physical objects
 - ▶ Speed limited by transportation means: horse, bird, train, car
- ▶ 1837: Workable telegraph invented by Samuel Morse
- ▶ 1838: Demonstration over 10 miles at 10 w.p.m
- ▶ 1868: transatlantic cable laid
- ▶ Morse Code was dots and dashes, or short signals and long signals



HISTORY OF TELEPHONE CONT.

Alexander Bell
invented telephone

1876



1878

Public switches
installed at New
Haven and San
Francisco, public
switched telephone
network is born

Early Phone Switch Center

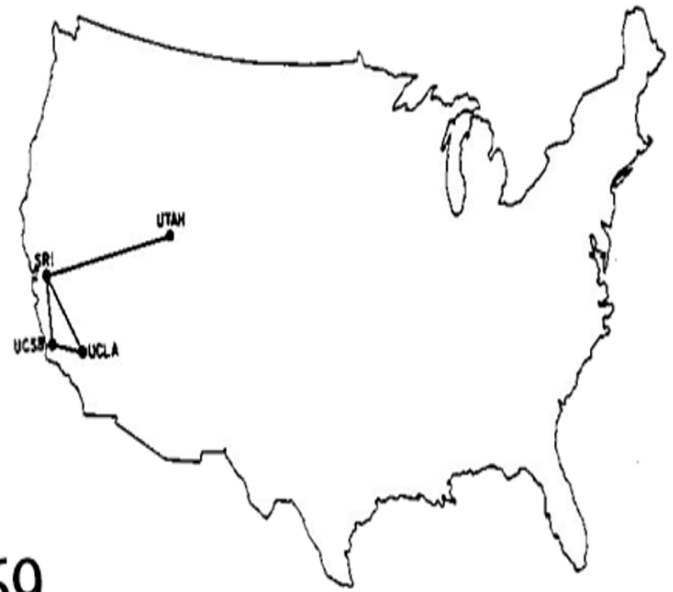


WHAT IS THE INTERNET ?

- ▶ A network of networks, joining many government, university and private computers together and providing an infrastructure for the use of E-mail, bulletin boards, file archives, hypertext documents, databases and other computational resources
- ▶ The vast collection of computer networks which form and act as a single huge network for transport of data and messages across distances which can be anywhere from the same office to anywhere in the world.

A GLANCE AT HISTORY OF THE INTERNET

- ARPANET developed by DARPA
- The first ARPANET link was established between the University of California, Los Angeles and the Stanford Research Institute on 22:30 hours on October 29, 1969 .The early Internet was used by computer experts, engineers, scientists, and librarians.
- Network Access Points (NAPs) established at end of NSFnet
 - The original “exchange points”
- The early internet runs on the telephone infrastructure



1969

A GLANCE AT HISTORY OF THE INTERNET CONT.

- ▶ Internet Assigned Numbers Authority (IANA) was established informally as a reference to various technical functions for the ARPANET.
- ▶ **IANA** is the institution which runs TLDs and deals with assignment of IP addresses and other related attributes.
- ▶ IANA was managed mostly by Joh Postel and Joyce Reynolds.
- ▶ Internet Corporation for Assigned Names Numbers (ICANN) was formed in 25th November, 1988.
- ▶ 14th March, 2014 - NTIA Announces Intent to Transition Key Internet Domain Name Functions.

SUMMARY OF MAJOR INTERNET ACCESS TECHNOLOGIES



Fixed Line Narrowband

- Dialup
- ISDN (Integrated Services Digital Network)

Fixed Line Broadband

- DSL (ADSL, SDSL)
- Cable and Hybrid Fibre (FTTC, G.fast)
- Fiber Optic (FTTH, FTTP, FTTB)
- Powerline Communications

Wireless Broadband

- Fixed Wireless Access (Wifi, WiMAX)
- Mobile (2G, 3G, 4G, 5G)
- Satellite (C band, KU band, K band, KA band)

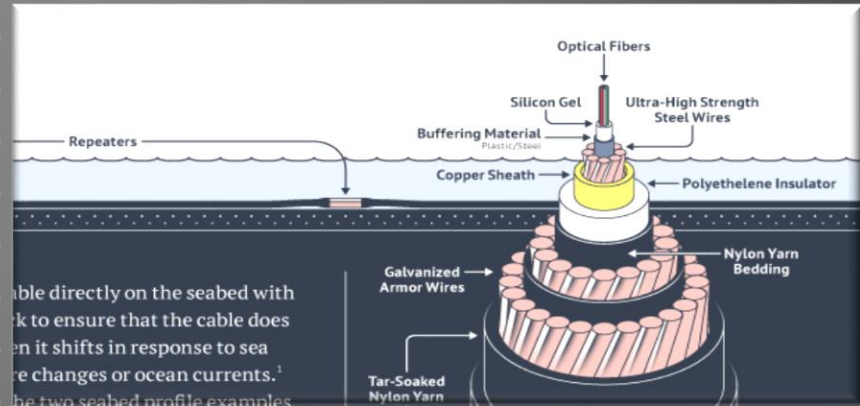
**LINKING THE
WORLD –
THE
SUBMARINE
CABLE
SYSTEM**

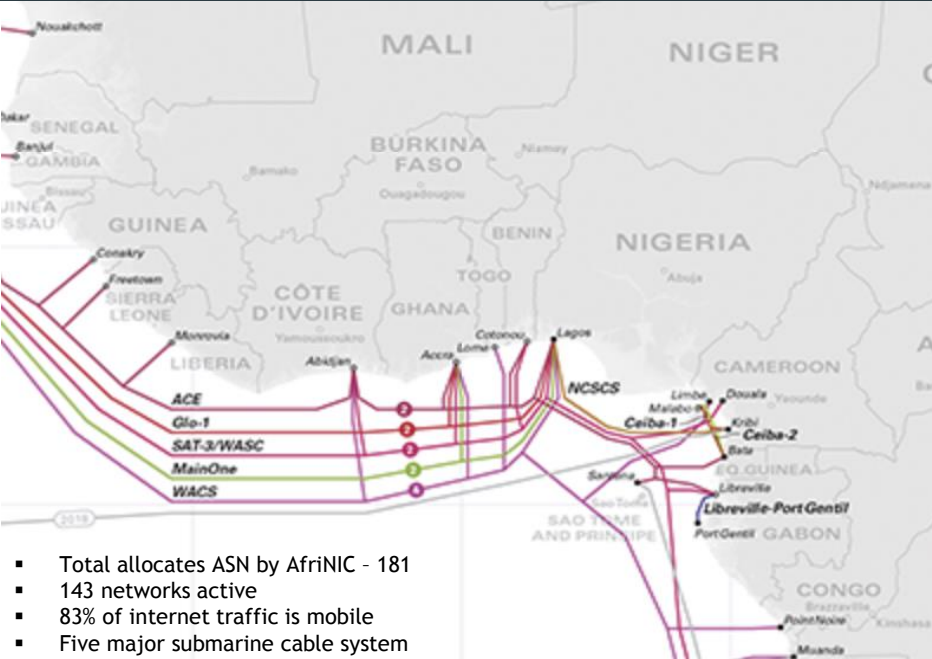


THE SUBMARINE CABLE SYSTEM



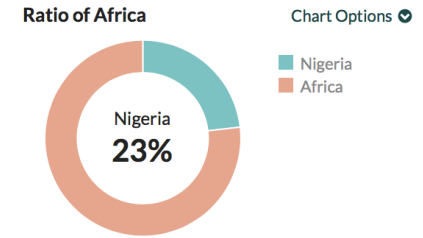
This is an undersea cable to run between the USA and the UK. 53 TBps fiber optic, 4568 km long and cost 300 million.



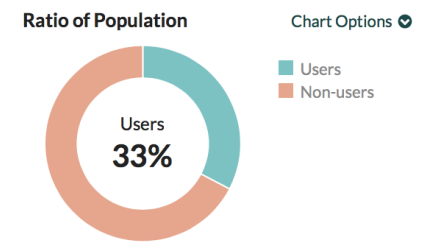


- Total allocates ASN by AfriNIC - 181
- 143 networks active
- 83% of internet traffic is mobile
- Five major submarine cable system

Internet Users
90,192,646
 People



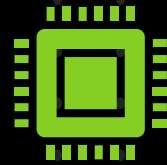
Population
185,989,640
 World bank data.



Internet in Nigeria

<https://wider.isoc.org.za/profiles/country-NG-nigeria/>

INTRODUCTION TO INTERNET PROTOCOL (IP)



Every device connected to the Internet needs a unique number, known as an IP address. There are two types of IP address: IPv4 and IPv6. When the commercial Internet was in its infancy, the pool of around 4 billion IPv4 addresses seemed huge. No one could have predicted the impact the Internet had on our lives and it soon became clear that the pool of IPv4 addresses was not going to last as long as was hoped. IPv6 was developed as the solution. The pool of IPv6 addresses contains 2^{128} IPv6 addresses, or roughly 340 trillion, trillion, trillion addresses.



However, IPv4 and IPv6 are not directly compatible. This means that network and content operators need to make their networks and websites available over both IPv4 and IPv6 for the foreseeable future so that everyone can access the Internet whether they are using an IPv4 or an IPv6 address to do so.

WHAT IS AN IP ADDRESS

- ▶ An IP address is a unique number that identifies a computer on a TCP/IP network. An IP address also gives routing information. IP addresses are logically assigned.
- ▶ The network adapter has a physical (MAC) address. The MAC address is a permanent part of that adapter. The MAC address is only useful on the same physical LAN segment.
- ▶ The IP address is used to route packets between networks. When a message reaches the physical segment of the destination host, the IP address is matched to a physical address by the router.
- ▶ An IP address usually uses dot decimal notation, with the decimal values separated by periods (for example, **10.1.2.3**). Each dot-separated number is a decimal representation of one byte (8 binary digits, or bits) of the 32-bit address. IP addresses are made up of two parts: a network number, referring to the network that the computer is part of, and a unique host number, specific to the computer that uses that IP address.



SNAPSHOT OF IPV4 & IPV6

IPV4

Deployed 1981

Address Size:

32-bit number

Address Format:

Dotted Decimal Notation:

192.149.252.76

Prefix Notation:

192.149.0.0/24

Number of Addresses:

$2^{32} = \sim 4,294,967,296$

IPV6

Deployed 1999

Address Size:

128-bit number

Address Format:

Hexadecimal Notation:

3FFE:F200:0234:AB00:0123:4567:8901:ABCD

Prefix Notation:

3FFE:F200:0234::/48

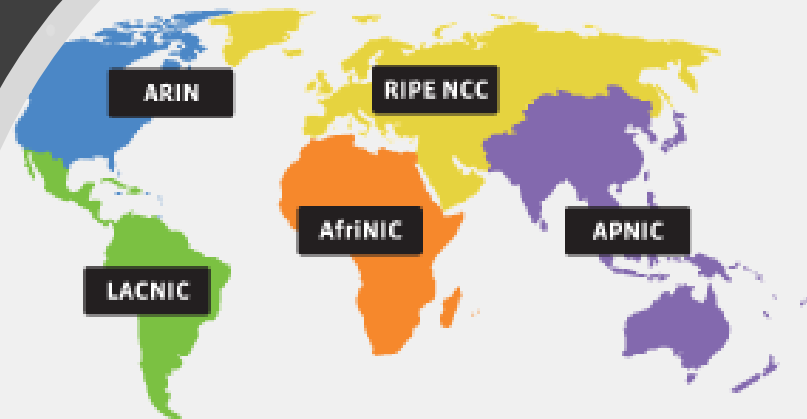
Number of Addresses:

$2^{128} =$

$\sim 340,282,366,920,938,463,463,374,$
 $607,431,768,211,456$

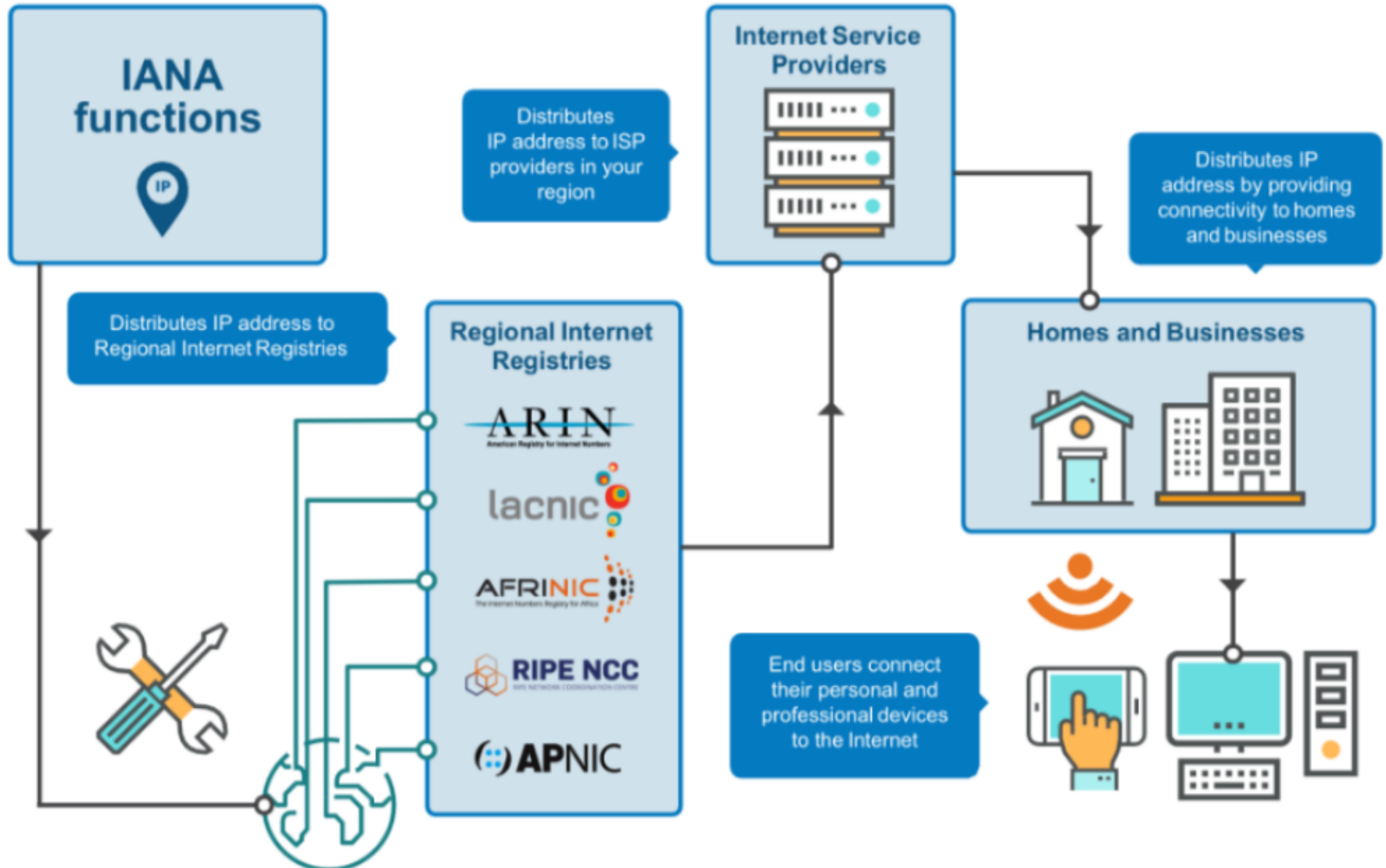
WHO ALLOCATES IPs?

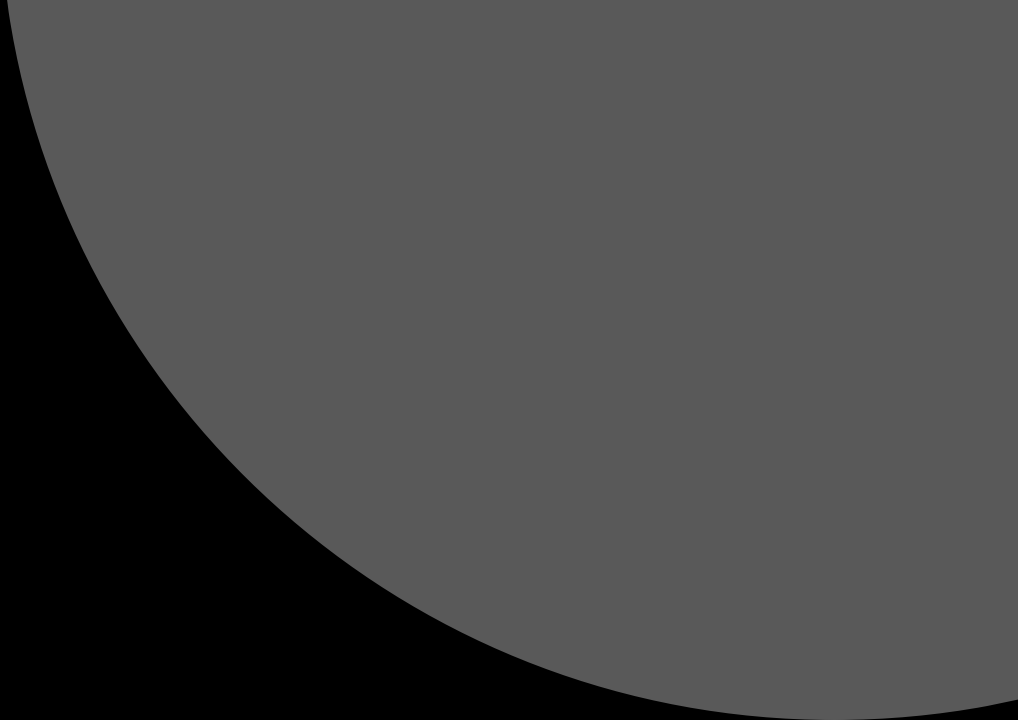
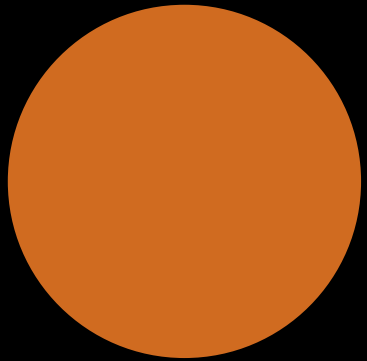
- The Internet Assigned Numbers Authority (IANA) manages the IP address space allocations globally and delegates five regional Internet registries (RIRs) to allocate IP address blocks to local Internet registries (Internet service providers) and other entities.
- IANA is operated by the Internet Corporation for Assigned Names and Numbers, also known as ICANN.



Registry	Area Covered
AfrINIC	Africa Region
APNIC	Asia/Pacific Region
ARIN	North America Region
LACNIC	Latin America and some Caribbean Islands
RIPE NCC	Europe, the Middle East, and Central Asia

How Internet Protocol (IP) Addresses are Distributed





THE DOMAIN NAME SYSTEM(DNS)



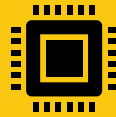
OVERVIEW OF THE DOMAIN NAME SYSTEM

- ▶ **DNS** is an abbreviation for **Domain Name System**, a system for naming computers and network services that is organized into a hierarchy of domains. **DNS** naming is used in TCP/IP networks, such as the Internet, to locate computers and services through user-friendly names.

COMPUTERS USE IP ADDRESSES. WHY DO WE NEED NAMES?



Easier for people to remember because it is hard to remember everyone's IP address



Computers may be moved between networks, in which case their IP address will change



The DNS makes it easier by allowing a familiar string of letters (the "domain name") to be used instead of the arcane IP address.



So instead of typing 52.24.164.21, you can type www.nigeria.gov.ng. It is a "mnemonic" device that makes addresses easier to remember

NAMES AND ADDRESSES IN GENERAL

- ▶ An address is how you get to an endpoint
 - Typically, hierarchical (for scaling):
 - 8th Floor, NCR Building,
Broad Street, Marina,
Lagos, Nigeria
- ▶ “A name indicates what we seek. An address indicates where it is. A route indicates how we get there.”

~ Jon Postel

NAMING HISTORY

- ▶ 1970's ARPANET
- ▶ 1980's NSFNET
 - Host.txt maintained by the SRI-NIC
 - pulled from a single machine
 - Problems
 - traffic and load
 - Name collisions
 - Consistency
- ▶ DNS created in 1983 by Paul Mockapetris (RFCs 882 & 883 which described the DNS, these RFC's were superseded by RFC's 1034 & 1035), modified, updated, and enhanced by a myriad of subsequent RFCs.

THE DOMAIN NAME SYSTEM WAS BORN



DNS is a Distributed Database for holding name to IP address (and other) information



Distributed:

Shares the administration
Shares the load



Robustness and performance through:

Replication
Caching



A critical piece of Internet infrastructure

OLD SOLUTION: HOSTS.TXT

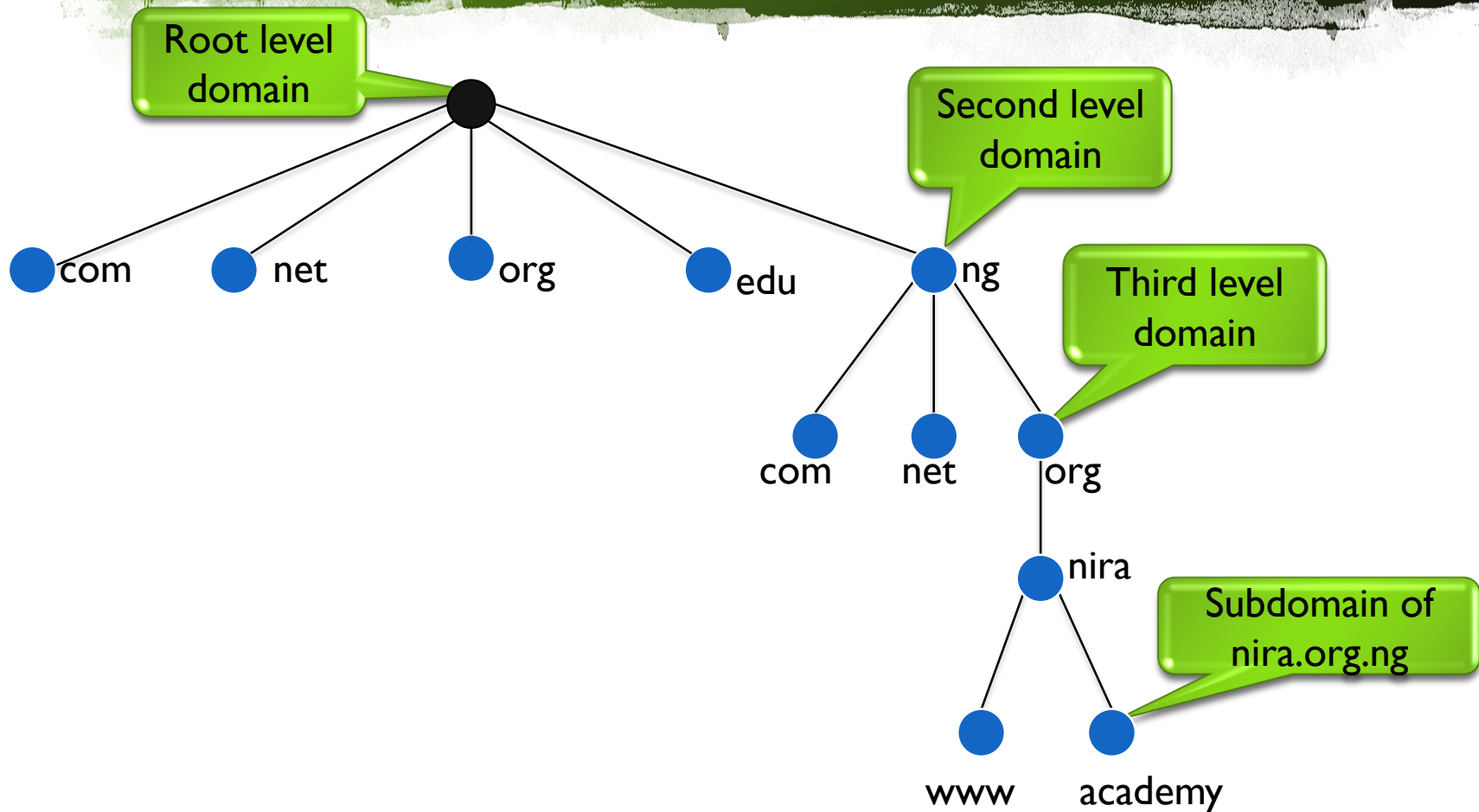
**A centrally-maintained file,
distributed to all hosts on the
Internet**

This feature still exists:

- ▶ /etc/hosts [Unix]
- ▶ c:\windows\system32\drivers\etc\hosts [Windows]

```
196.216.148.233    monitoring.ixp.net.ng
196.216.149.45    www.ixp.net.ng
192.168.1.1       File-server
```

NEW SOLUTION: DNS IS HIERARCHICAL

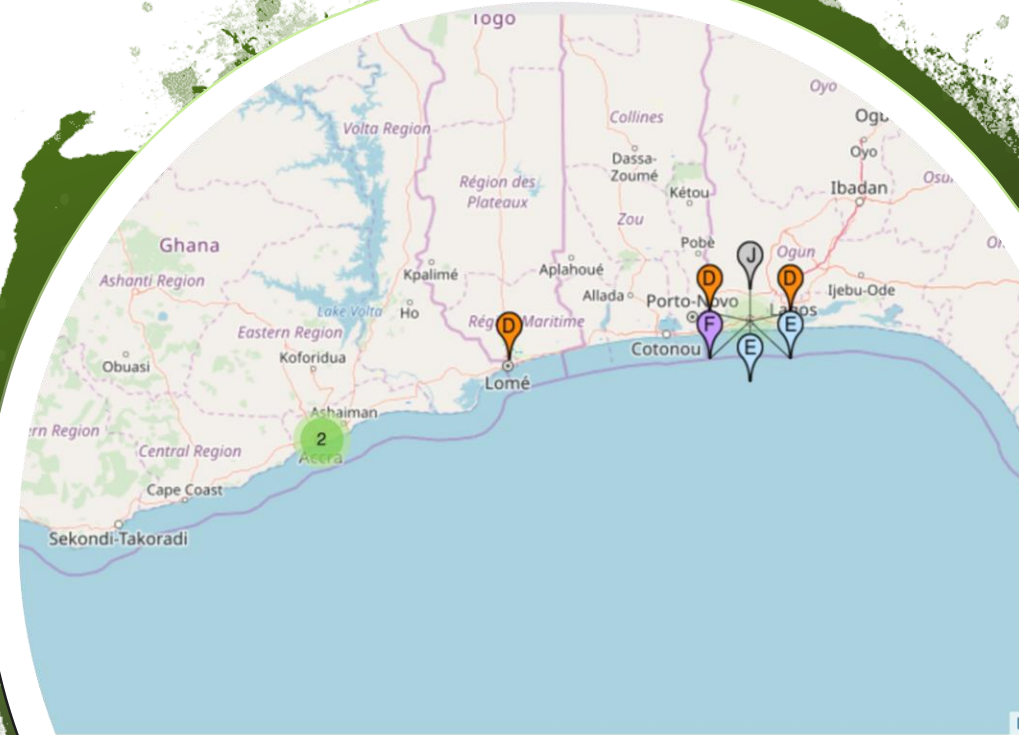


THE 13 ROOT SERVERS

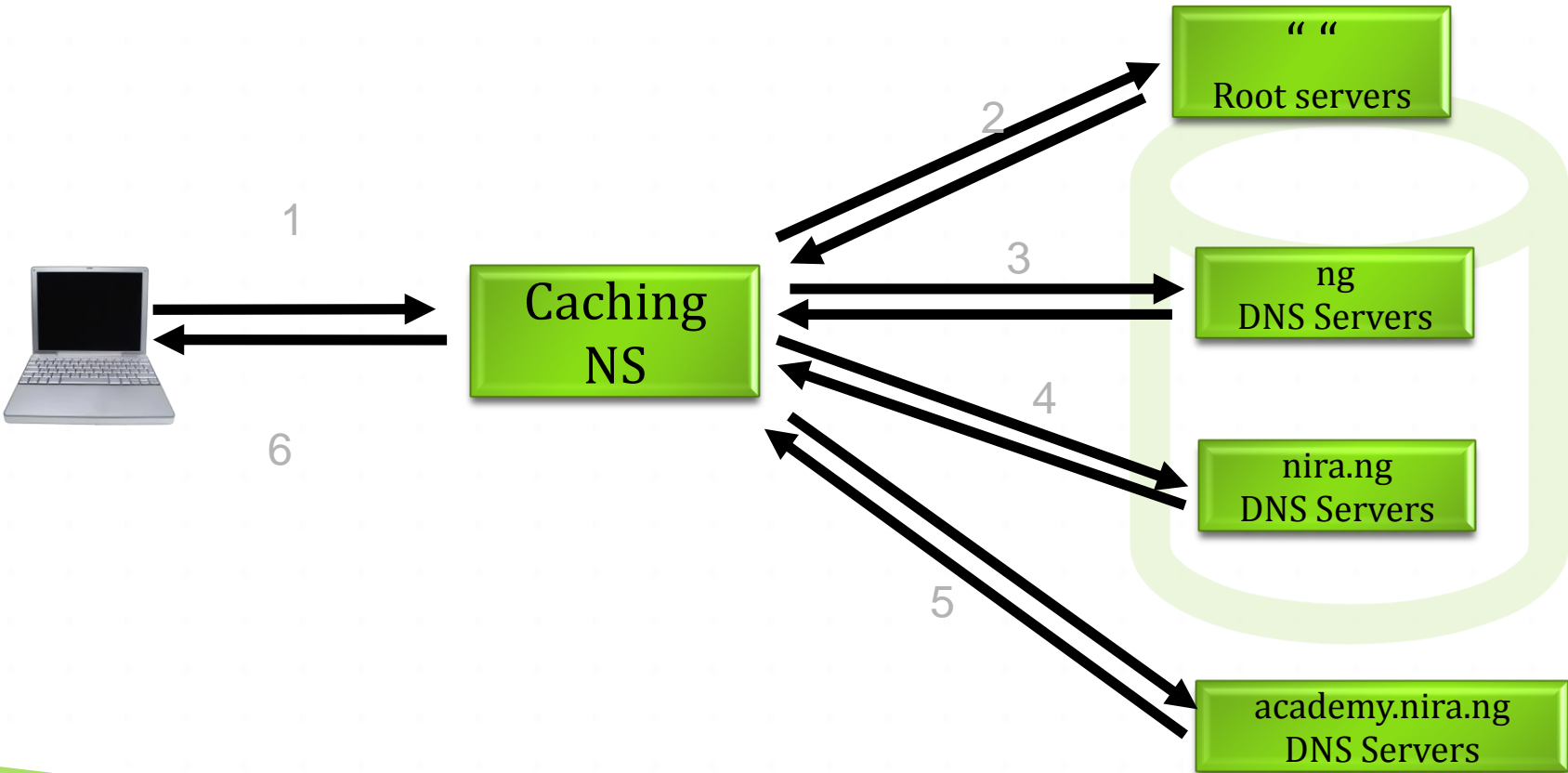
List of Root Servers

Hostname	IP Addresses	Manager
a.root-servers.net	198.41.0.4, 2001:503:ba3e::230	VeriSign, Inc.
b.root-servers.net	192.228.79.201	University of Southern California (ISI)
c.root-servers.net	192.33.4.12	Cogent Communications
d.root-servers.net	199.7.91.13, 2001:500:2d::d	University of Maryland
e.root-servers.net	192.203.230.10	NASA (Ames Research Center)
f.root-servers.net	192.5.5.241, 2001:500:2f::f	Internet Systems Consortium, Inc
g.root-servers.net	192.112.36.4	US Department of Defence (NIC)
h.root-servers.net	128.63.2.53, 2001:500:1::803f:235	US Army (Research Lab)
i.root-servers.net	192.36.148.17, 2001:7fe::53	Netnod
j.root-servers.net	192.58.128.30, 2001:503:c27::230	VeriSign, Inc.
k.root-servers.net	193.0.14.129, 2001:7fd::1	RIPE NCC
l.root-servers.net	199.7.83.42, 2001:500:3::42	ICANN
m.root-servers.net	192.27.33, 2001:dc3::35	WIDE Project

- Source: <https://root-servers.org>



HOW DNS QUERY WORKS



CACHING
REDUCES THE
LOAD ON
AUTH
NAMESERVERS

Especially important at the higher levels: root servers, GTLD servers (.com, .net ...) and ccTLDs

All intermediate information is cached as well as the final answer - so NS records from REFERRALS are cached too

TOP LEVEL DOMAIN (TLD)

- ▶ Country-code top-level domains (ccTLD): Two letter domains established for countries or territories - ISO 3166
- ▶ Internationalized country code top-level domains (IDN ccTLD): ccTLDs in non-Latin character sets (e.g., Arabic or Chinese).
- ▶ Generic top-level domains (gTLD): Top-level domains with three or more characters
- ▶ Sponsored top-level domains (sTLD): These domains are proposed and sponsored by private agencies or organizations that establish and enforce rules restricting the eligibility to use the TLD.
- ▶ Infrastructure top-level domain : This group consists of one domain, the Address and Routing Parameter Area (ARPA).



REGULATORY BODY OF THE INTERNET

Internet Corporation for Assigned Names and Numbers (ICANN)



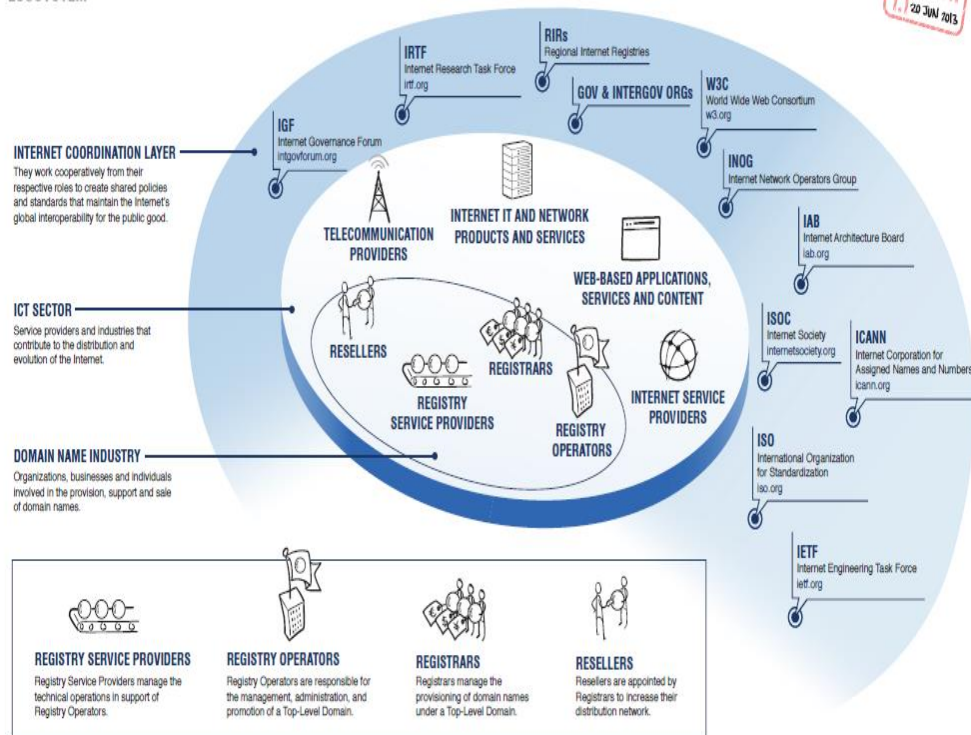
At the heart of ICANN's policy-making is what is called a “**multistakeholder model.**” This decentralized governance model places individuals, industry, non-commercial interests and government on an equal level. Unlike more traditional, top-down governance models, where governments make policy decisions, the multistakeholder approach used by ICANN allows for community-based consensus-driven policy-making. The idea is that Internet governance should mimic the structure of the Internet itself borderless: and open to all.

THE DOMAIN NAME ECOSYSTEM

Source:
<https://newgtlds.icann.org/en/announcements-and-media/infographics/dns-industry-ecosystem>

THE DOMAIN NAME INDUSTRY ECOSYSTEM

VERSION 1.1 20 JUN 2015



This graphic is a living document, designed to provide a high level view of the relationship between the different parties of the Domain Name Industry. It is for illustrative purposes only and is not intended to be a definitive guide. Some of the names of the documents may vary. Please provide feedback at www.updatelists.com/domainnameindustry

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REGIONAL INTERNET ASSOCIATIONS - ccTLDs

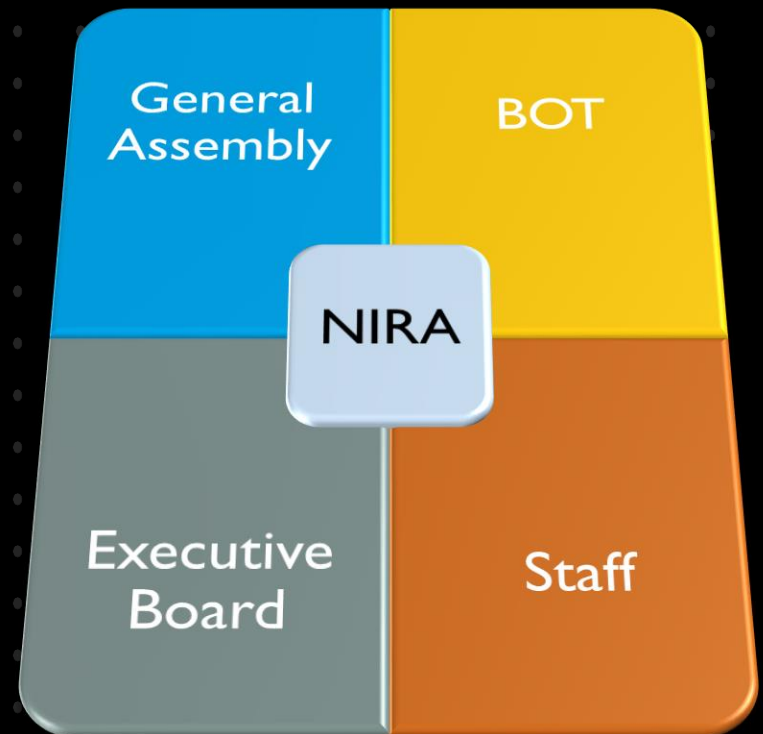
- ▶ AfTLD: African Top Level Domain
- ▶ CENTR: Council of European National Top Level Domain Registries
- ▶ APTLD: Asia Pacific Top Level Domain
- ▶ LACTLD: Latin America and Caribbean ccTLD



NIRA STRUCTURE

NIRA is a Not-For-Profit , Multi- stakeholder, Membership based Organization. NIRA operates the 3R (Registry, Registrar and Registrant) Model

- General Assembly – All Stakeholders
- 9 Board of Trustees
- 10 Executive Board
- Permanent Staff
- Committees :
 - Establishment & Finance
 - Technical
 - Accreditation & Business Development
 - Audit
 - Communication & Publicity
 - Domain name policy
 - Stakeholder Engagement



CSR ACTIVITIES OF NIRA

- NiRA Academy
- Ndukwe Kalu Foundation (NKF)
- .ng Awards
- NiRA E-library
- .ng Media College
- Internship Programmes
- NG Internet Crime Advisory Group (NICAG)
- Youth Empowerment Activities – training, workshops
- Sponsorships/partnership (NITDA, NCC, NIGF, NACOSS, ngNOG, etc.)
- Participation at conferences, Workshops, Exhibitions, etc.



GLOBAL DOMAINS NAME STATISTICS

1994 - approximately 30,000
domain names worldwide

2019 – Over 351 Million
Domain Names

CENTRstats Global TLD Report 2018/1

Global TLD Market

GLOBAL MARKET | APR 2018

Estimate domains/growth of all TLDs*

		Growth (YOY)*	Domains (est. million)
ccTLDs	Africa (58)	16.2%	3.3
	Americas (53)	3.6%	13.7
	Asia (98)	1.8%	37.6
	Europe (58)	3.6%	72.2
gTLDs (1,238)		0.2%	186.5
		1.4%	333.1

History

The Applicant Guidebook has gone through several iterations in draft form and is the result of years of careful implementation of GNSO policy recommendations and thoughtful review and feedback from the ICANN stakeholder community. Each version of the Applicant Guidebook was posted for public comment. More than one thousand public comments have been reviewed and considered, making the program what it is today.



Applicant Guidebook June 2012
• January 2012

2011

Applicant Guidebook September 2011

- May 2011
- April 2011 Discussion Draft
- November 2010 (Proposed Final version)
- May 2010 (version 4)
- February 2010 (excerpts)
 - October 2009 (version 3)
 - May 2009 (excerpts)
 - March 2009 (version 2)

2010

The first version of the Applicant Guidebook was posted October 2008. The Applicant Guidebook documents how ICANN has implemented the GNSO policy recommendations and is a comprehensive guide for applicants on the program's requirements and evaluation process.

2009

Applicant Guidebook (version 1) Oct. 2008

2008

In June 2008, during ICANN's Paris meeting, the ICANN Board approved the GNSO recommendations for introducing new gTLDs to the Internet's addressing system.

2007

ICANN's Generic Names Supporting Organization (GNSO) conducted their policy development process between December 2005 and September 2007. This work produced a set of principles and recommendations on what should be included when implementing the program.

2005

2004

.asia, .cat, .jobs, .mobi,
.post, .tel, .xxx, and .travel

ICANN successfully carried out two previous application rounds for new gTLDs

2000

.aero, .biz, .coop, .info,
.museum, .name, and .pro

Eight gTLDs predate ICANN's creation

Before 1998

.com, .edu, .gov, .int,
.mil, .net, .org, and .arpa

HISTORY OF GTLD

NEW GTLD APPLICATIONS TO ICANN



Application Statistics: Overview (as of 30 June 2019)

Total Applications Submitted	1930
Completed New gTLD Program (gTLD Delegated** - introduced into Internet)	1232
Applications Withdrawn	638
Applications that Will Not Proceed/Not Approved	43
Currently Proceeding through New gTLD Program*	17

AN OVERVIEW OF LOCAL HOSTING

The Internet statistics - ESTIMATES



There are over **4.4 billion** internet users worldwide out of the **7.7 Billion**.



About **351 million** registered domain at June 2019.



2.41 billion monthly active users at the end of June 2019. On average more than **350 million photos** uploaded to Facebook per day in 2017. **10 billion** Facebook messages are sent each day.



5 hours of video is uploaded to YouTube *every second* - 300 hours a minute, a decade every 5 hours and a *century* every 2 days- (more video uploaded in 1 day than NTA broadcasted in the past 40 years – assuming it runs 24/7).

Source:

- <https://newsroom.fb.com/company-info/>
- www.wikipedia.org
- <https://www.youtube.com/yt/about/press/>



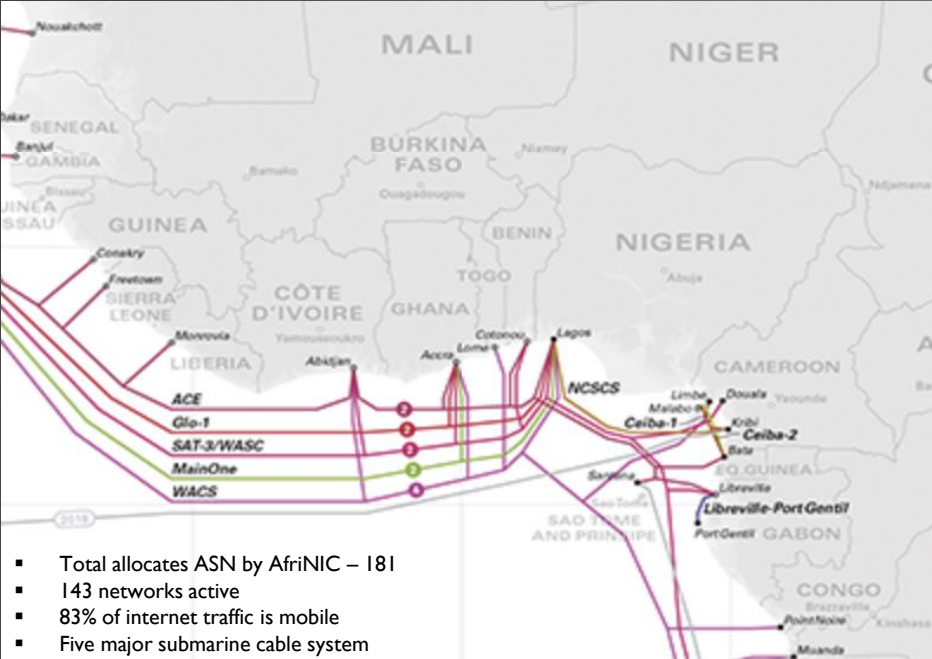
Wikipedia- the largest encyclopedia ever assembled has **25 million articles** (over 5 Million in English alone) in 285 Languages.

In 2015, Michael Mandiberg published the English Wikipedia as a **7473 volume set** of volumes 700 pages long. Each volume is assumed to be 25 cm tall, 5 cm thick, and containing 1,600,000 words or 8,000,000 characters.



Market Capitalization

- ☐ Amazon - \$984 billion
- ☐ Google - \$791 billion
- ☐ Facebook- \$590 billion



Internet Users

90,192,646
People

Ratio of Africa

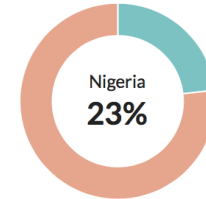


Chart Options

■ Nigeria
■ Africa

Population

185,989,640
World bank data.

Ratio of Population

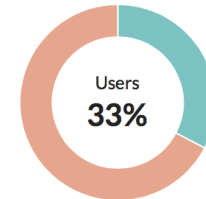


Chart Options

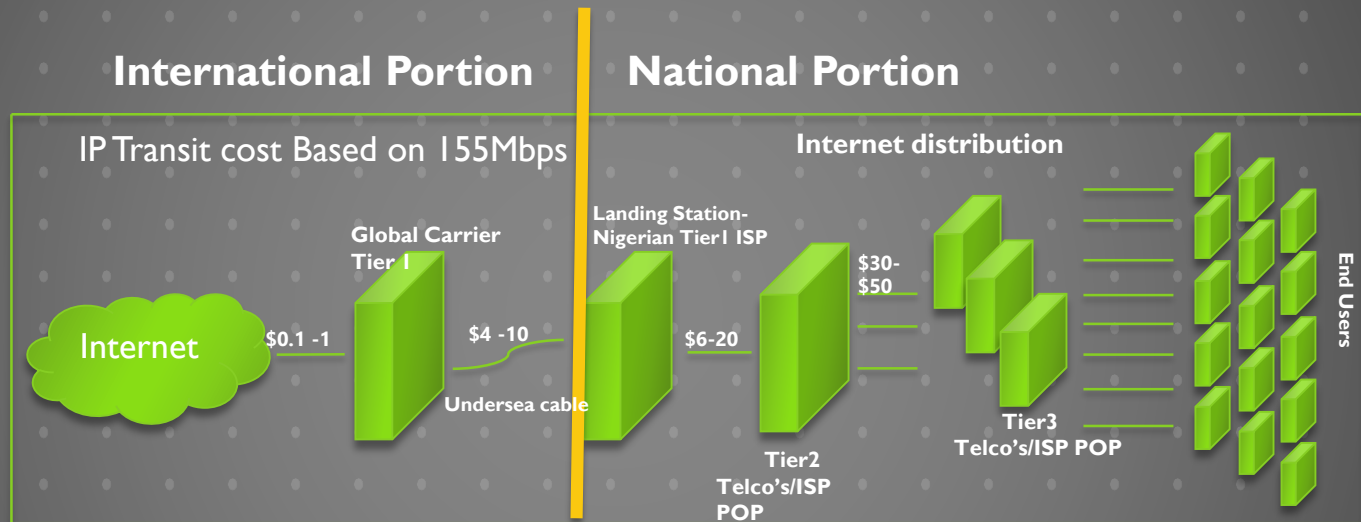
■ Users
■ Non-users

INTERNET IN NIGERIA

<https://wider.isoc.org.za/profiles/country-NG-nigeria/>

**With the awesome growth of the
internet content : where does
Nigeria stand ?**

WHY WE PAY MORE FOR INTERNET

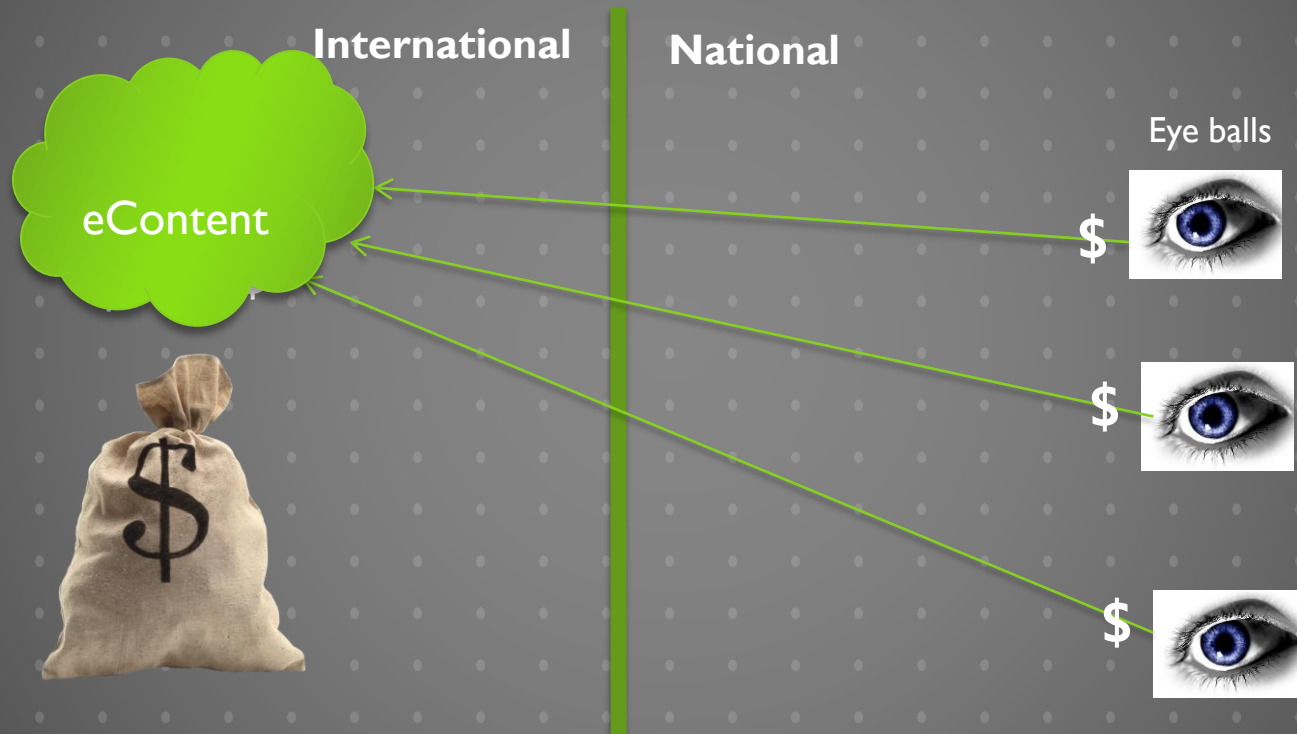


Increase in cost of IP at various point towards the Nigerian end users

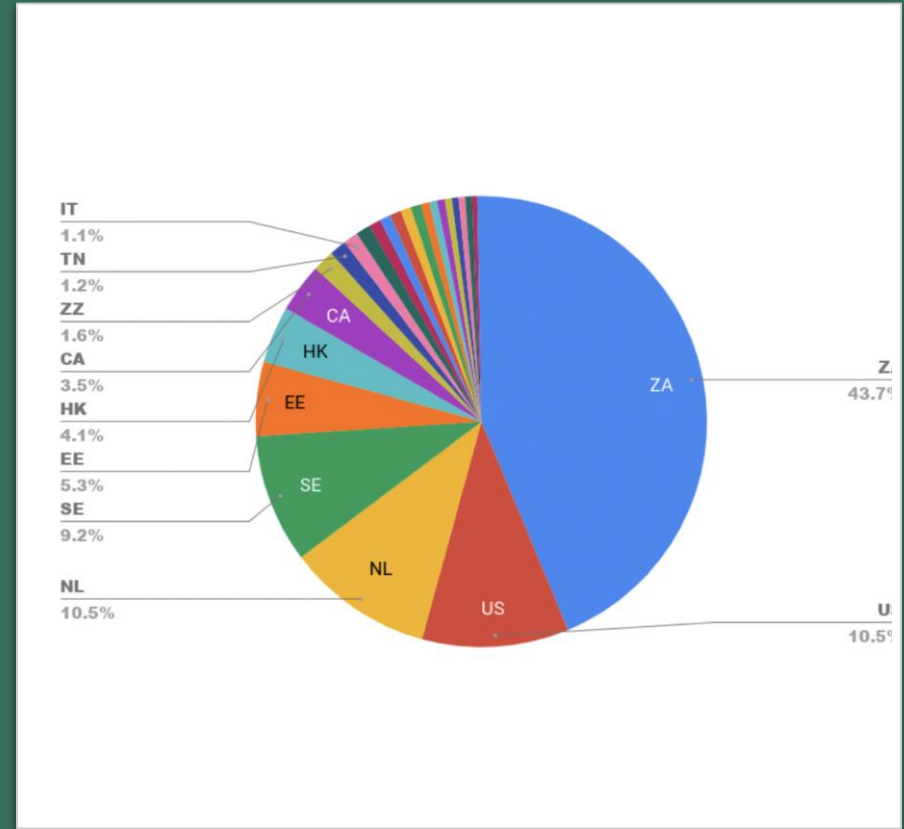


Cost increases as you move further away from the content

LOCAL HOSTING AS A DRIVER FOR ECONOMIC GROWTH



Nigeria is a net “**Importer**” of bandwidth. i.e More **DOWNLOADS** than **UPLOADS**

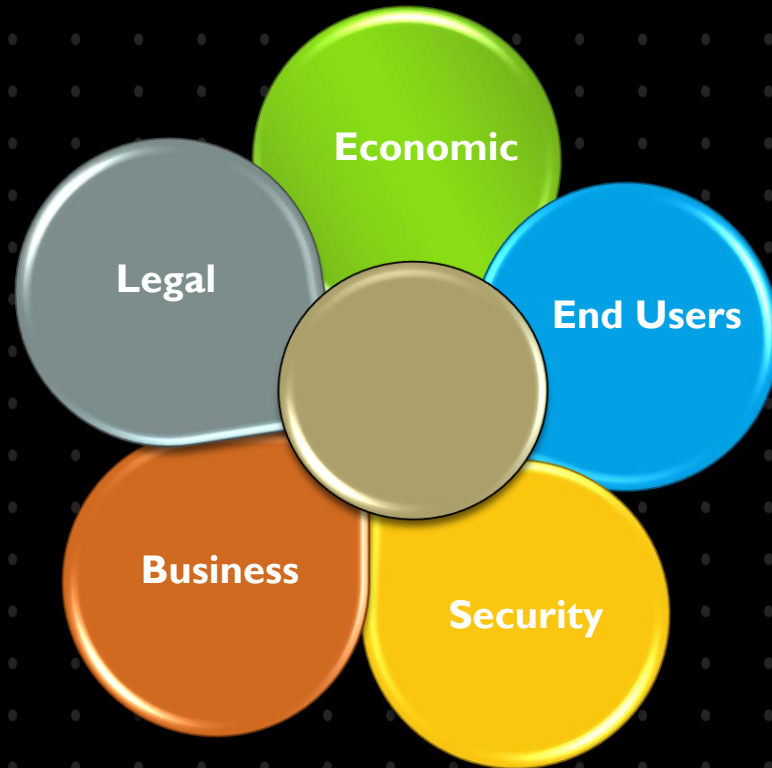


LOCATION OF AFRINIC IPS USED FOR HOSTING

Source: Cloudflare and TeleGeography

<https://blog.cloudflare.com/african-traffic-growth-and-predictions-for-the-future/>

IMPLICATIONS OF OVERSEAS DATA HOSTING





ABOUT IXPN

- WSIS summit in Tunisia 2005
- The president directed FMIC to establish an IXP in Nigeria
- NCC called a stakeholders forum in February 2006
- ISPAN chaired the implementation committee
- Internet eXchange Point of Nigeria (IXPN) LTD GTE is a not-for-profit and neutral organization
- NCC inaugurates an interim board in March 2007

The Role of IXPN



Keeping Nigerian
Internet traffic local



Reduces costs for
access to local
content



Enhance local
connectivity and
improve internet
experience of end
users



Promote and
encourage the
creation of local
content



Build technical skills
and capacity

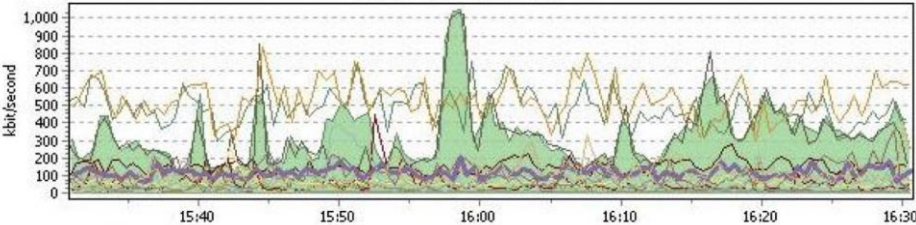


Act as an efficient
centralized service
launch point

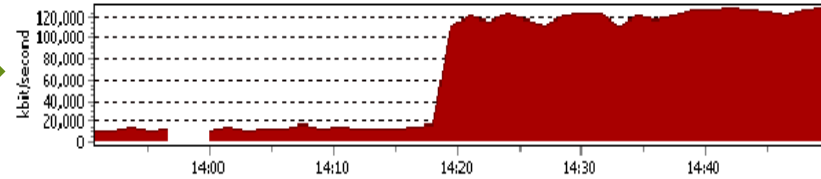
IXPN's IMPACT ON LOCAL TRAFFIC - 10,000% Increase in 5 years and localizing 50% of Internet traffic by connected ISPs.

July 2008

Live Graph
Last 60 Minutes - 30 sec Interval



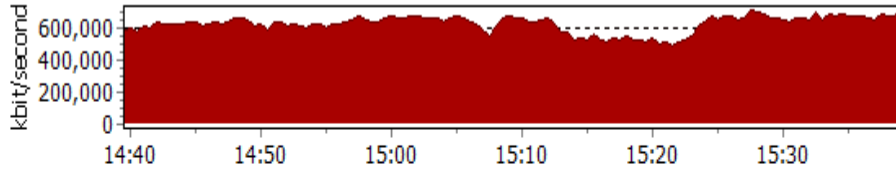
Live Graph - 60 Minutes - 90 sec Interval March 2011



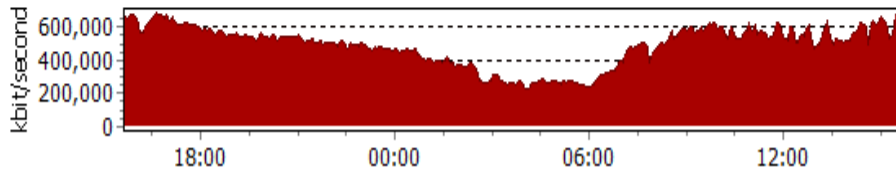
Sudden jump in traffic after the connection of a major content provider to IXPN.

June 2012

Live Graph - 60 Minutes - 30 sec Interval



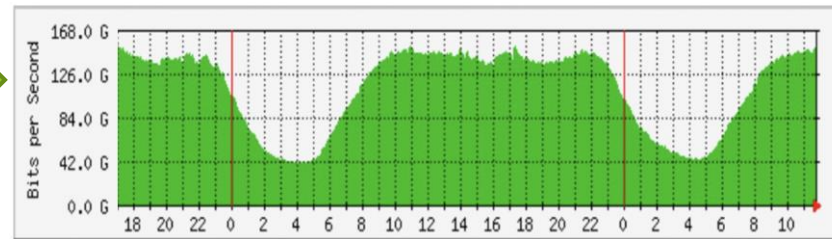
5 min Averages - 24 Hours



July 2019

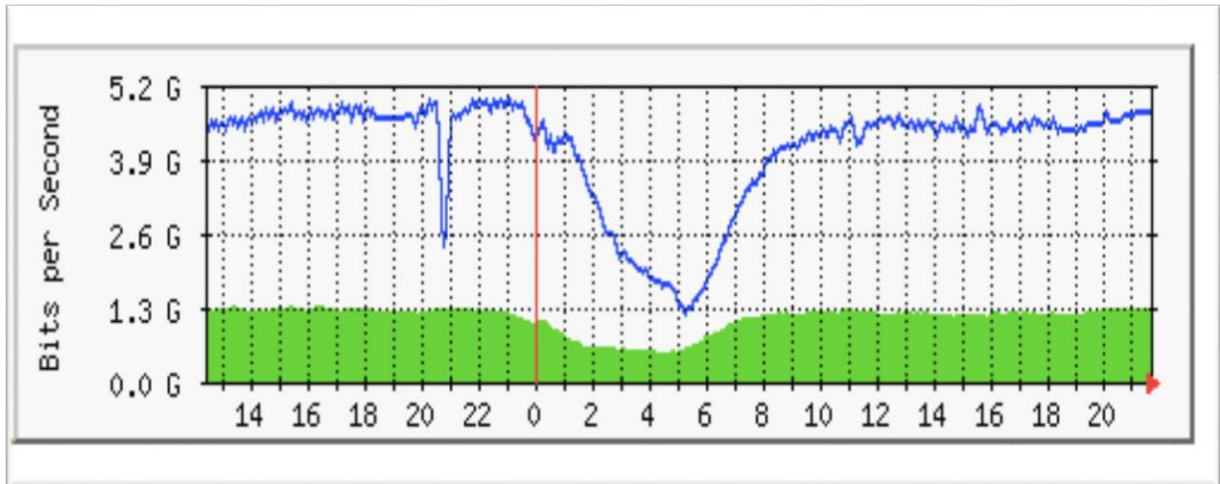
The statistics were last updated Wednesday, 10 July 2019 at 12:03

'Daily' Graph (1 Minute Average)



Max	Average	Current
160.9 Gb/s	114.4 Gb/s	139 Gb/s

IXPN'S IMPACT ON BANDWIDTH COST

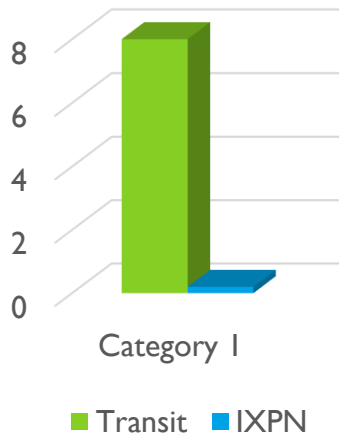


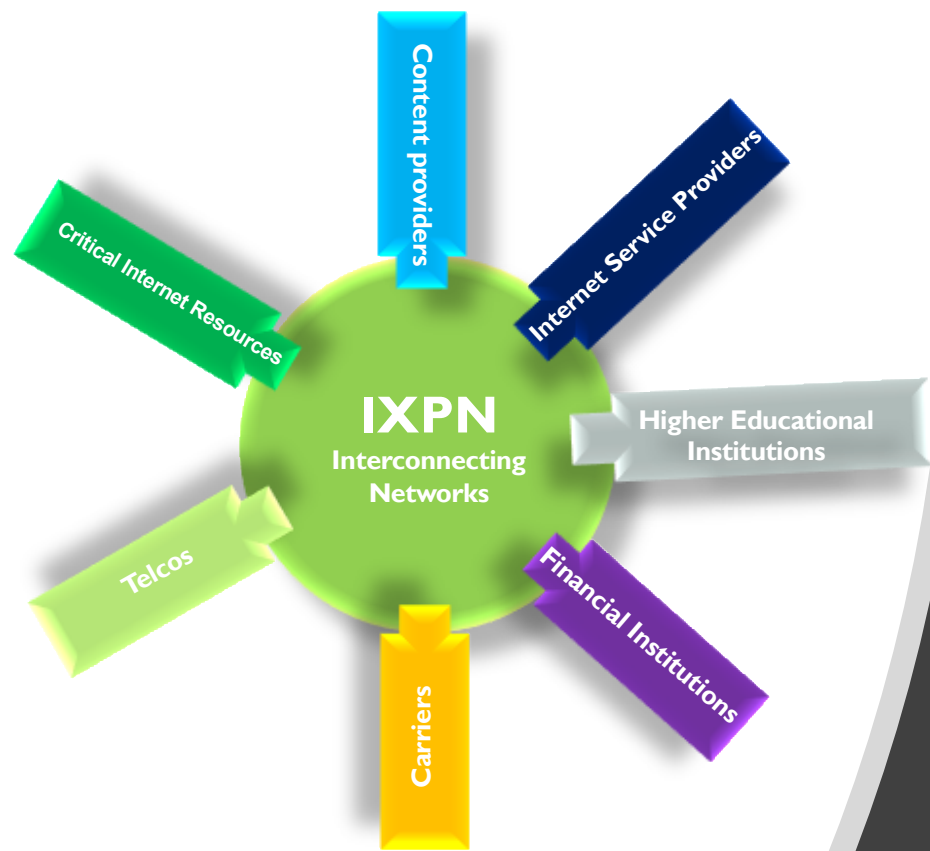
Analysis of savings to a particular member:

Paying \$1,000 for a 10GE Port
 50 % port utilization
 $\$1,000 \text{ divide by } 5,000\text{Mbps}$
 $= 0.2 \text{ USD (72 Naira) average cost per Mbps}$

$5000\text{Mbps} \times \$8 = \$40,000$ transit cost without IXPN
 Savings Monthly by passing traffic via IXPN
 $\$40,000 - \$1,000 = \mathbf{\$39,000 (14 \text{ Million Naira})}$

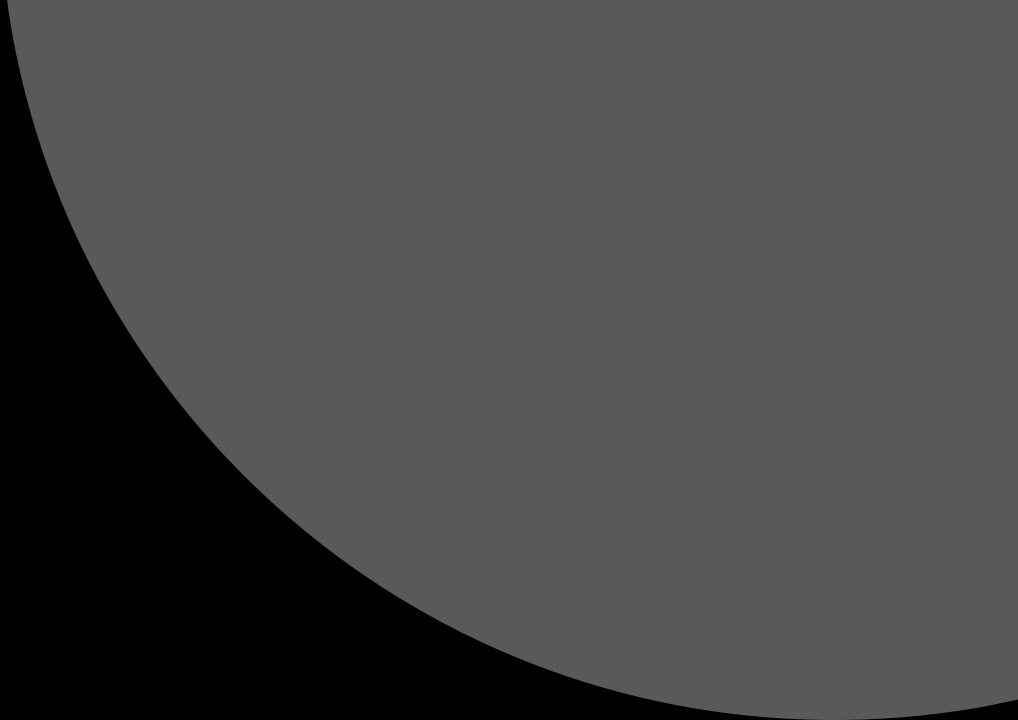
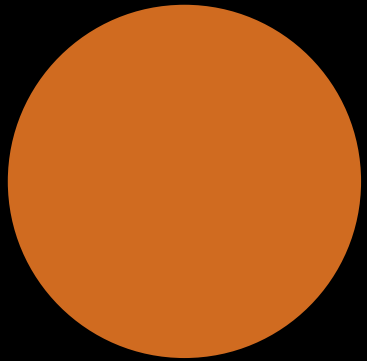
* Exchange Rate 1USD= N360





MORE ON IXPN

- 62 Members and counting...
- 4 PoP (Point of Presence) in Lagos: ICNL, Medallion, Rack Centre and MDX.
- 10Gbps Backbone fibre link between PoPs. Upgrade to 40Gbps in progress.
- Additional PoPs in 4 different cities: Abuja, Port Harcourt & Kano.
- Abuja and Port Harcourt connected to Lagos, via STMI circuit - Funded by the NCC.
- 140 Gbps peak aggregate traffic.



THANK YOU.

Questions