Does Research ICT Matter @ KEFRI?

A Presentation to researchers at KEFRI Headquarters,

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Transforming education and research using ICT

What is Our Agenda

- The Status of Research Productivity and Collaboration of KE Research Institutions
  - Is the research productivity of KEFRI visible to the world?
  - "Discovery and promotion" of KE researchers
- Toward an Kenyan/African Open Science Platform
  - What has changed? Why does it matter?
- KENET Research ICT Services
  - Facilitating Research Collaboration and Access to Global Grid Infrastructures
  - Federated Identity, Certification Authority, Open Access Research Data Repository, Research computing
- KENET as the Research & Education Network of Kenya
  - KENET Community
  - KENET History & Governance
  - KENET Mission and Values
  - KENET as a catalyst for transformation of research and education in KE
- Conclusions – How do you want KENET to support your research agenda?
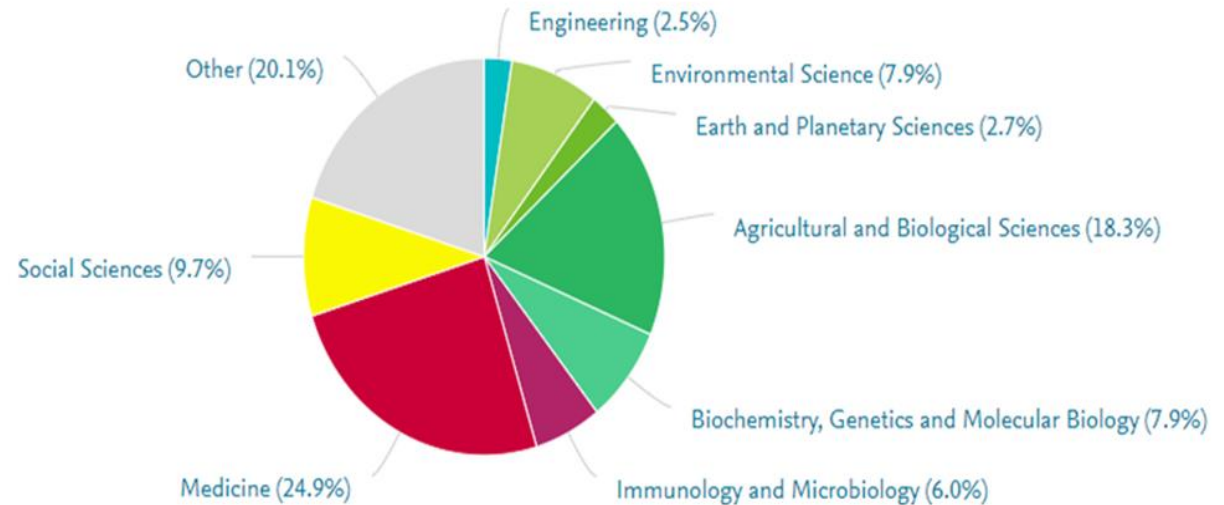- Research services survey

Disclaimer

- **We do not know what advanced research ICT services** are available to you today as researchers or research institutions.
  - *We shall administer a researchers' survey today and a comprehensive e-readiness survey in next 12 months*

- **We do not know the Research ICT services or Big Data initiatives** that you are pursuing
  - *For example, the CGIAR Big Data platform*

- **We do not know why there is low uptake of advanced Research ICT services available through KENET by KE researchers** in all fields!
  - *Common Research ICT services are widely available to scientists in Europe and North America and South Africa*

- **We do not know what is required to increase the Research productivity** of KE universities and research institutes by 10x or even 100x
  - is relatively low measured using research analytics tools like Elsevier.

- **KENET's mandate is to "discover" researchers and promote research collaboration using common research ICT services**
  - *One of the outcomes would be increased research productivity and science-driven social-economic development*

Status of Research Productivity Collaboration and of Kenyan Research Institutions 2012 – 2017

Source: Elsevier SciVal research intelligence tool

Leading disciplines in Kenya 2012-2017

Medicine is the leading discipline in Kenya based on publication counts; and has a Field-weighted Citation Impact of 126% more than world average. The citation impact of Engineering is 13% below world average

Engineering (2.5%)
Environmental Science (7.9%)
Earth and Planetary Sciences (2.7%)
Agricultural and Biological Sciences (18.3%)
Biochemistry, Genetics and Molecular Biology (7.9%)
Immunology and Microbiology (6.0%)
Medicine (24.9%)
Social Sciences (9.7%)
Other (20.1%)

Subject Area	Publications	Citations	Authors	FWCI
Medicine	6,137	77,398	6,532	2.26
Agricultural and Biological Sciences	4,524	31,601	4,996	1.27
Earth and Planetary Sciences	659	4,262	746	1.12
Engineering	613	2,008	832	0.87

Research Productivity of Kenya compared with selected Benchmark Countries – 2012-2017
source: Elsevier Scival, World Bank

Country	Research Productivity (2012 - 2017)	Population in Millions (2016)	GDP per capita (USD) (2016)
Brazil	411,120	207.70	8,649.95
South Africa	118,811	55.91	5,273.59
Egypt	97,762	95.69	3,514.49
Nigeria	37,831	186.00	2,177.99
Kenya	15,065	48.46	1,455.36
Tanzania	7,860	55.52	879.19
Ethiopia	11,682	102.40	706.76
Uganda	8,297	41.49	615.31

Top 10 Collaborating Countries With Kenya 2012-2017 (Source: Elsevier SciVal)

Country	Number of Publications	Number of Kenyan co-authors with collaborating country	Number of collaborating country co-authors with Kenya
United States	4,997	4,999	11,874
United Kingdom	2,925	2,942	4,787
South Africa	1,591	1,763	1,977
Germany	1,195	1,297	1,939
Netherlands	973	1,103	1,213
Canada	936	1,174	1,443
Uganda	865	1,200	1,059
Tanzania	757	1,285	1,000
Australia	753	845	1,325

KEFRI Research productivity and collaboration

Summary of Scholarly Output and Publication areas of KEFRI – 2012-2017

Metric	Score
Scholarly output	51
Authors	45
Field Weighted Citation Impact	1.52
Citation Count	174
Citations per Publication	3.4
h5-index (5 year h index)	7

Pie chart of publication areas:
- Other (3.1%)
- Energy (3.1%)
- Social Sciences (10.3%)
- Medicine (4.1%)
- Environmental Science (22.7%)
- Biochemistry, Genetics and Molecular ... (9.3%)
- Earth and Planetary Sciences (3.1%)
- Agricultural and Biological Sciences (44.3%)
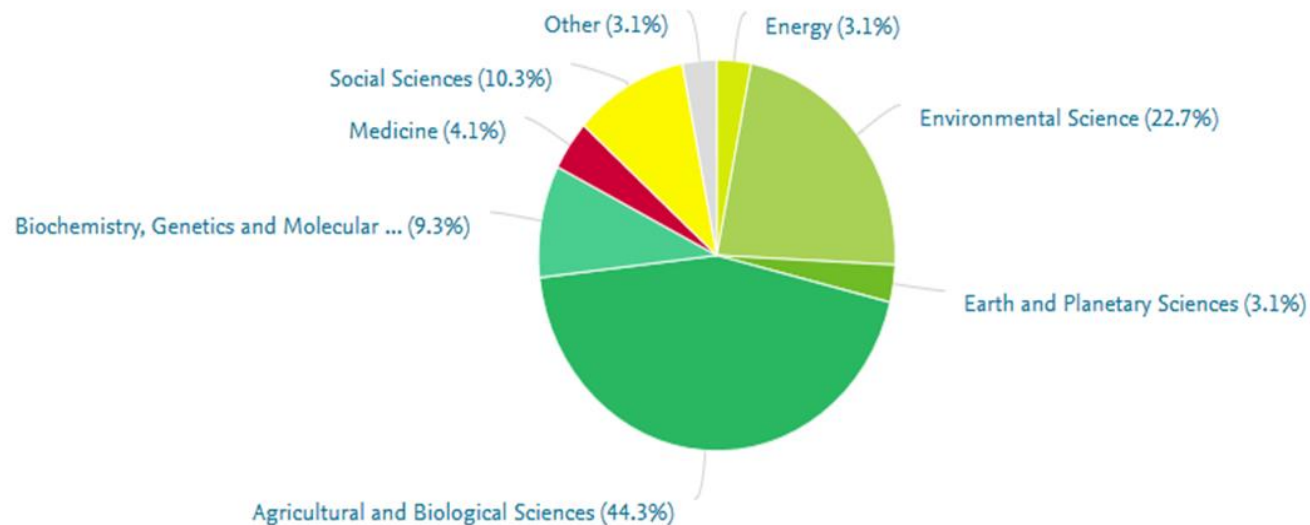
KEFRI growth in publications per year (2012-2017)
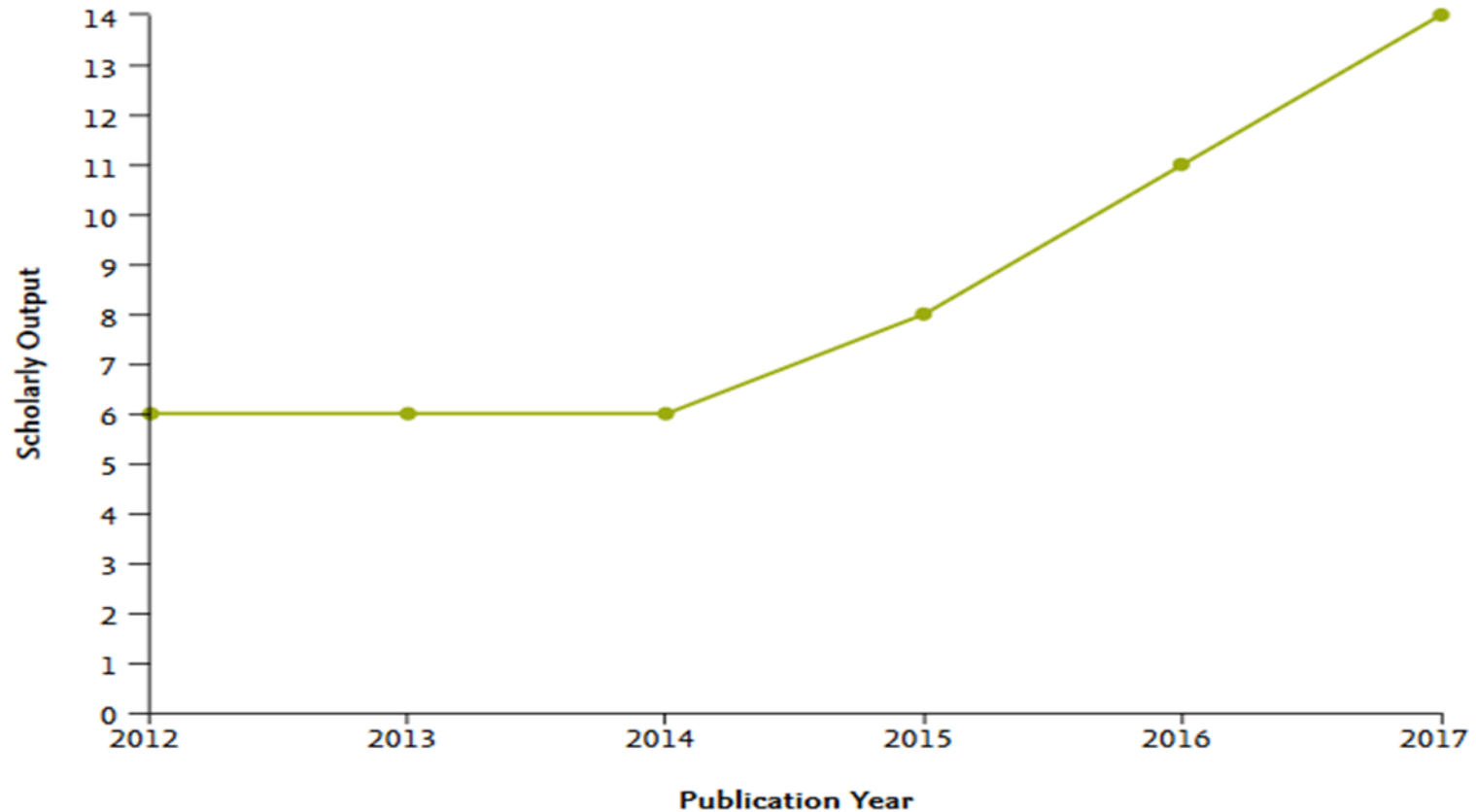
"Discovering" researchers
Top 10 authors @ KEFRI 2012-2017

Name	Publications	Most recent publication	Citations	Citations per Publication	Field-Weighted Citation Impact	h-index
1. Odee, David Warambo	16	2017	29	1.8	2.69	13
2. Omondi, Stephen Fredrick	7	2017	13	1.9	0.42	3
3. Muturi, Gabriel M.	4	2017	15	3.8	1.09	4
4. Ochieng, John Otieno	4	2017	4	1	8.84	1
5. Mullah, Collins Jared Amwatta	3	2014	11	3.7	0.37	2
6. Kigomo, Bernard N.	2	2014	9	4.5	0.4	2
7. Kiptot, Evelyne	2	2012	28	14	1.33	7
8. Machua, Joseph	2	2015	6	3	0.56	3
9. Magare, Charles	2	2017	3	1.5	17.57	1
10. Musyoki, Josephine Kamene	2	2016	1	0.5	0.22	1

Benchmarking of KE research institutes
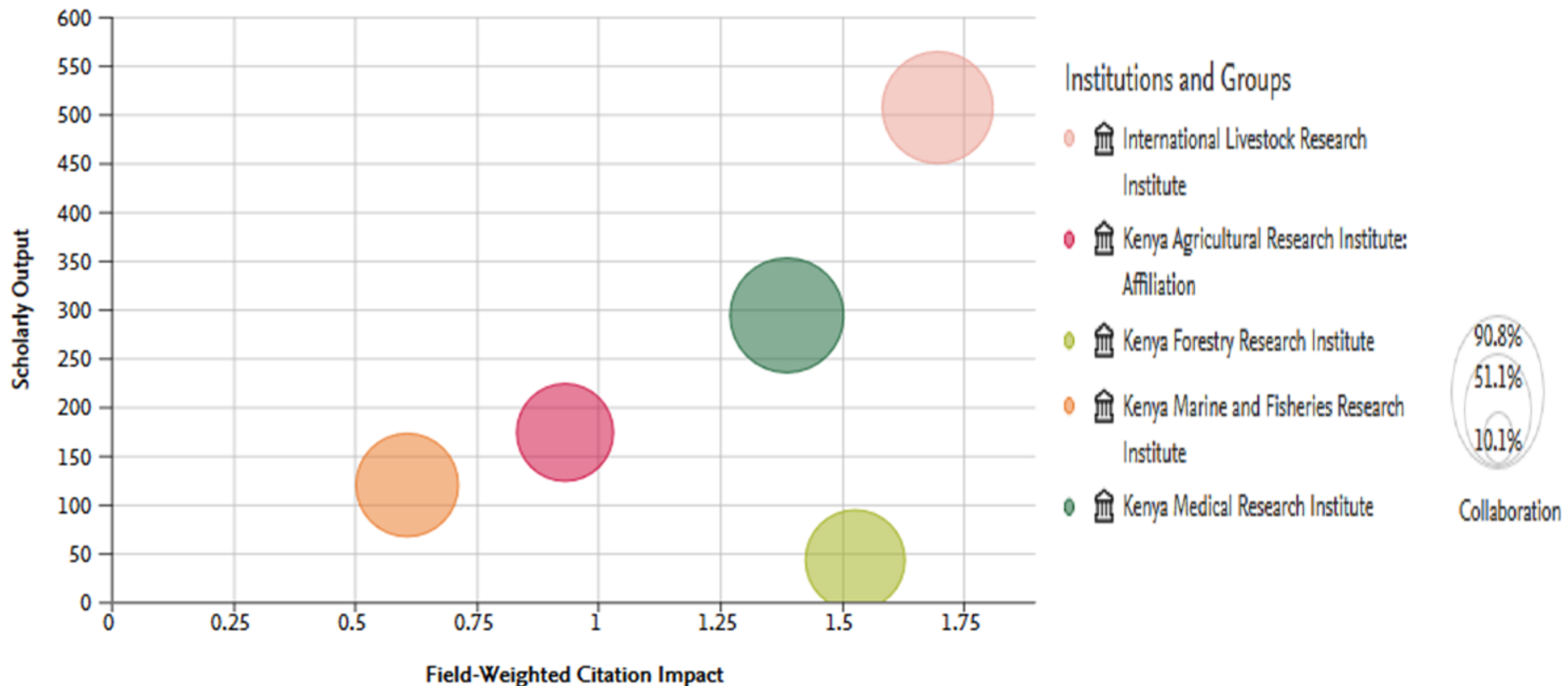
Benchmarking in terms of scholarly output for 5 KE research institutes (2012-2017)

Name	Scholarly Output	Field-Weighted Citation Impact	Collaboration (%)
International Livestock Research Institute	982	1.9	88.2
Kenya Agricultural Research Institute: Affiliation	234	1.05	70.5
Kenya Forestry Research Institute	51	1.52	74
Kenya Marine and Fisheries Research Institute	166	0.72	72.9
Kenya Medical Research Institute	2005	2	89.7

Does Research ICT for research productivity?

- Research / Science is now data intensive and collaborative
- Research collaboration requires what are called e-infrastructures (in Europe) or Cyberinfrastructures (North America)
  - Research institutes in South Africa, Europe, or North America have 10 Gb/s or 100 Gb/s higher connections to Global research & education networks
  - Researchers require high-speed data transfers and petabytes of storage (e.g., researchers in climate change areas)
  - Researchers require federated identity for collaboration and digital certificates (or passports)
  - High-performance computing necessary for data-intensive research
    - Learning algorithms or analysis of large data sets
- Basic High speed Internet and secure WiFi (e.g., eduroam).

Q & A on Research Productivity Reports ?

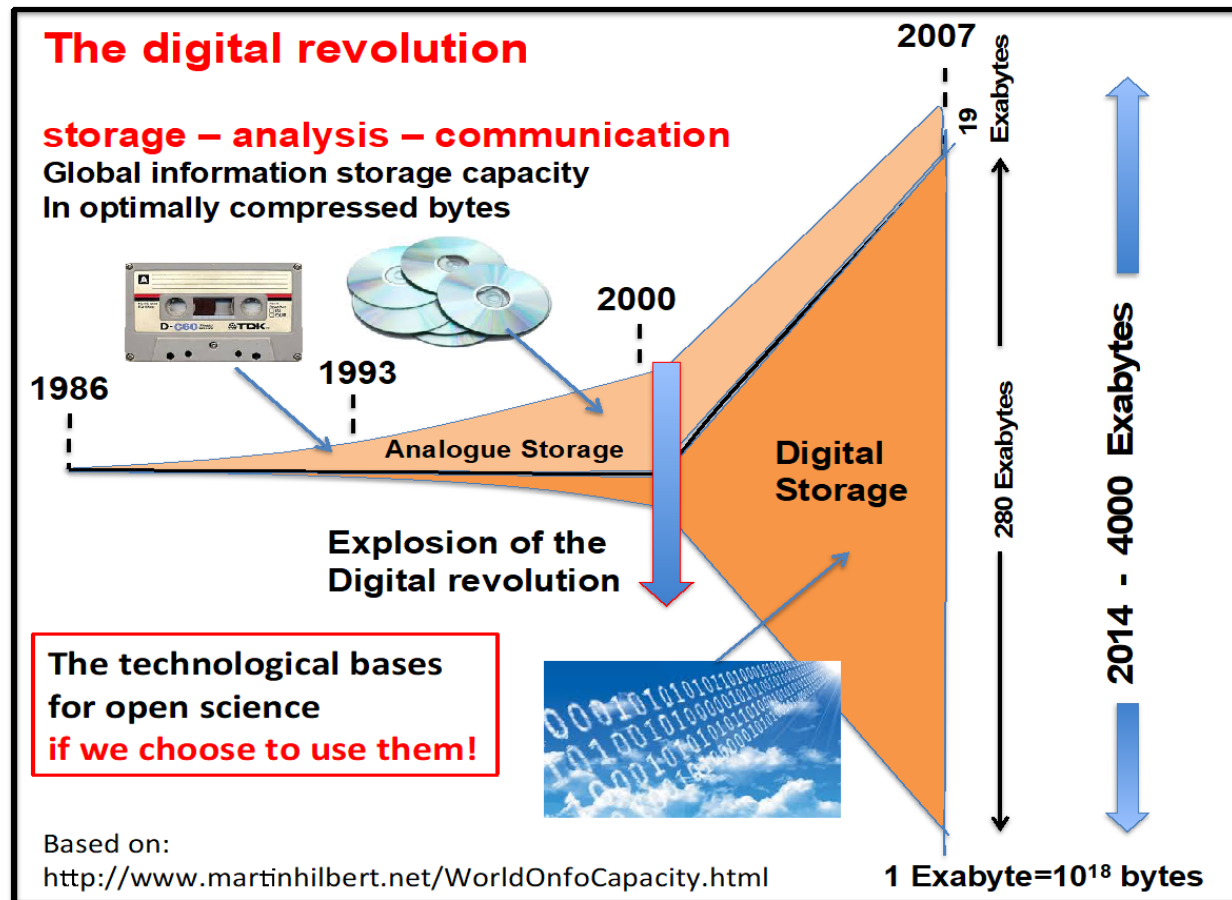- Are you surprised?

- What will you do?

Transition to Open Science Platforms

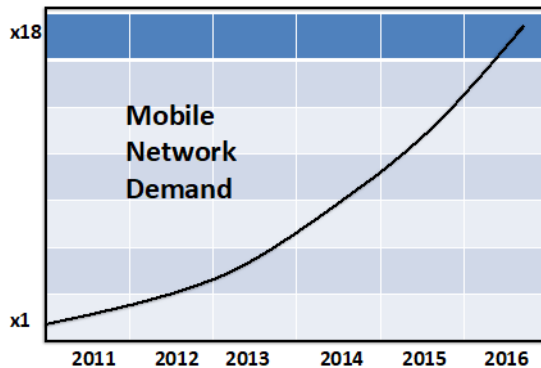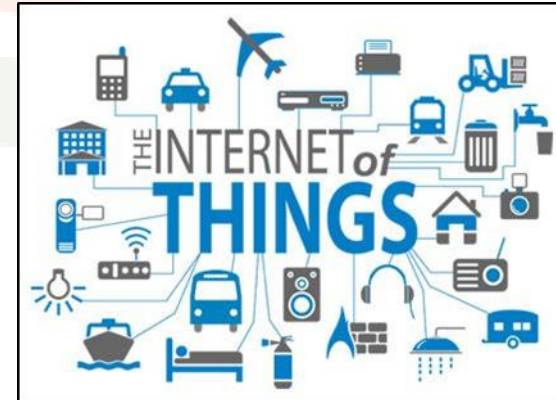KENET is following the Horizon 2020 SciGaia Open Science Platform

http://www.sci-gaia.eu/osp/

The Digital Explosion

The digital revolution

storage – analysis – communication
Global information storage capacity
In optimally compressed bytes

1986   1993   2000   2007

Analogue Storage

Digital Storage

Explosion of the Digital revolution

The technological bases for open science
if we choose to use them!

19 Exabytes

280 Exabytes

2014 - 4000 Exabytes

Based on:
http://www.martinhilbert.net/WorldOnfoCapacity.html

1 Exabyte=10^{18} bytes

Drivers of Change (Adopted from Big Data International Accord)

Increased connectivity

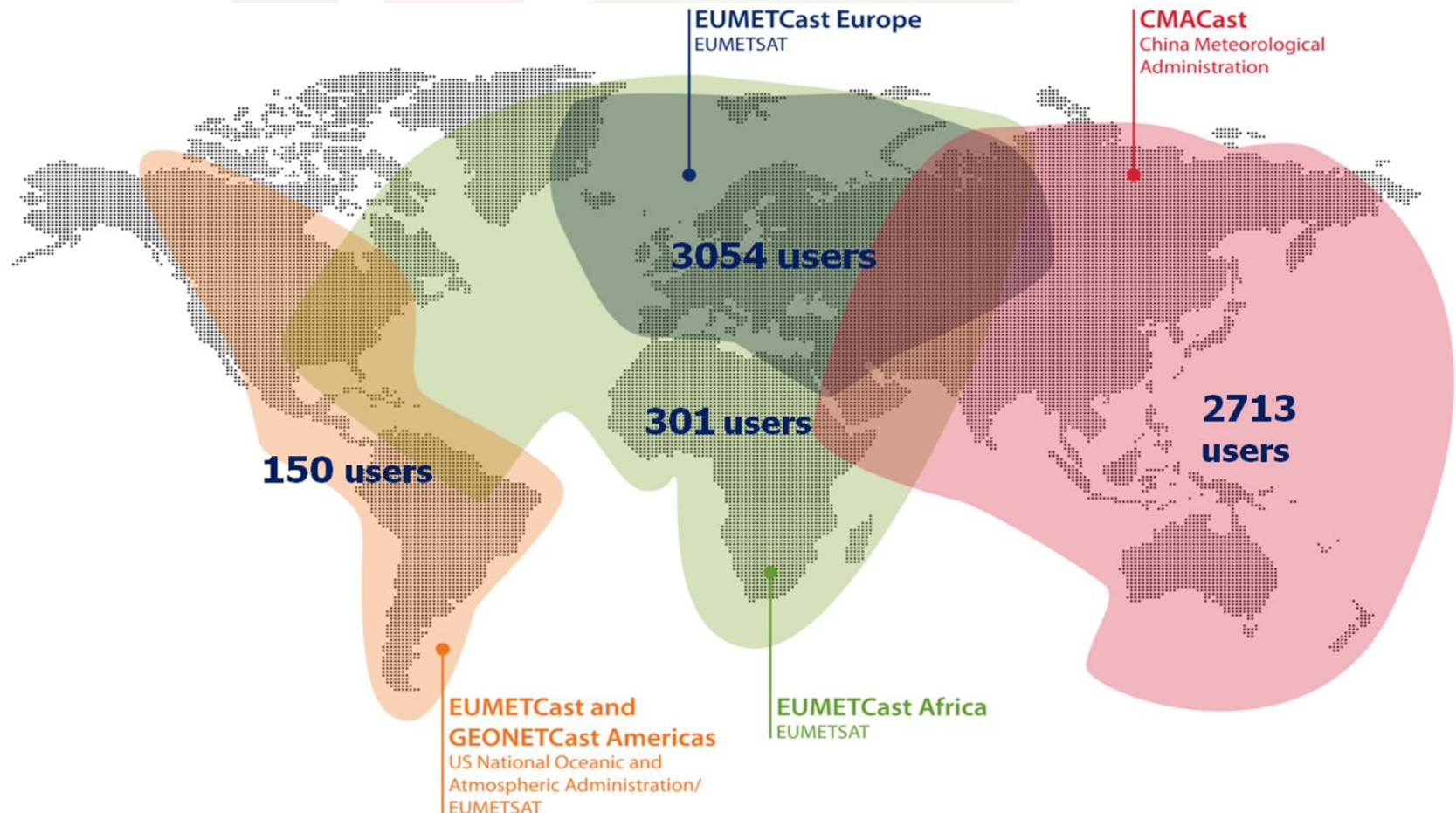Increasingly diverse data Sources – **sensor networks** for monitoring environment / pollution?
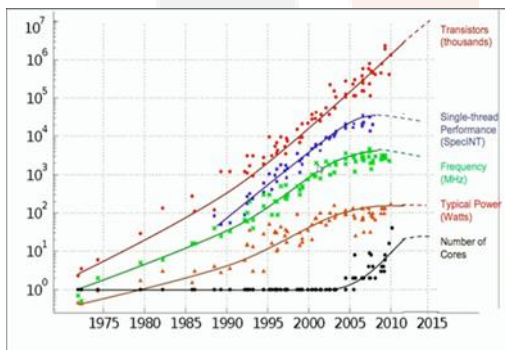
Increase in Computing power Moore's Law
(Number of transistors double every 2 yrs)
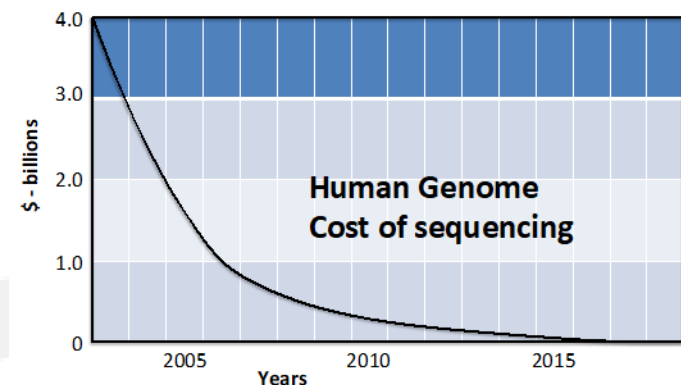
Cost reduction

Other sources of Big Data for Science
## Satellite weather forecasting data – Kenya National Meteorological Center subscribes to EUMETSAT services

EUMETCast Europe
EUMETSAT

CMACast
China Meteorological Administration

3054 users

301 users

2713 users

150 users

EUMETCast and GEONETCast Americas
US National Oceanic and Atmospheric Administration/ EUMETSAT

EUMETCast Africa
EUMETSAT

Q: So what does all this data offer to science?

A: Not causality, but the capacity to identify patterns in multi/hyper-dimensional data

Q: Is that all?

A: Recognition of new patterns leads to new questions and new answers – its what Darwin, Newton and Marx did

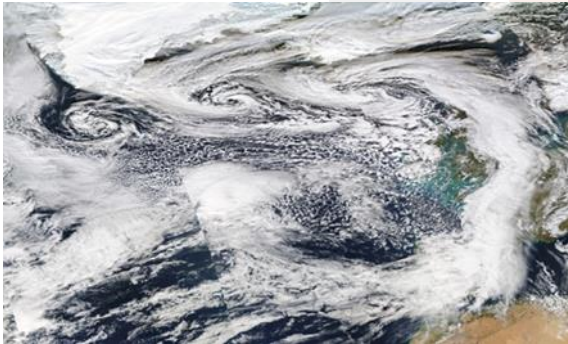**Remember Anthonie van Leeuwenhoek (1632-1723)**

White blood cells   Red blood cells   Yeast cells

Sperm cells   Bacteria cells
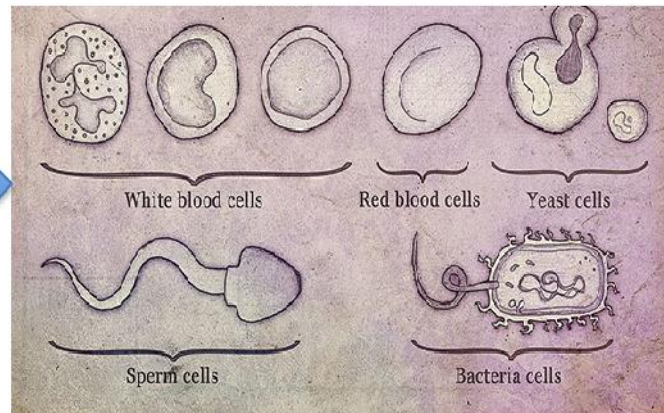
Leeuwenhoek saw a microscopic world that had not been seen before. We now have a "Digital Microscope".
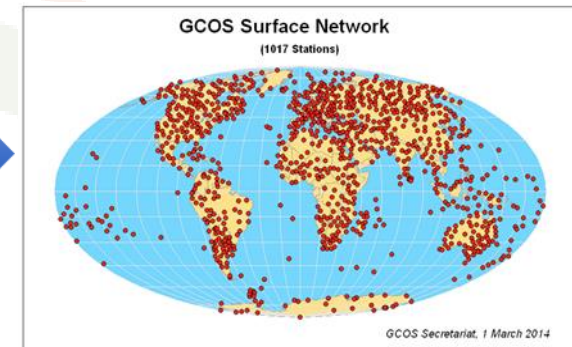
An example: data-modeling: iterative integration
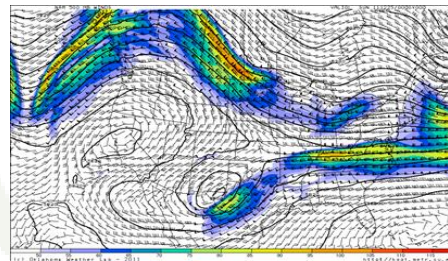
Satellite observation
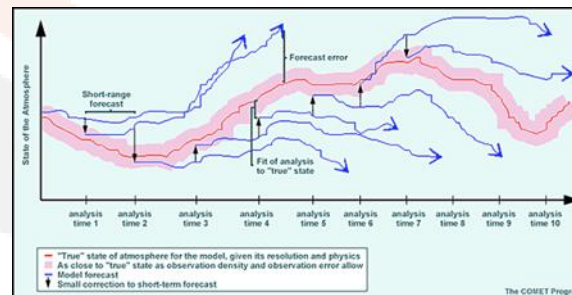

Surface monitoring

Initial conditions

Model forecast

Model-data iteration - forecast correction using learning algorithms

Artificial intelligence & learning machines

Learn from experience

Learn from experience

Follow instructions

Q & A on Open Science Platforms (10 minutes)

- How is big data affecting your research? Do you have all the tools?

- http://bigdata.cgiar.org/about/ - the Platform for Big Data in Agriculture;

- What is the equivalent platform that would support Agricultural Research Collaboration in Kenya?

KENET builds shared e-infrastructures for KE researchers

- Building and maintaining a high-speed national research & education network with connection to European research networks (e.g., GEANT)
  - Eduroam – secure WiFi for researchers
  - Initial World Bank / GoK funding for the network
  - Most member research institutes have last mile fiber at 1 Gb/s or above – e.g., KEMRI, Ampath, KALRO
- Critical elements:
  - Identity Provider for KE researchers (necessary for access to research resources worldwide
  - Digital certification authority (accredited by EUGRIDPMA in January 2016)
  - High-end ICT talent to develop and manage the advanced e-infrastructures
- Research computing with Applications for Data Analysis using R
- Access to High-Performance Computing facilities in South Africa and European Grid Infrastructure (EGI)
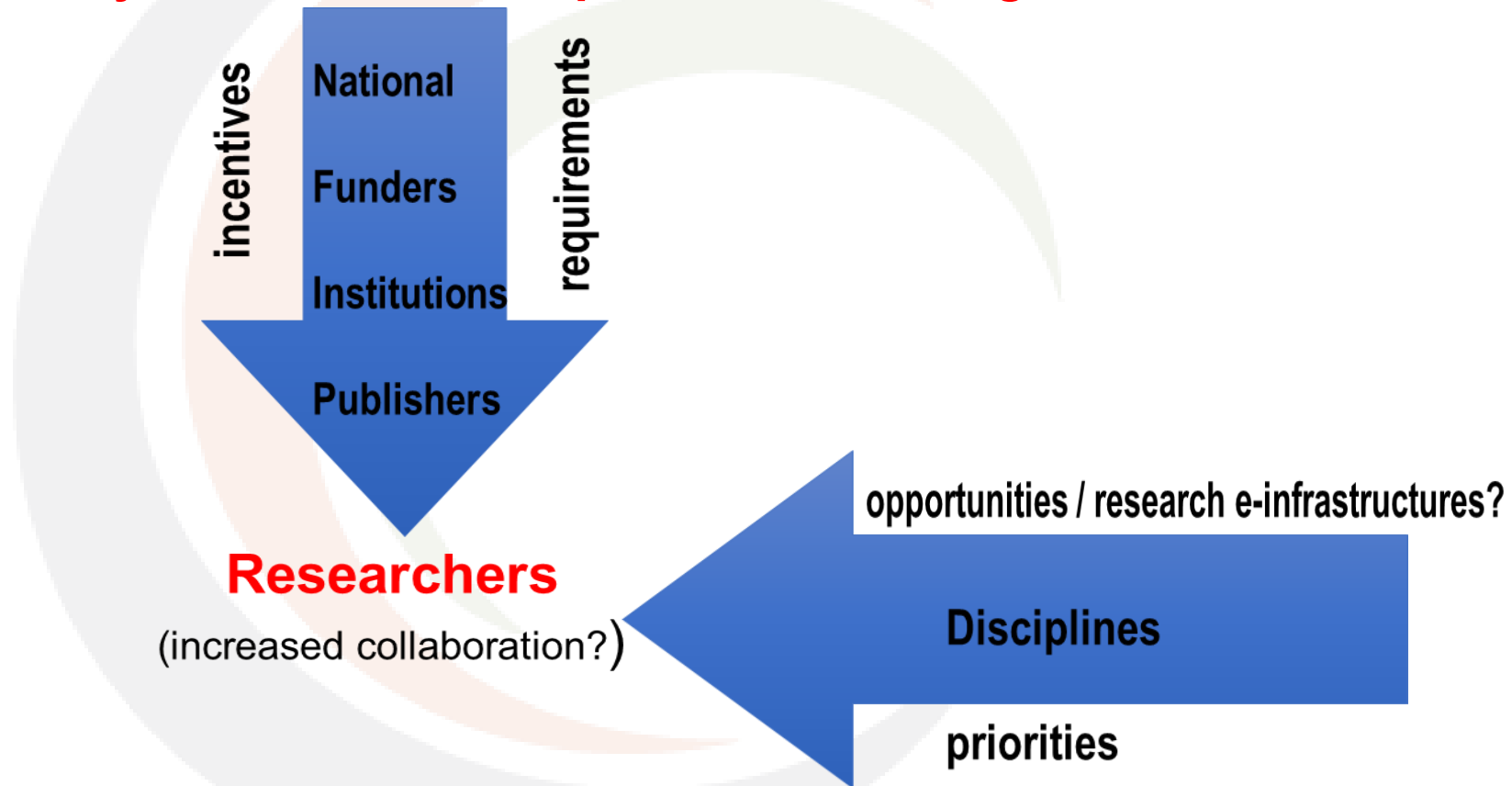- Open Research Data Repository – federated

Components of KE E-Infrastructures or Cyberinfrastructures
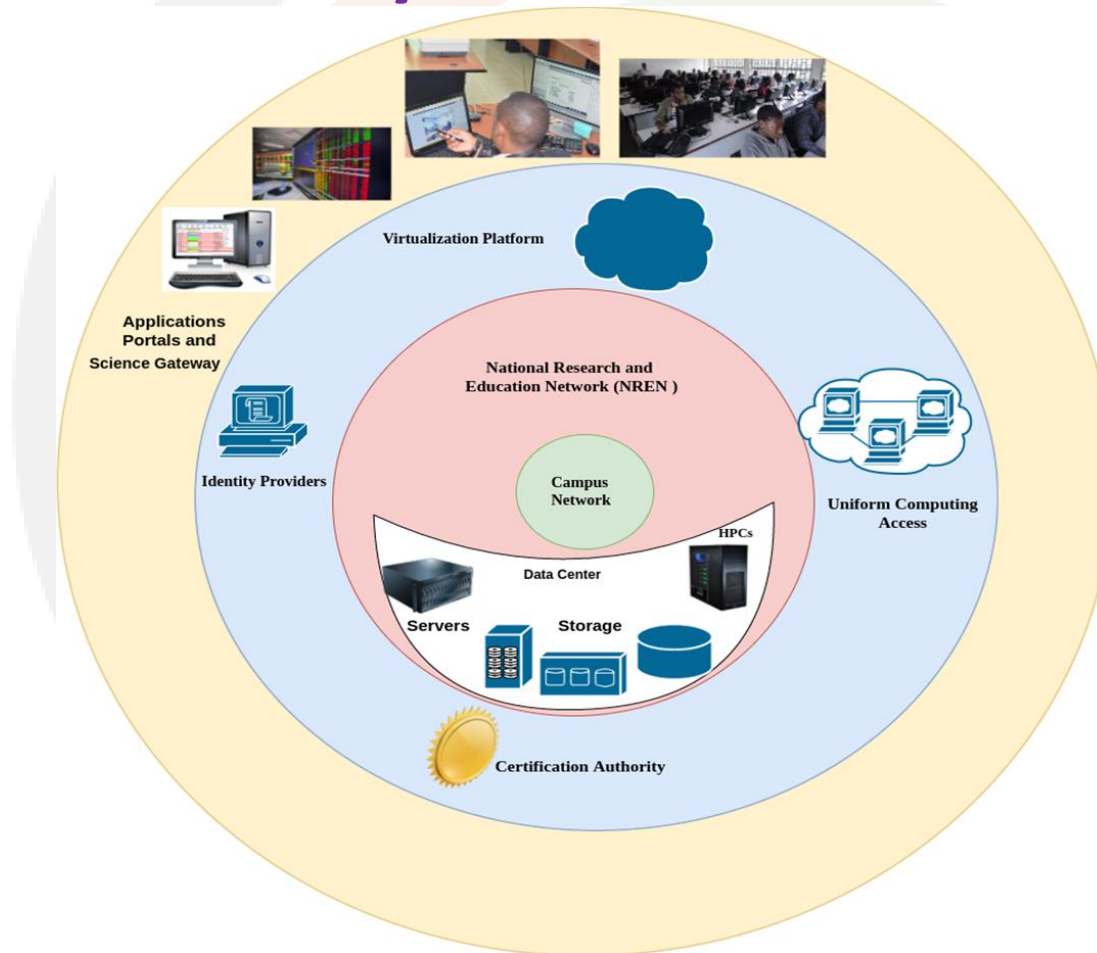
Why is utilization of research infrastructures low in Kenya?
Are you aware what is possible in through KENET?

incentives

National

Funders

Institutions

Publishers

requirements

Researchers
(increased collaboration?)

opportunities / research e-infrastructures?

Disciplines

priorities

Do you think emerging Kenyan Research Platform / e-infrastructures shall increase KE research productivity?

KENET Research Services & Infrastructures

What research ICT services do you need?

- **Basic services** – reliable broadband Internet + secure WiFi + email
  - Eduroam is a secure WiFi that allows you to roam all over the research world!
  - KENET provides reliable Internet services to institutions all over the country – no researcher is isolated!
- Community cloud services (requires community data centers)
  - Reliable leased servers and storage – no need to buy hardware when you are in remote areas
  - Research computing and applications – e.g., R for statistical analysis
  - Short-term and long-term research data storage (for 1 TB and above storage needs)
  - Web-conferencing / video conferencing applications – e.g., Vidyo
- Digital Certificates and Identity Provider for access to Global research infrastructures and services (e.g., Grid Infrastructures)
- Grantee for collaborative research projects with ICT components or research data repositories e.g., NRF, Newton Fund, USAID, etc.

KENET Identity Provider IDP – Part of GRIDP through Sci-GaiA project
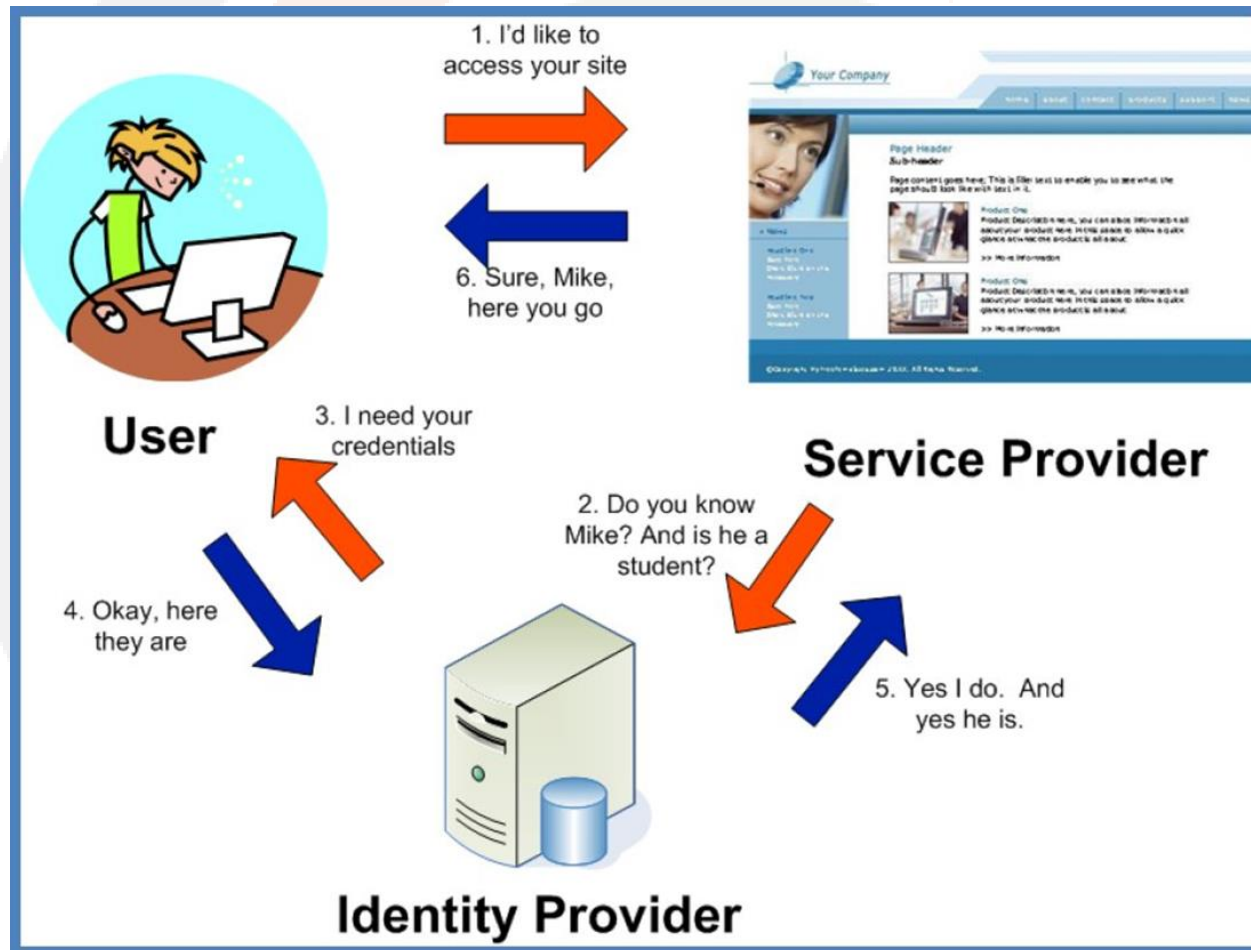
KENET Digital Certificates allow researchers to Access global research resources

- Made possible by
  - Digital certificates – an electronic passport
  - Provides Federated login ID to research resources e.g EduGAIN resources
  - Example is [ELIXIR](#) (European life-sciences Infrastructure for biological Information)
  - Supports research collaboration
- Example resources
  - ORCID - Open Researcher and Contributor ID (persistent digital identifier)
    - *Widely used in Europe for tracking the research productivity of researchers*
  - EGI – European Grid Infrastructures (*cloud compute & storage for virtual research communities*)

How does KENET support researchers / institutions?

- **"Discovers researchers"** and facilitates Special Interest Groups and forums
  - SIG on engineering education and research – 2014
  - SIG on Computational Modelling and Materials Science - 2016
  - SIG on computer science and information systems - 2018
  - SIG on Medicine and Public Health Education and Research – 2018
  - *SIG on Agriculture (includes Livestock) – 2018??*
- **Registration of researchers in need of access to global e-infrastructures**
  - High Performance Computing facilities
  - Cloud storage
  - Eduroam secure roaming WiFi for global research and education community
- **Offers Travel grants for researchers and graduate students**
- **Aims to employ a PhD-level part-time Research Associate for each SIG area**
  - Research associate must be full-time faculty/researcher of a member institutions with a PhD

KENET as NREN of Kenya

KENET Trust Objects (2000)

1. provide sustainable and high-speed Internet connectivity to educational and research institutions;
2. facilitate electronic communication among beneficiaries in educational institutions;
3. support sharing of teaching and learning resources among educational institutions;
4. support teaching and learning over the Internet for beneficiaries in educational institutions both in Kenya and outside;
5. collaborate in developing locally relevant learning materials in educational institutions; and
6. collaborate in research in educational and research institutions.

KENET Governance

- KENET is constituted as a **not-for-profit** TRUST with 11 Registered Trustees
  - Seven Vice Chancellors + Director KMFRI; PS, TVETs ; DG CA; CEO Private sector (see https://www.kenet.or.ke/node/10 for biographies.
  - Governed by Board of Trustees, Assisted by Management Board
  - Member institutions and academic community are the beneficiaries
- KENET is a membership organization and only serves members
  - *All KENET services are therefore VAT exempt because not considered a business*
- KENET licensed as a Alternative Network Facilities Network Operator by Communications Authority of Kenya since 2002
  - It builds and maintains the physical national broadband network
- KENET is an implementation agent of the Government of Kenya and other donors (KTCIP, Google, Foundations etc)
  - Partnerships for research and infrastructure expansion
- KENET is **endorsed** as the National Research and Education Network for Kenya by Ministry of Education
  - *Largest African NREN in Africa after TENET in South Africa (Internet bandwidth subscriptions now 18 Gb/s)*
  - Exchanges traffic with other NRENs in the world at NO cost
  - Connects KE universities and research institutions to Global Research & Education Networks

The KENET Academic Community And Partners
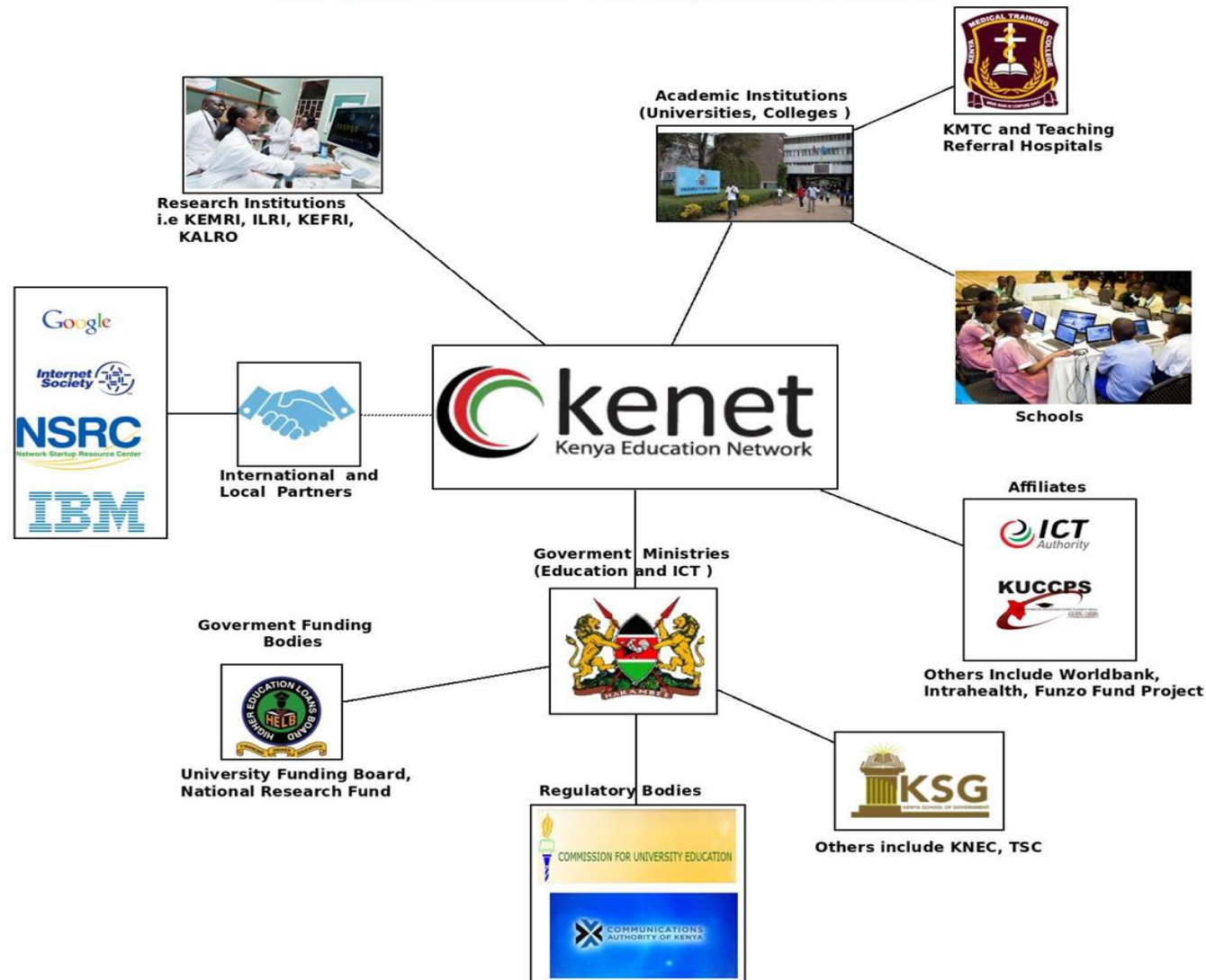
Size of KENET Community – over 740,000 users

Member category	Number of members	Size of Beneficiary community (i.e., students, faculty, researchers, staff)
Universities / University college	67	651,362
Research Institutions	16	3,319
Tertiary colleges (TVETs, medical colleges, TTCs etc)	20	83,095
Government Institutions/ Affiliate members	19	4,877
Total	122	742,653

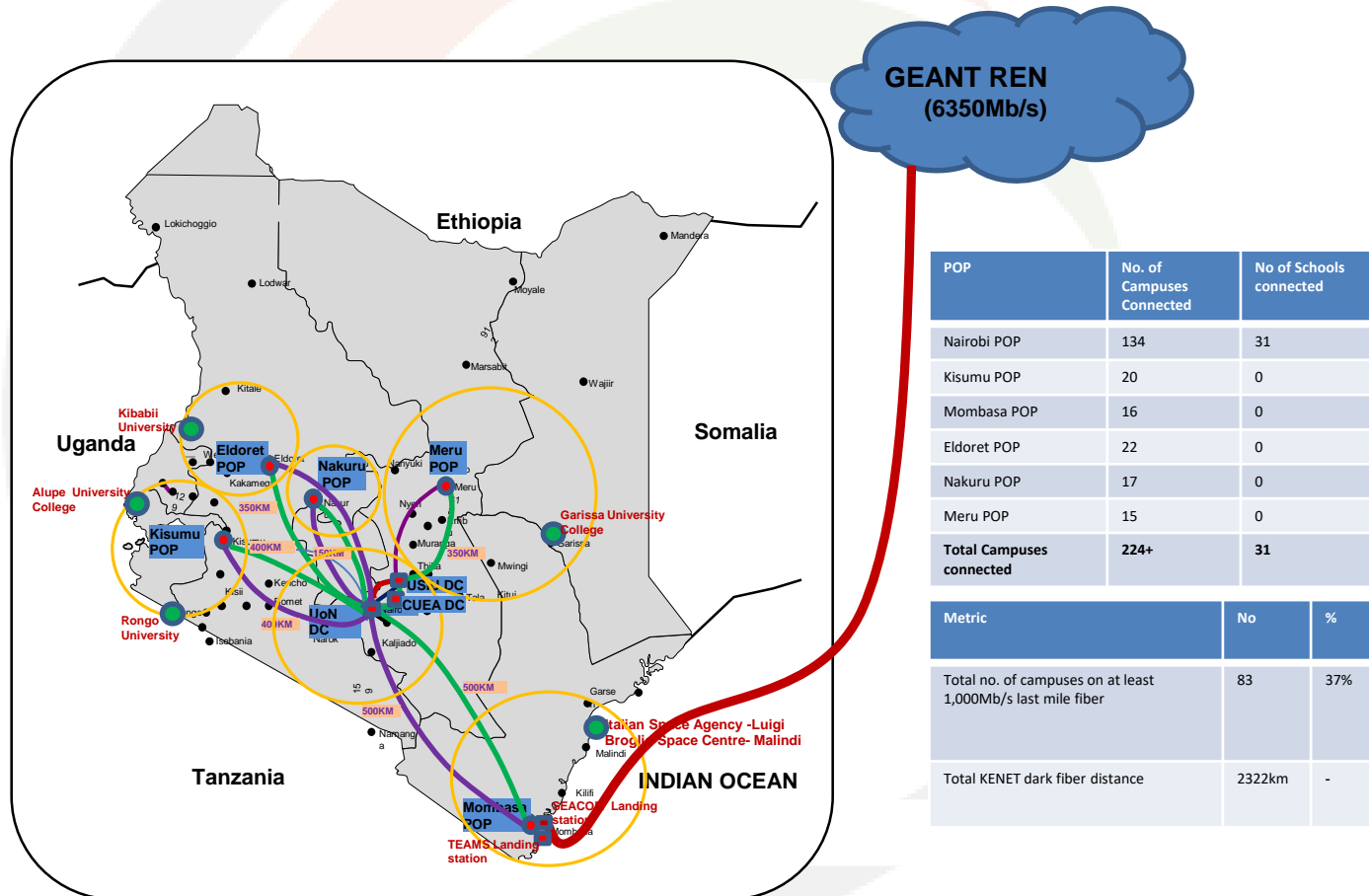# KENET recognized as part of National Innovation System of Kenya *Source: STI Policy and Strategy 2014*
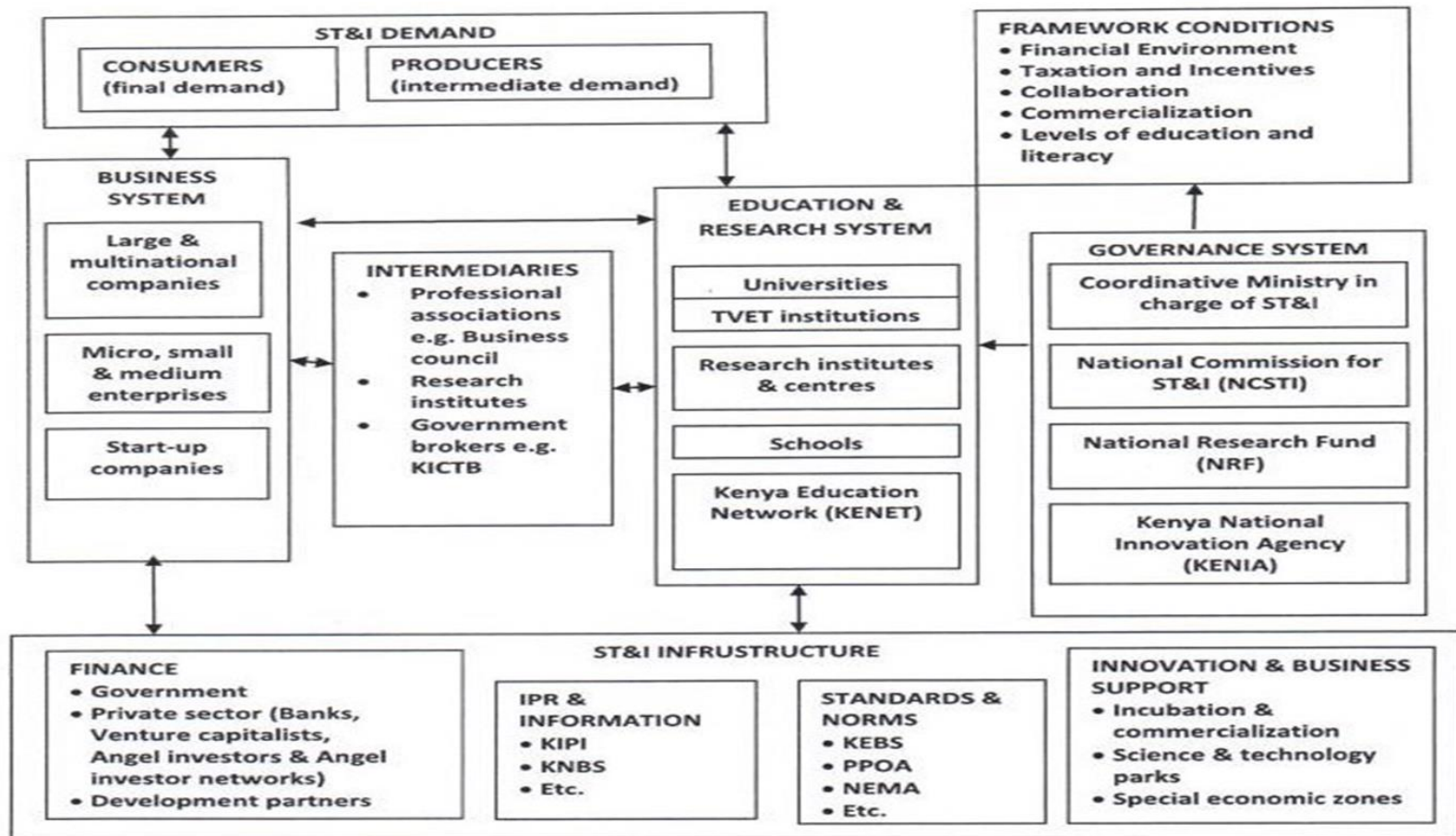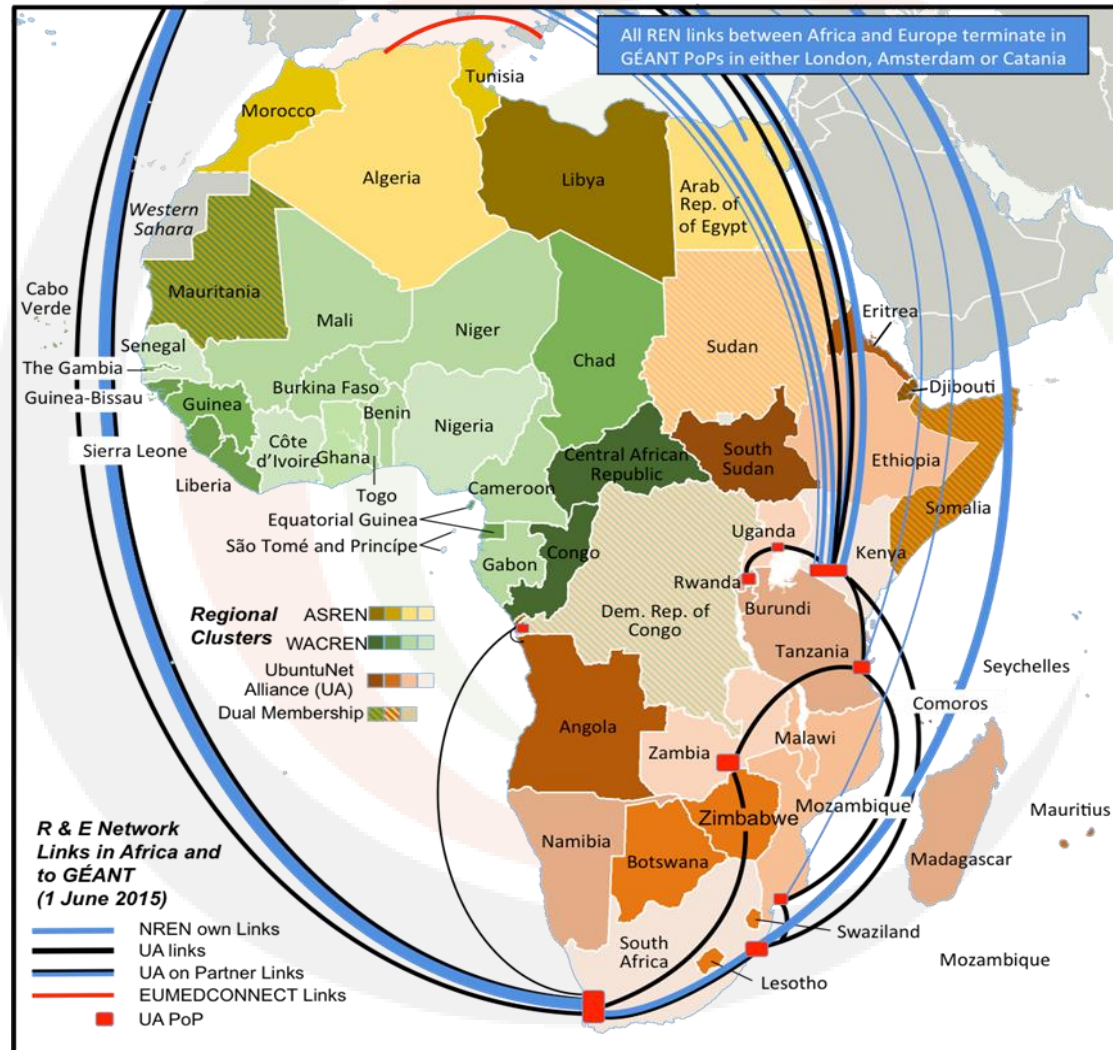
KENET as the NREN of KE

- **Mission - Catalyst for transformation of education and research using ICT**
  - Discovers and supports research and innovation champions
  - Facilitates and funds the activities of Special Interest Groups in STEM areas
- **Collects Annual Core Data of Connected Member Institutions**
  - *Data-driven advocacy*
- **"Monitors and generates"** research productivity reports (includes collaboration, benchmarking) for Kenyan universities and research institutes – (*Source: Elsevier SciVal tool*)

KENET National Broadband Network Coverage and part of Global Research & Education Networks

POP	No. of Campuses Connected	No of Schools connected
Nairobi POP	134	31
Kisumu POP	20	0
Mombasa POP	16	0
Eldoret POP	22	0
Nakuru POP	17	0
Meru POP	15	0
Total Campuses connected	**224+**	**31**

Metric	No	%
Total no. of campuses on at least 1,000Mb/s last mile fiber	83	37%
Total KENET dark fiber distance	2322km	-

Africa NRENs – source: World Bank report 2016

Conclusions

- KENET builds and operates national research e-infrastructures on top of its national broadband network
  - **Foundation is a broadband national network and data centers**
  - **KENET is the Trusted Identity Provider for the research community in KE**
  - **It issues digital certificates that are "digital passports" for access to research resources outside KE**
- Setting up the research e-infrastructures or cyberinfrastructures is slow and requires very specialized skills
  - **KENET has taken 5 years to develop the capacity and build necessary critical research infrastructures**
  - **Requires critical mass of high-end ICT talent (network engineers, computer scientists, and data science professionals)**
  - Resources are shared and increasingly community cloud-based (i.e., outside research institute data center / server room)
- **KENET is also a human network, an academic community**
  - **Special Interest Groups building expected to spur collaboration**
  - **Has a budget for organizing capacity building forums for faculty and researchers**
- **KENET is not the only catalyst for research in KE – research funding is also crucial**
  - **Kenya now has its own National Research Fund (2% of GDP by law)**
- **Is it possible for** KE researchers to achieve 10x or 100x increase in research productivity with improved Research ICT Services?

Q & A and Researchers' Survey 2018

- Please take some 10 minutes to complete the researchers' survey questionnaire

Thank You

www.kenet.or.ke

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