

KENET as the National Research and Education Network of Kenya

1. KENET as an Organization

KENET is a not-for-profit membership organization that is incorporated as a Trust under the Trustees (Perpetual Succession) Act, Cap 164. KENET is governed by an 11-member Board of Trustees assisted by a 10-member Management Board. The 11 Trustees comprise seven Vice Chancellors of public and private universities, the CEO of Kenya Marine and Fisheries Institute (KMFRI), the PS - State Department of TVETs, Director-General of Communications Authority, and a Private sector CEO (see https://www.kenet.or.ke/board_of_trustees for names and brief biographies of the current Trustees).

KENET was endorsed by the Ministry of Education as the National Research and Education Network (NREN) of Kenya in the year 2009. It is a unique organization because it is practically an extension of the ICT directorates of member institutions. It has been licensed since 2002 by the Communications Authority of Kenya (CA) to build and operate the private national network that interconnects the institutional campus networks and to provide Internet and community cloud services to member institutions. KENET also operates the international circuits to Europe that connect the local private broadband network to the global research and education network community in the rest of the world and to the global Internet (see Figure 1). Member institutions sustain KENET by *subscribing* to Internet bandwidth or community cloud services.

The University of Nairobi hosts the KENET headquarter offices at the Jomo Kenyatta Memorial Library while USIU library hosts the satellite offices. Most of the critical network and data center equipment is hosted by member universities across Kenya.

KENET was first constituted as a Trust in the year 2000 (see [Trust Deed 2000](#)) as a **vehicle** for absorbing a \$1.1 million Internet bandwidth infrastructure grant received by the Government of Kenya from the US government through USA International Development Agency ([USAID](#)). The grant was used to build last mile links to six strategic institutions (e.g., JKUAT, Moi, Maseno, and Africa Nazarene University) and to connect member universities and colleges to the Internet through Telkom Kenya's Internet backbone at a subsidized rate that was 50% of the commercial rate. In the year 2005, KENET received another grant of \$0.5 million grant from the Rockefeller and Ford Foundations to establish the first KENET international VSAT gateway and provide Internet bandwidth services to eight universities under the subsidized Partnership for Higher Education in Africa bandwidth consortium.

In the year 2007, KENET members, most of them universities, received an infrastructure grant of \$22.5 million from the Government of Kenya for expansion of their Internet infrastructure. This was part of

Kenya Transparency and Communication Infrastructure Project (KTCIP) funded by the World Bank through the then Kenya ICT Board (now [ICT Authority](#)). KENET was then **appointed the implementation agency** of the Ministry of ICT and ICTA for the expansion of the private national broadband network. KENET was then responsible for the network design, preparation of bidding documents, and overall project management. KENET was also served an implementation agency Google-funded Universities campuses WiFi coverage expansion projects in the period 2010-2015. Google

At the end of the KTCIP network expansion project in 2013, KENET had connected 55 campuses of member institutions, established two tier-2 data centers at USIU and UoN, created five Points of Presence in different parts of Kenya, procured 1200 Mb/s of international circuits to London and set up a fully operational Network Operations Center (NOC) in Nairobi. *All of the assets procured under the project are held in trust by KENET for all the connected member institutions* that are the beneficiaries of the KENET Trust according to the Trust Deed.

Since 2013, the network has expanded to **244** connected campuses of member institutions across the country and 32 connected schools mainly in Nairobi county with five schools in Kiambu, Kitui, Mombasa, and Marsabit counties. As of April 2018, KENET had **9.35 Gb/s** of international circuits to European Research and Education networks (through GEANT cloud) and was distributing **17.2 Gb/s** of Internet traffic. Figure 1 shows the KENET network coverage.

KENET National Broadband Network Coverage

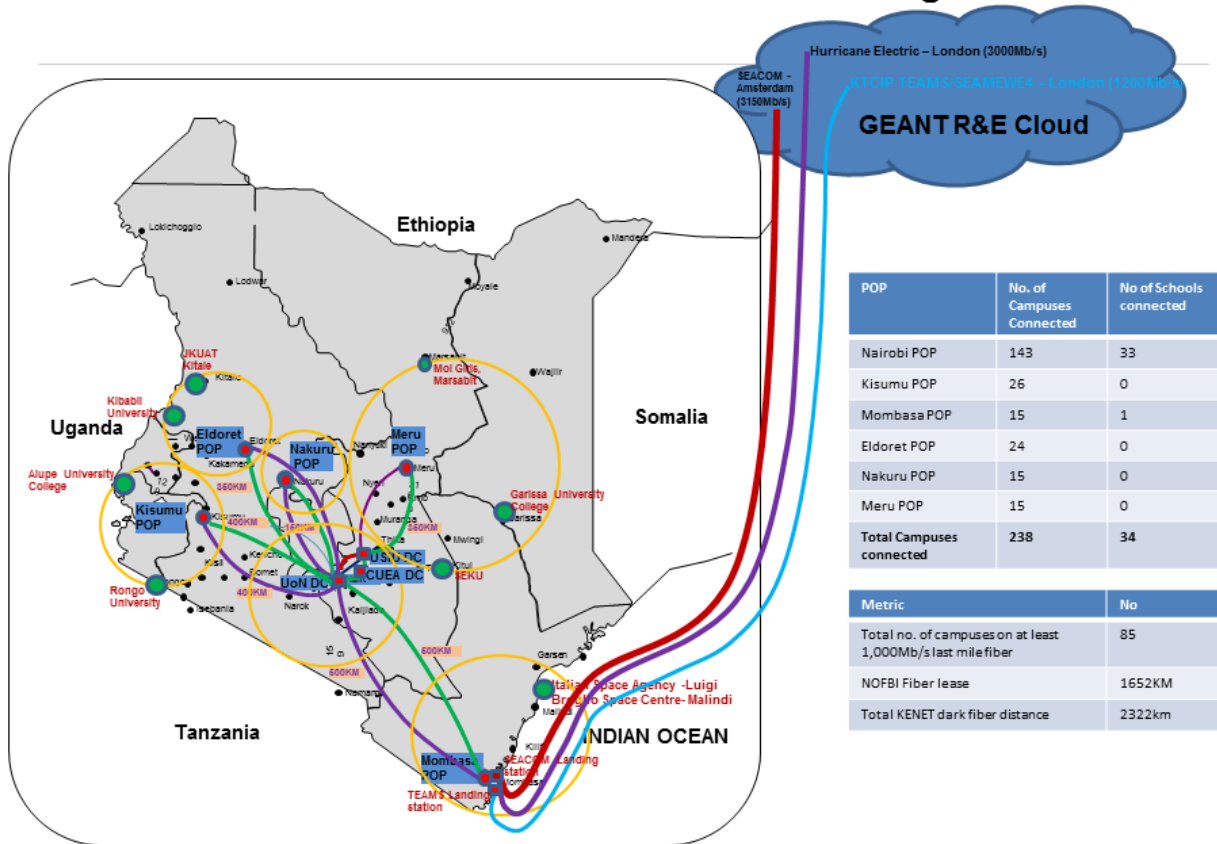


Figure 1: KENET network coverage and connectivity to global research & education networks (April 2018)

KENET had a staff complement of 40 employees, most of them highly-skilled ICT staff and network engineers (April 15, 2018). The ICT staff design, build and operate the broadband network and the associated Network Operations Center (NOC). The staff are also responsible for provisioning and supporting the Internet bandwidth and **community cloud services** to members. For example, ICTA as a member of KENET subscribes to cloud services worth Ksh 3,981,600 per year.

KENET is also recognized by the African Regional Registry of Internet Numbers ([AFRINIC](#)), as the NREN of Kenya and is the custodian of the Internet address blocks allocated to the academic community of Kenya. It is also one of the four shareholders of the Kenya Network Information Center ([KENIC](#)), the not-for-profit company licensed to operate the top-level DOTKE (.ke) Domains Registrar of Kenya.

KENET was granted VAT exempt status by KRA in 2013 in recognition of the fact that it is NOT a business. This is because it operates a private network mainly to support educational technology and research services for a closed group of member institutions.

2. KENET membership and community

KENET had 128 members (excluding schools) as of April 2018 as shown in Table 1 below. The community of 744,065 users includes students, teaching staff, researchers and administrative staff.

Table 1: KENET Members and Size of Community

Member Category	Number of Members	Size of the community (students, staff, faculty, researchers)
Public Universities / Public University Colleges	35	529,411
Private Universities /Private University Colleges	32	121,951
Research Institutions	17	5,606
Technical Training Institutes and Tertiary Colleges	17	46,693
Hospitals and Medical Training Colleges	6	36,402
Government Institutions in education / research sectors	21	4,002
Total	128	744,065

The connected campuses of the member institutions are located in 36 counties in across the country.

Although almost all of the public and private universities are connected members of KENET, less than 15 of the 100+ public TVET institutions are currently members of KENET. **Connecting all of the TVETs shall require external funding, similar to KTCIP funding in 2007, to build last mile connectivity and to pay the recurrent cost of Internet bandwidth and cloud services.**

There are six connected hospitals and diploma-level medical colleges, but this number is expected to grow to close to 20 when all the teaching and referral hospitals in Kenya are connected. KENET shall also target public hospitals that provide internship training to medical students.

KENET had connected 34 schools as of April 2018 as part of the KENET [Schools Connectivity Initiative](#) that aims to provide affordable, safe and secure Internet services to schools. The last mile fiber links for 31 of the 34 schools are provided for FREE by the Wananchi Group as part of the Nairobi Schools Connectivity CSR pilot project that started in 2014. The other five schools include Alliance Girls and Alliance Boys High Schools in Kiambu and Lawson School in Kitui that have been connected from neighboring university campuses to reduce last mile costs (PUEA and SEKU respectively). Moi Girls Secondary School, Marsabit was originally connected using a Ford Foundation grant in 2014 but since March 2018, the last mile link has been subsidized by Safaricom. Only Jaffreys Academy in Mombasa is connected without any subsidy. We note that the [Kenya National ICT Plan 2014-2017](#) envisaged that all

public secondary schools would be connected to KENET backbone network by 2017. This did not happen but 894 secondary schools are being connected to the Internet by three commercial operators using the Universal Service Fund.

3. KENET Services and Sustainability

One of the key objects of the KENET Trust Deed 2000 was the provision of affordable and sustainable high-speed Internet. This was to support teaching, learning and research. Internet connectivity also supports administrative and business functions of member institutions. The other main group of services provided by KENET are Community Cloud Services to support administrative, learning and research services of connected institutions.

3.1 Affordable and sustainable high-speed Internet services

Member institutions sustain KENET through subscriptions to broadband Internet services. The revenue from Internet services contributes up to 97% of the KENET annual revenue. KENET is also the academic community custodian of public Internet addresses (IPv4 or IPv6 addresses) that are necessary for access to the Internet by users. Each connected member institution is allocated a pool of public Internet addresses by KENET at no additional cost.

KENET also peers with other networks in Kenya at the Kenya Internet Exchange Point, as well as privately with the large Internet Content Providers with a presence in Kenya (e.g., Google and Akamai). Internet traffic peering in Kenya has the overall impact of reducing the cost of Internet therefore making it more affordable for connected member institutions.

The ability to aggregate the Internet traffic of member institutions drives down the retail Internet prices to member institutions as shown in Figure 2. Apart from the affordable prices, all members, including members subscribing to low capacity of Internet, benefit from receiving **platinum level customer support** from third party last-mile leased lines providers (e.g., Liquid Telecom, Safaricom, JTL, or TKL) because they are treated as a part of one large customer, KENET. About **80%** of the 17.2 Gb/s of Internet bandwidth subscriptions were being distributed over KENET-owned private network links which further contributes to driving down the retail prices.

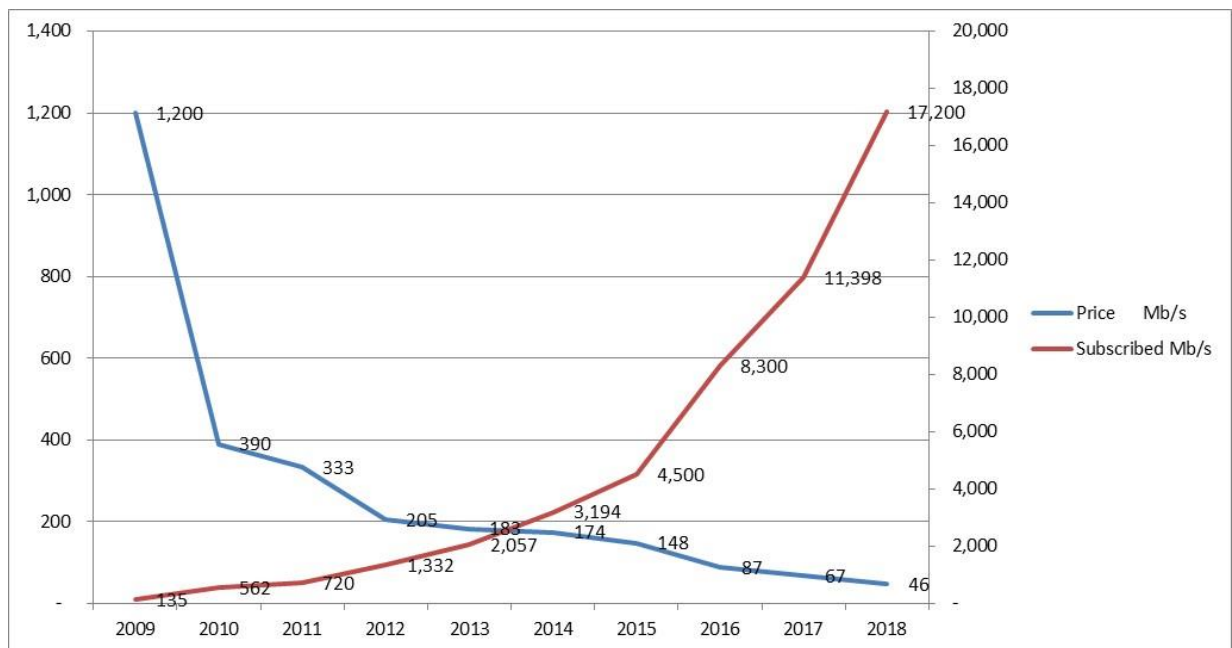


Figure 2: Internet price and volume of traffic trends 2009 - 2018

3.2 KENET Community Cloud Services

The other main group of services provided by KENET are called **community cloud services**. These services include the following:

- Web hosting (KENET hosts the institutional websites of 70 members in its data center as a FREE membership service)
- Co-location of servers (e.g., for disaster recovery)
- Virtual servers – for research, learning management systems, or other administrative applications
- Backup storage or leased disaster recovery site services
- Virtual labs for research or training
- Cloud-based web and video conferencing to support collaboration and remote teaching

Many of the community cloud services are offered as **bundled member services** on top of Internet bandwidth services (e.g., KENET hosts websites of over 70-member institutions). Although the community services were contributing only 3% of the KENET revenue in FY 2017/2018, the cloud services are critical for member institutions.

In order to provide the cloud services, KENET now operates **three** tier-3 data centers at three universities in the Nairobi area with a total rack space capacity of **38 racks**. These small data centers are still much cheaper to operate compared to leasing rack space in the carrier-neutral data centers in Kenya. We estimate that these data centers shall be adequate for another three years.

Some critical government member institutions that subscribe to the community cloud services are ICTA and HELB. All KENET community cloud services are priced competitively compared to public cloud services (e.g., Microsoft Azure, Amazon Web Services or Google Cloud). Moreover, they have the added advantage of in-country **low-cost high-speed dedicated** links between the primary sites in the member institutions and KENET data centers.

3.3 Technical Advisory and Direct Engineering Support Services

KENET provides technical advisory services to member institutions in the following key areas:

1. Scalable campus network design and the associated preparation of RFPs, technical support in evaluation of tenders, and project management of campus projects
2. Campus LAN optimization and network management
3. WiFi coverage extension and setting up of **eduroam**, the secure global roaming WiFi service for academic institutions, as well as implementation of automatic on-boarding of users.
4. Setting up open source firewalls and conducting penetration tests.

These services are offered on a **cost-recovery basis**, with member institutions simply paying for KENET engineers' time, travel and accommodation costs. In the last three years, KENET has offered technical advisory services to **nine member institutions**, mainly universities, for campus projects valued at about **Ksh 157 million**.

In addition to technical advisory services, KENET offers donated Direct Engineering Support (DES) services to selected member institutions that have limited technical ICT capacity (e.g., new university colleges), institutions that host KENET equipment nodes, select institutions with a high concentration of students and faculty in STEM degree areas. In a typical DES, KENET engineers spend time to diagnose and resolve campus network problems which may be related to design or equipment configuration. In addition to resolving the network problems, KENET also donates the required network expansion equipment, including WiFi access points.

In the last three years, KENET has conducted DES in 31 institutions and set up networks with a replacement value of **Ksh 102 million**. The network switches are often donated by [NSRC](#), a KENET partner based at the University of Oregon, that ships refurbished network switches to KENET.

3.4 KENET Sustainability Plan

One of the conditions of the disbursement of the World Bank/KTCIP grant to KENET member institutions was a sustainability plan. The sustainability plan developed in 2008 was based on bandwidth subscriptions commitment (or Internet budgets) of connected member institutions. The aggregated Internet bandwidth budgets were to pay for all recurrent expenses as well as depreciation and amortization costs.

As a not-for-profit organization, KENET only needs to break even by paying for all operational costs as well as the cost of renewal of the network and limited network expansion. However, the KENET Board of Trustees normally sets some surplus targets in the annual budget. The surplus and the accumulated depreciation fund are then used for network expansion and renewal.

The Board of Trustees also created a research fund that accumulates 2% of the Internet bandwidth revenue. This research fund is used to support **catalytic** research projects in educational technology and other STEM research areas through award of research mini-grants to early-career faculty in member institutions. In addition, the research fund supports core data collection and ICT readiness or e-readiness surveys of the Kenyan higher education and research sectors. The research results are used for data-driven ICT adoption advocacy in member institutions. For example, an [e-readiness portal](#) is maintained that provides benchmarking data for Kenyan universities.

KENET has been sustainable in its operations since the year 2015 after implementation of the \$22.5 million KTCIP network expansion project. However, the strategic plan for the period 2016-2020 identified the need for additional external infrastructure funding to support the broadband connectivity expansion (e.g., to connect TVETs and to upgrade the backbone network) and grants to support research and educational technology projects.

4. Subscription and Implementation Agency Services for KENET members

4.1 Subscription of KENET ICT services by member institutions

As explained earlier, KENET provides ICT subscription services to member institutions only. It is therefore not a business although it is required to be sustainable. All the services must be provided at prices that are competitive since member institutions are free to procure services from other providers of similar if KENET prices are high.

Member institutions that were part of the KTCIP project signed a commitment of their annual Internet expenditure through KENET. They were therefore part of the sustainability plan of KENET. Most members compare KENET prices with those of competitor ISPs in order to justify **subscription to KENET ICT services**.

In general, KENET has not been responding to tender for Internet services from member institutions. This is because, as previously mentioned, KENET is not an external entity to the member institutions but rather practically an extension of the ICT infrastructures of member institutions. For example, the five founder universities, represented in the Board of Trustees by their respective Vice Chancellors, are also some of the largest subscribers to KENET ICT services in terms of revenue. It would therefore be absurd for KENET to respond to open invitations to bid from universities that are represented in the Board of Trustees in addition to being members of KENET.

4.2 – KENET as an Implementation Agency of Member Institutions

KENET has also served in the past as an **independent implementation agency** of the member institutions, Government of Kenya as well as partners such as Google when they need to support universities campus infrastructure projects. This is because it has the specialized ICT and engineering capacity to support institutions in technical network design, preparation of RFPs as well as project management. As mentioned above, KENET offers technical advisory services on a cost-recovery basis of the engineers' time or by donating the engineers time and some equipment in what is called Direct Engineering Support services.

5. Operation and Funding of Selected NRENs in Africa, Australia, Europe and North America

National Research and Education Networks (NRENs) in different countries are normally setup by the community of universities and research institutions. In all cases, they are not-for-profit organizations that operate high-speed networks to support research and education. The two leading NRENs in Africa are TENET in South Africa and KENET in Kenya (see World Bank report on stages of maturity of [African NRENs](#)). Other progressive NRENs in Africa include RENU in Uganda and ZAMREN in Zambia.

Europe and the North America have mature NRENs, sometimes funded by government and in other cases by the member institutions. Table 2 lists examples of NRENs in different parts of the world. The best NRENs are directly funded by their respective countries, mainly by Ministries of Education, Science and Technology and indirectly by member universities and research institutions.

Notice that in all cases, member institutions do NOT procure services from NRENs but rather **subscribe** to services. This is because member institutions are part of the NREN that operates the network and provides the ICT services.

Table 2: Examples of NRENs in different parts of the world

Name of Network	Type of Organization / NREN that operates the network	Sources of Funding
AARNet Pty – Australian Academic and Research Network	Not-for-profit company; Licensed telecommunications carrier Owned by universities and research institutions	Membership subscriptions Commonwealth investments
CENIC – Corporation for Education Network Initiatives of California	Company by Limited Guarantee Operates the California State REN (CalREN)	Member subscriptions State of California appropriations for community colleges, public libraries, museums and hospitals
DFN – German Research Network	DFN-Verein, non-profit association of universities and research institutes which operates the Operates the German REN	Members of the association through subscription to services
JISC – Joint Information Systems Committee	JISC a not-for-profit company limited by guarantee (Charity); It is a membership organization Operates JANET – Joint Academic Network, the high-speed network of UK research and education community	Higher education subscriptions; UK funding bodies for Higher Education and Further Education
SANREN / TENET – South African NREN	SANREN is Competency Area of CSIR, Department of Science and Technology, Republic of South Africa. It builds and maintains the broadband network. TENET is a limited company by guarantee owned by public universities of South Africa. It operates the network on behalf of the universities	Government through CSIR + subscriptions to member services (includes Internet services)

6. Conclusions

KENET as the National Research and Education Network (NREN) of Kenya is a uniquely placed as an extension of the ICT directorates of member institutions that provides shared ICT services to its member institutions. **It has been licensed as a not-for-profit private research and education operator by Communications Authority of Kenya since 2002 with all operator license fees waived.** KENET

operates the national broadband network that interconnects universities and research institutions in Kenya. It also operates international circuits to Europe to connect the KENET community to the global Internet as well as other NRENs in around the world through GEANT, the European regional REN.

Moreover, in the past 10 years, KENET has built the ICT and engineering capacity to provide technical advisory services, to operate a broadband network as well as data centers that support community cloud services. It is therefore able to provide technical advisory services to member institutions, including campus network design, capacity building and project management. That is, KENET serves as an implementation agency for member institutions that do not always have the specialized high-end ICT expertise. It has also provided similar services to partners that aim to support member universities (e.g., Google).

Revenue collected from Internet bandwidth and community cloud services subscriptions by members (including ICTA) has allowed KENET to operate a sustainable network since 2015. Member institutions sign a **framework services agreement** with prices reviewed on an annual basis. Thus, it has achieved high levels of efficiency in provision of connectivity services, capacity building and community cloud services. Member universities have now requested KENET to explore the possibility of providing cloud-based ERP services. A special ERP expert group is developing a framework for provision of cloud-based ERP services. *Similar to other NRENs in the rest of the world, member institutions do NOT procure connectivity or cloud services from KENET but rather **subscribe** to the different ICT services.*

In future, the main unique service offering will be the provision of advanced research infrastructures and ICT services to support the Kenyan Open Science Platform. This would provide access to research computing (including High Performance Computing), research data storage and federated Open Data Repositories for different research areas. KENET research infrastructure would therefore be critical for implementation of the [Sector Plan for Science Technology and Innovation 2013-2017](#). This was the role envisaged for KENET in the [Science Technology and Innovation policy framework of 2012](#) as an operator of the broadband network that would support collaboration in higher education and research institutions.

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