KENET NETWORK INFRASTUCTURE

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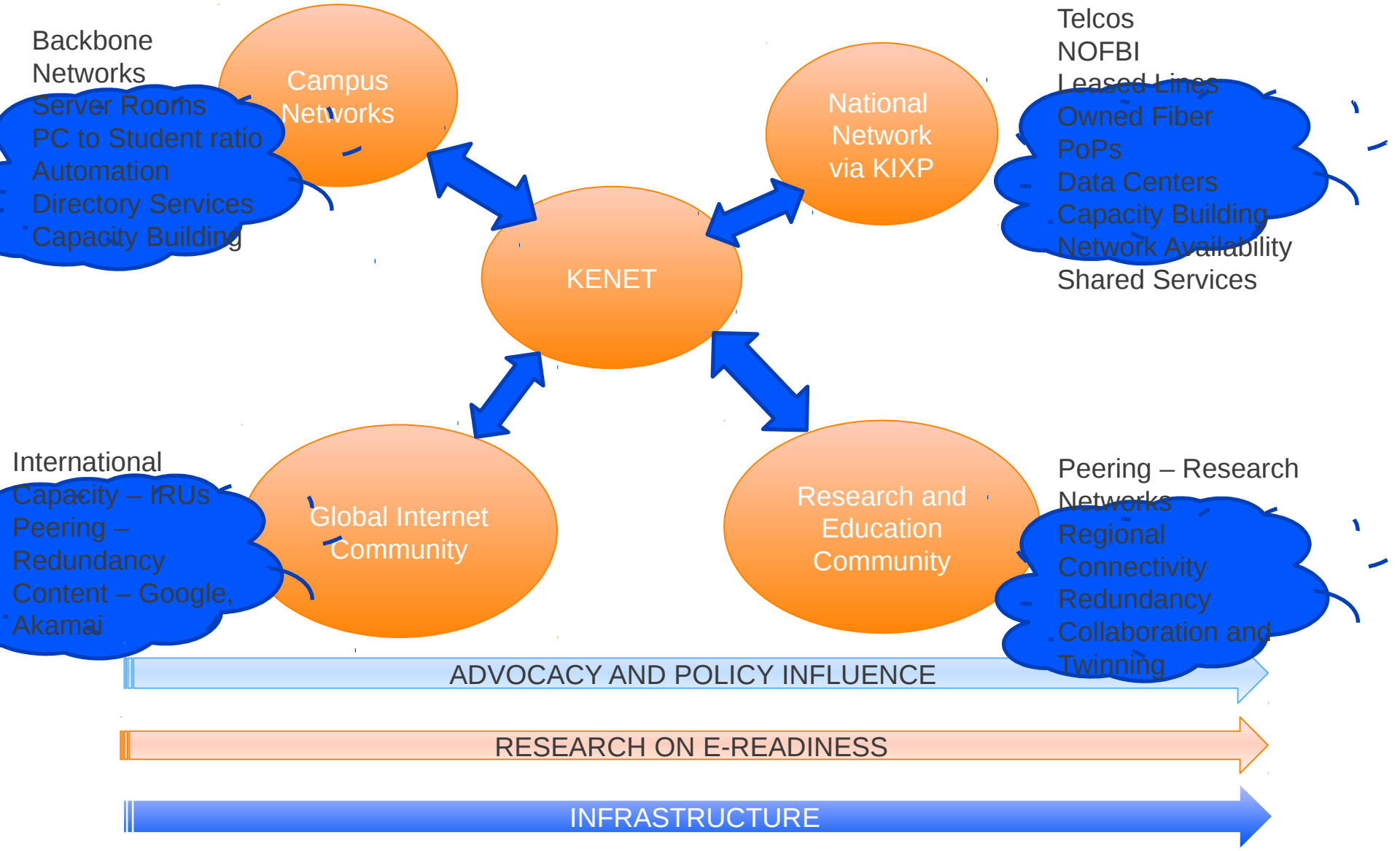
kenet
Kenya Education Network

Country of marathon winners?

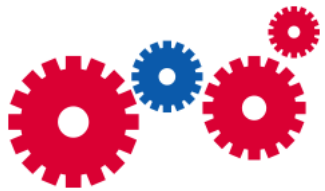
Contents

KENET SPHERES OF INFLUENCE



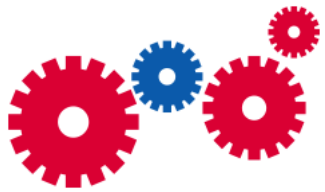
Distribution Network

- *Infrastructure Options*
  - *KENET owned fiber*
  - *Commercial fiber Leased lines*
  - *KENET owned radios*
  - *Commercial radio Leased lines*
  - *IRU (Indefeasible Rights of Use) Circuits*
- *Infrastructure Rationale*
  - *High Capacity/Low Congestion*
  - *Availability (Primary/Backup)*
  - *Scalability (Financial & Technical)*
  - *Traffic Aggregation*



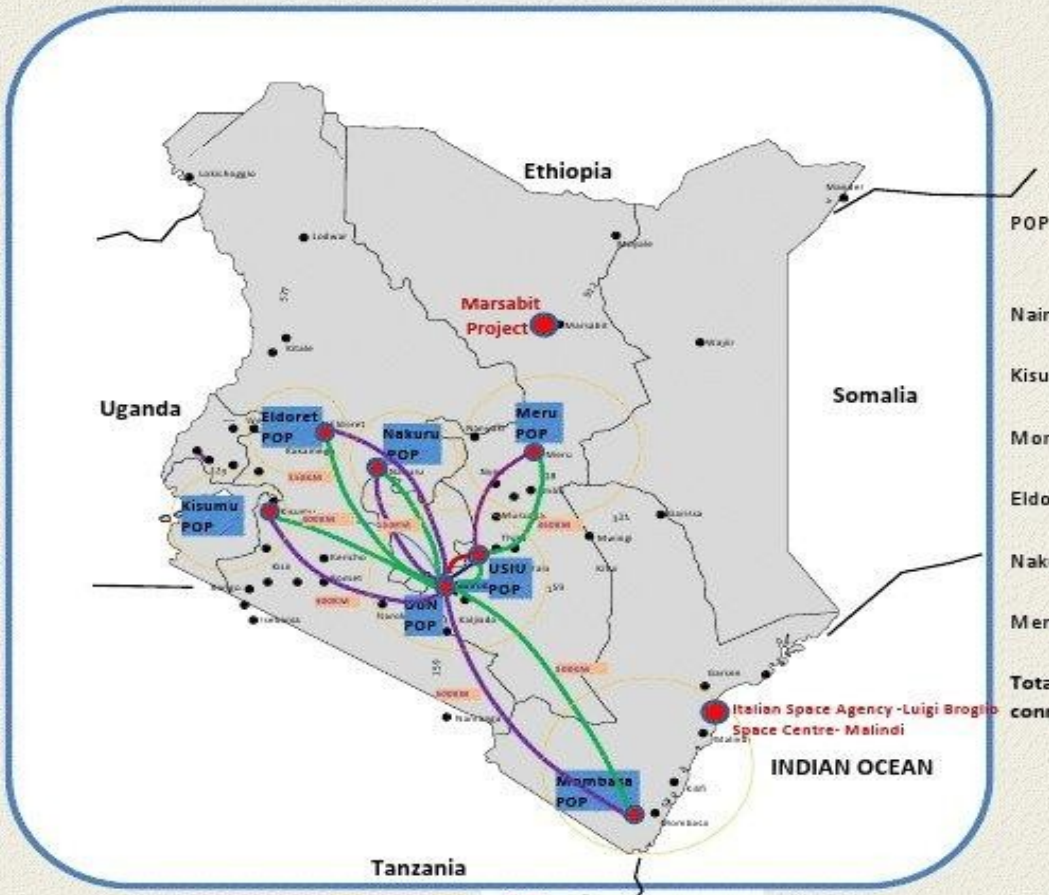
Distribution Network - PoPs

- *KENET PoPs*
  - *6 Regions*
  - *Nairobi Cluster with 9 PoPs*
  - *KENET Members connected to nearest PoP*
  - *KENET members connected to 2 PoPs where possible*
- *PoP Locations*
  - *Most PoPs located at member campuses*
  - *3 are at Provider locations (IXP, International Capacities)*
  - *Equipment hosting agreements with our members*
- *Inter POP Links*
  - *Terrestrial fiber leased lines*
  - *Dark fiber*



National Network - Locations

KENET Rapid Growth in Connected Campuses (over 40 new campuses in FY 2011-2012)



POP	Number of Campuses Connected
Nairobi POP	59
Kisumu POP	14
Mombasa POP	9
Eldoret POP	12
Nakuru POP	9
Meru POP	11
Total Campuses connected	**114**

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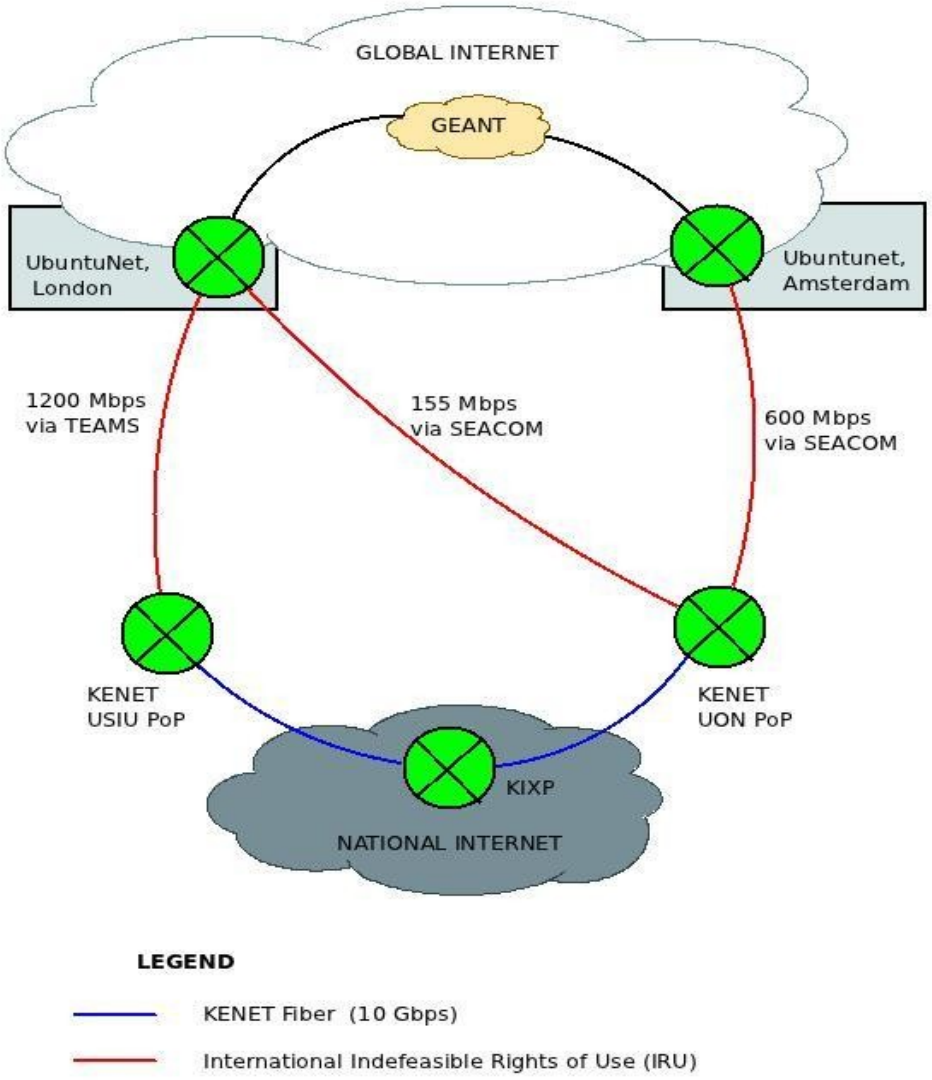
Distribution Network - Capacities

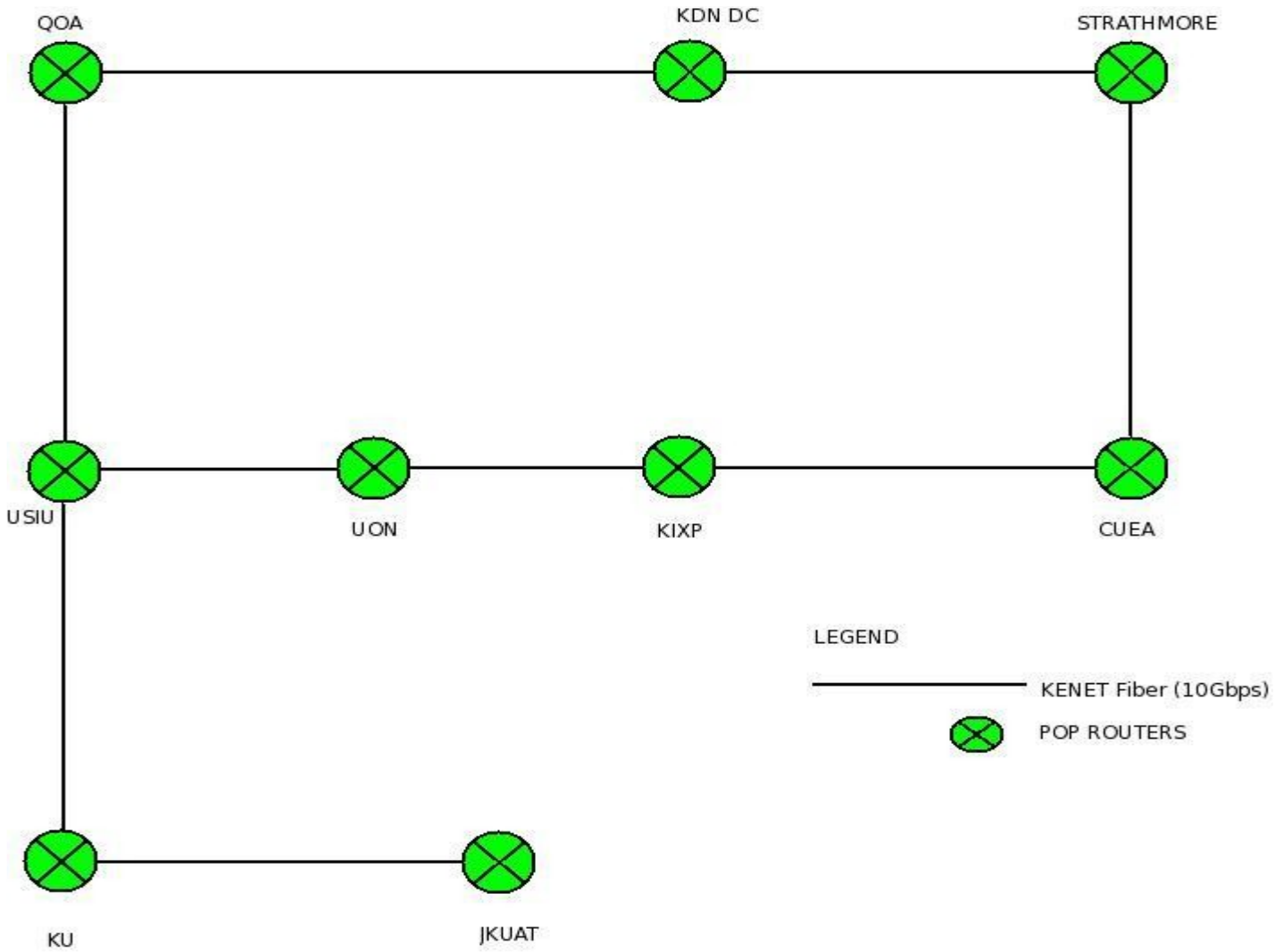
Infrastructure Type	Number of links	Capacity of links (Mbps)
KENET Owned Fiber	10	25,000
Commercial fiber leased lines	90	2,281
KENET Owned Radios	12	382
Commercial radio leased lines	29	286
Total	**141**	**27,949**

International Bandwidth



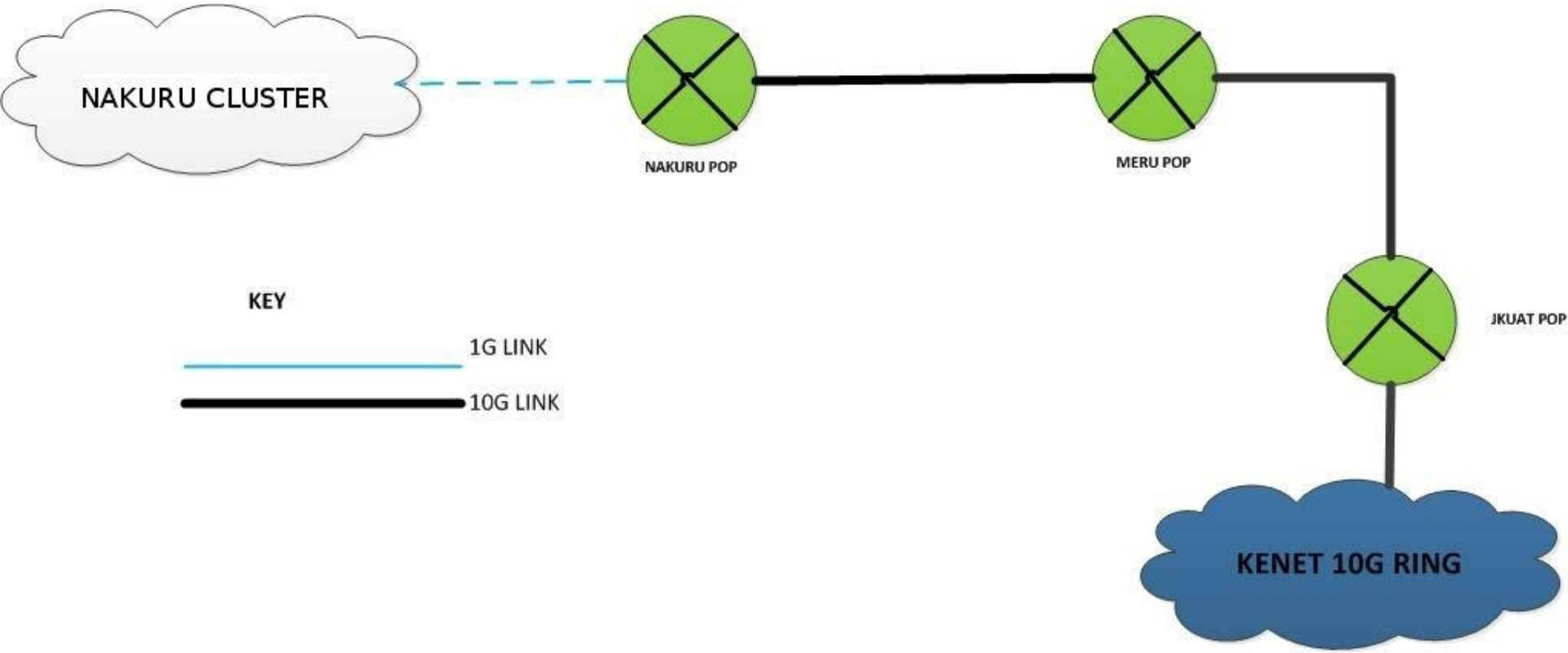
- Total capacity 1.95Gbps
- Both commodity & REN traffic via UA
- Redundant equipment
- Redundant links
- Peer locally at the Kenyan Internet Exchange
- BGP Community to Ubuntunet
- Ubuntunet performs BGP dmz-load balance in London
- SDH Links

Core Network - Ring



- *High Capacity core network*
- *Flexibility - Backhauls International Traffic*
- *Reduced recurrent costs*

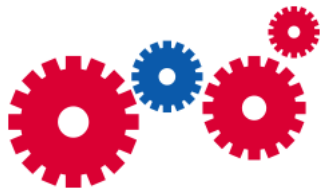
10Gbps Terrestrial Fiber



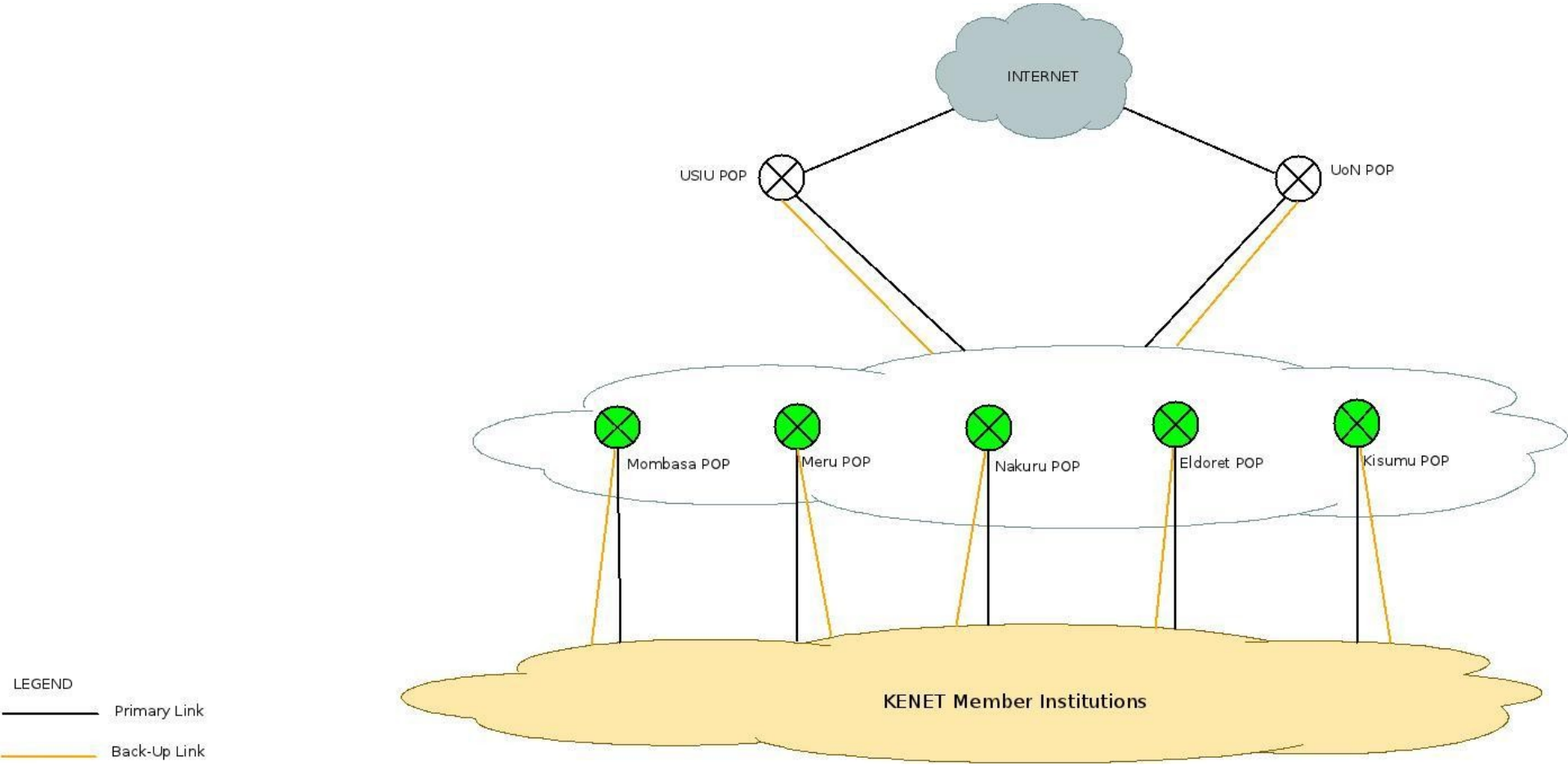
- *10Gbps to Nairobi core ring*
- *724km of fiber to KENET Points of Presence*

Distribution & Access Network

- *Infrastructure*
  - *Dark fiber*
  - *KENET owned fiber*
  - *Fiber Leased circuits/Metro Ethernet*
  - *KENET owned P2P radios*
  - *Radio leased circuits*
  - *KENET Access router at each site*
  - *At least /24 IPv4 to each campus*
- *Routing*
  - *BGP Peering & OSPF*
  - *One (1) campus dual homing*
  - *One (1) campus dual homing – REN Traffic Only*
  - *Three (3) campuses on IPv6 - /48 prefixes*

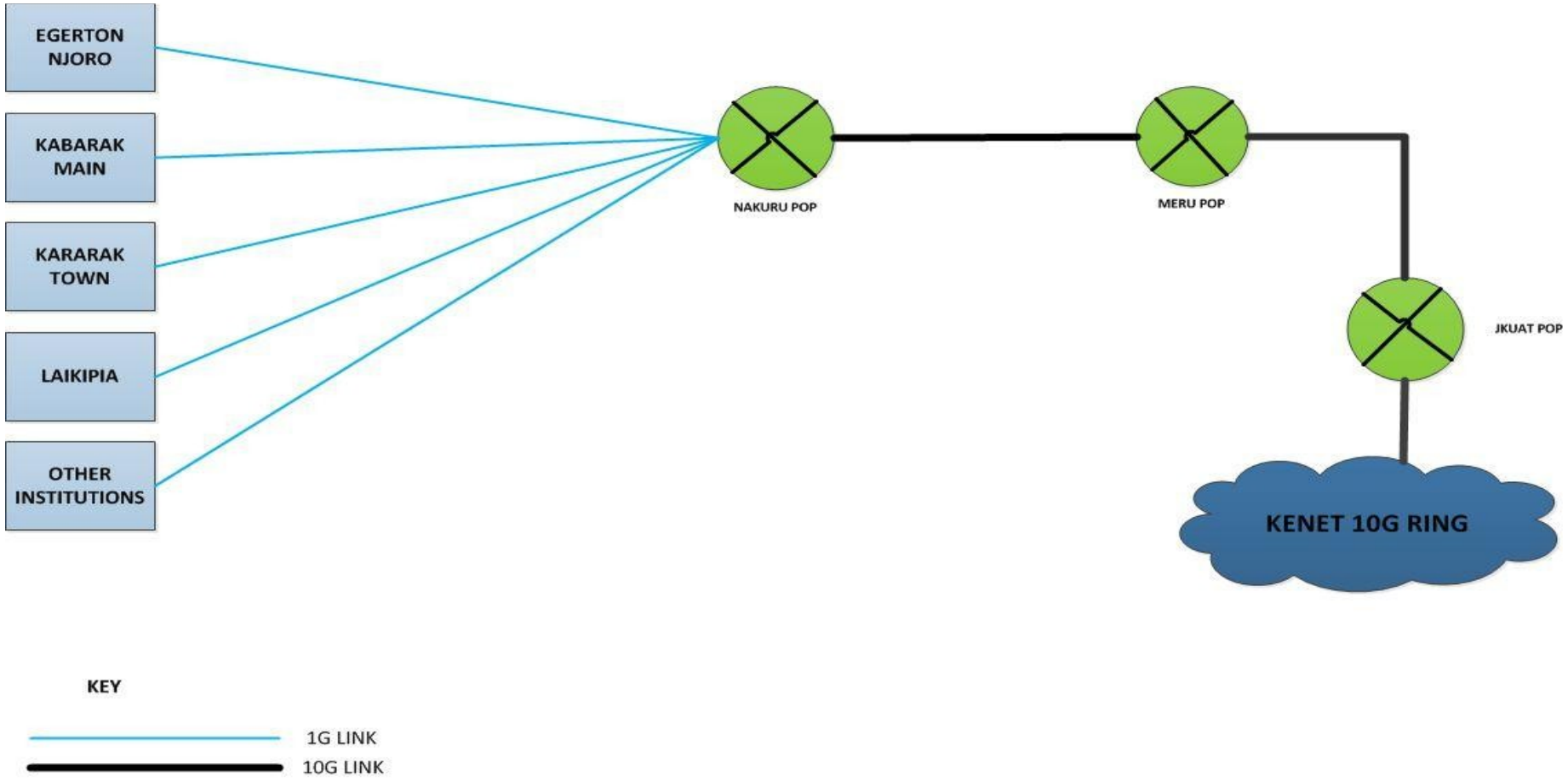


Distribution & Access Network



- *2 Core sites in Nairobi - Redundant*
- *Campuses mapped to 2 Points of Presence (PoPs)*
- *PoPs with redundant connections to Nairobi core ring*

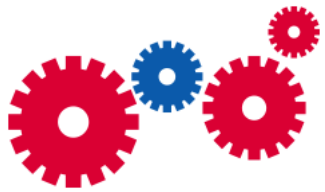
1Gbps Access Fiber



- *188km interconnecting 18 campuses*
- *Upcoming phase, 34km for 15 campuses*

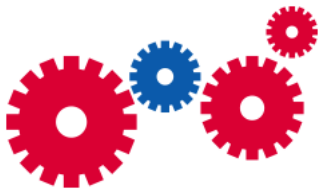
Network Routing

- *Peer with members (Total 114 campuses)*
- *Campuses peer with private ASN*
  - *Redundant peering points*
  - *Peer on Loopback interfaces*
- *Infrastructure runs on OSPF*
  - *Quick auto-failover to backup*
  - *OSPF Areas based on region/PoP*
- *Campus IP addresses routed via BGP*
  - *BGP Community for REN traffic*
  - *Multi-home members too*
- *Peer at the Kenyan Exchange*
  - *1Gbps port to KIXP*
  - *10Gbps core network*
  - *Provides cheap and very fast throughput*
  - *Local traffic not affected by undersea fiber faults*
  - *Very low congestion*



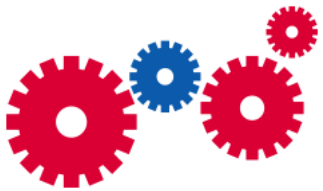
Network Routing - IXP

- *IXP Capacity*
  - *10Gbps from KENET*
  - *1Gbps port into IXP*
  - *2 ms max latency*
- *IXP Routes*
  - *BGP Peering*
  - *1166 routes learnt*
- *IXP Link Utilization*
  - *Very little local content – Approx 20Mbps average*
  - *Achieved 500Mbps – Google Cache*
  - *Backup path for Google Content*
- *Future*
  - *Provide 1Gbps for Mlab servers*
  - *Host Mlab servers within KENET*
  - *Possibility of having a Google Node, Akamai, etc*



Network Operations

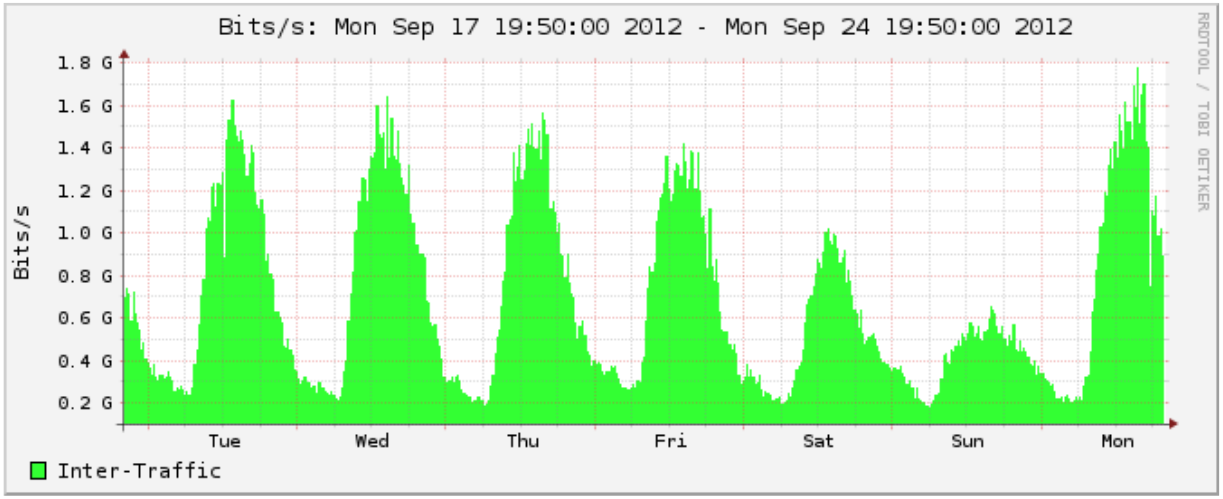
- *Network Operations Center (NOC)*
  - *NOC Team composed of young engineers*
  - *Offer first line support*
  - *Escalate difficult problems*
  - *Assisted by NOC tools for monitoring*
- *Why NOC Tools?*
  - *Keeps eye on network health*
  - *Check availability & uptime*
  - *Link latency*
  - *Link utilization*
  - *Fault documentations*



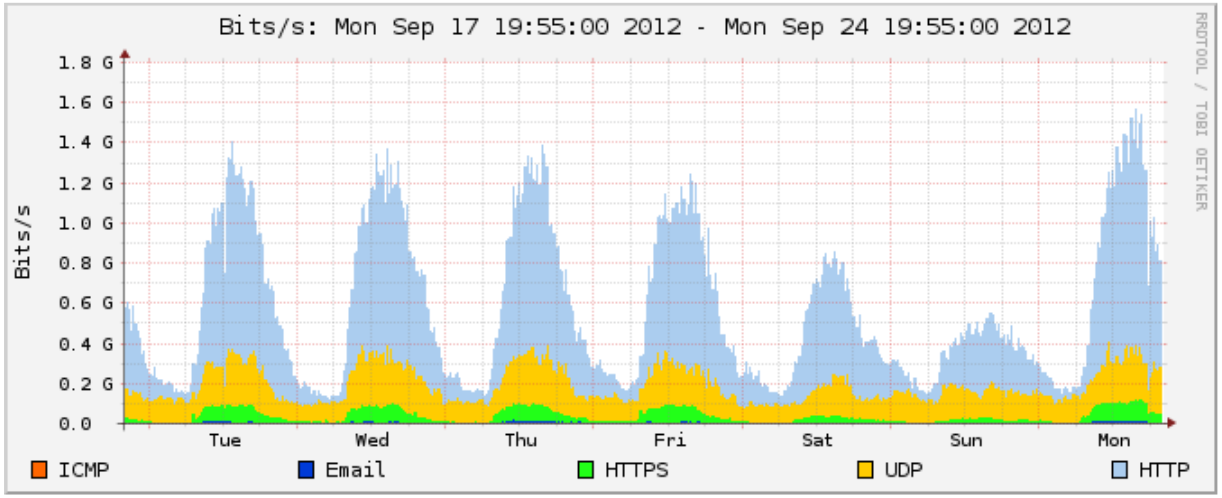
Open Source NOC Tools

- *Availability & Reporting*
  - *Use open source tools*
  - *Nagios – Availability & Uptime*
  - *OpenNMS – Network Reports*
  - *Escalates prolonged downtimes*
  - *Integrated with SMS alerts*
- *Link Utilization*
  - *Cacti*
  - *OpenNMS*
  - *NfSEN – Netflow Collector*
- *Link Latency*
  - *Smokeping*
- *Helpdesk*
  - *Vtiger (Ticketing)*

Open Source NOC Tools (Contd..)

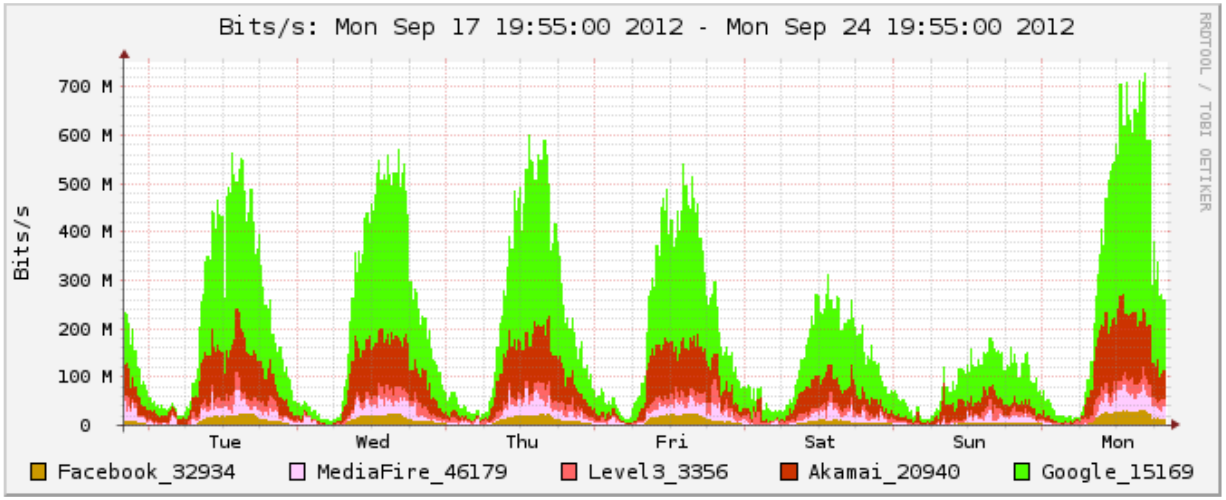


Total Traffic - Uplink + Downlink

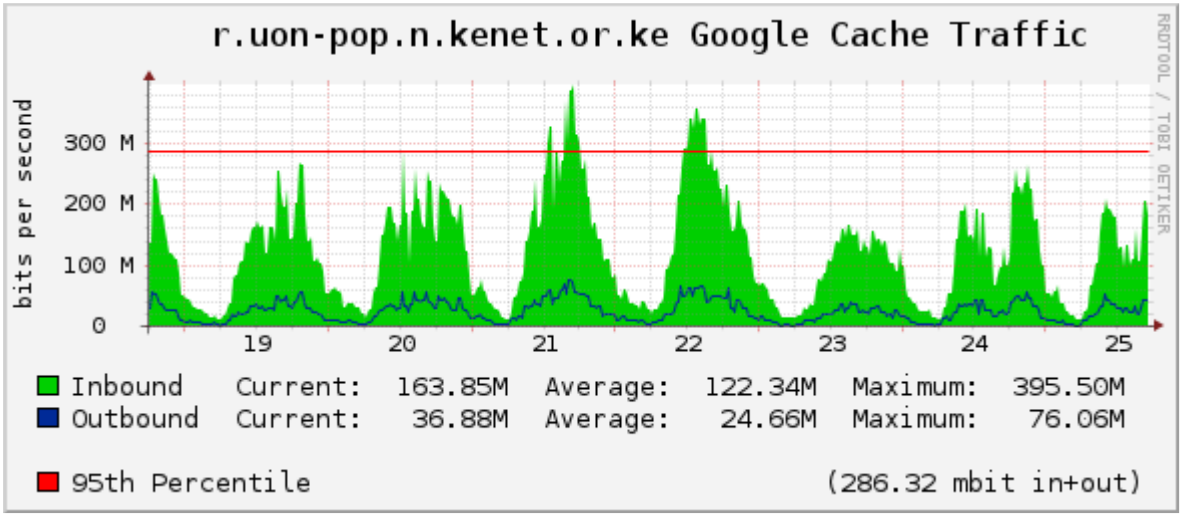


Top Ports

Open Source NOC Tools (Contd..)



Top AS Numbers



Google Cache

Open Source NOC Tools - NfSEN

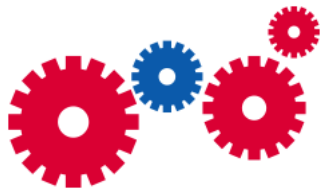
Top Regions

Other Open Source Tools

- *Network Documentation*
  - *Netdot*
  - *IP Address management*
  - *Live network map*
- *Configuration Backup*
  - *RANCID*
- *Log Collector*
  - *Greylog*
- *Authentication*
  - *AAA on all routers*
- *Central Authentication & Accounting*
  - *TACACS+ Server*

Technical Services To Members

- International bandwidth
  - 1.95 Gb/s Capacity on TEAMS and SEACOM cables
- Local connectivity
  - High capacity, low congestion links
  - 70 % of links on fiber
- Highly skilled technical staff
  - Training services
  - Technical support to members
- Shared Services
  - Video Conferencing facilities
  - IP Management, Campus Network Design
  - Domain and web hosting
  - VPNs
  - Virtual Hosting, Storage & Colocation



KEY ACHIEVEMENTS SO FAR

- More than 114 campuses connected in 4 years
- Distributing more than 1.95 Gbps of international bandwidth
- 10 Gbps fiber dark fiber ring connected key sites in Nairobi
  - Commissioned in Feb 2012.
- Development of 2 data centers
  - Shared services, colocation
- Partnership with local operators and leased line providers
  - KDN, FON, Jamii, Safaricom and Telkom Kenya
- Collaboration with other NRENs,
  - Ubuntunet Alliance, Internet 2, DFN, International Universities and Research Bodies
- International Collaboration and Partnership
  - Google implementation partner, IBM research lab, NSRC for capacity building
- High Speed network
  - http://www.itnewsafrica.com/2012/04/africas-top-ten-countries-with-fastest-internet-speeds/
  - Generates > 400 Mbps of Google/You tube traffic
- Winner of CIO awards 2011
  - Implementation of GoK/World bank funded projects

Challenges Faced in running network

- *Power & Environment*
  - *Lack of backup power*
  - *Lack of power regulation/stabilization*
  - *Lack of dedicated equipment room*
- *Network Infrastructure & Operations*
  - *Fiber optic cable vandalism*
  - *Radio link interference*
  - *Need for 24hrs Surveillance*
- *Campus Networks*
  - *Lack of adequate planning*
  - *Wireless NOT replacement for cables LAN*
  - *Network segmentation*
  - *Human capacity*

Q&A