Introduction & Problem Setup

- Lack of knowledge of ISPs peering or transit habits
  - A few previous studies on some specific countries (KE, TN, NG)
  - Initiatives to localize transit emerge
- Some knowledge of physical infrastructure
  - Satellite links, submarine cables, fragmented terrestrial optical infrastructures, a few (24) IXPs not well spread in Africa
- Perceived QoS is poor
  - High latency & low bandwidth
- Transit costs are high
  - About US $600 millions yearly spent in transit fees for intra-African traffic

Goals & challenges

- Contributions
  - Investigate access to access networks connectivity
  - Identify ISPs playing major role in transit in Africa
  - Analyze the impacts of the characteristics of the observed inter-domain paths in the end-to-end delay
  - Compare v4 to v6 routing infrastructure
  - Discover new peering links and IXPs
- Challenges
  - Find a relevant number of hosting locations in Africa
  - Choose cheap & robust devices (power outages and surges)
  - Fulfill legitimate security and privacy conditions of ISPs

Methodology: 3 Measurement Campaigns over 6 months, IP geolocation, IP to AS mapping & Data filtering

RIPE Atlas Infrastructure
Over 7700 probes scattered in the world & over 350 probes in Africa

Data collection

3 Measurement campaigns
1st campaign: 675k v4 paris-traceroutes
  - All v4 probes
  - Entire continent
  - Nov 30, 2013 - Apr 06, 2014

2nd campaign: 408k v4 & 21k v6 paris-traceroutes
  - All the v4 & v6 probes
  - Southern Africa
  - June 01 - August 01, 2014

3rd campaign: 3k v4 paris-traceroutes
  - v4 probes
  - Gambia (GM)
  - August 06 - 16, 2014

Dataset treatment

- IP to AS mapping with TC
  - 164 Ases classified in WAf, EAf, SAf, RAf, Int

Raw data Sanity check

- IP to CC lookup with 6DBs
  - 8,328 v4 & 456 v6 IPs
  - 94.1% v4 & 98.1% v6 IPs geolocated: Country path inference

Path dynamics

AS path length distribution

Technico-economic Insights

Emergence of new IXPs: Benin-IX (BJ) - 3 peers

Emergence of new IXPs: case of SIXP (GM) - 3 peers

Conclusions

- The African interdomain topology is quite stable over time
- Observing it from a couple of location gives a biased view
- Lack of interconnection among African ISPs (ZA being an exception)
  - ZA is adopted as a hub for West-East communications
  - IXPs in ZA appears on 58% paths traversing ZA
- Long AS paths and RTTs, sometimes among ISPs in the region or country
- Transit habits vary throughout the continent
- Frequent usage of IXPs such as JINX, DINX, CINX, NAPAfrica, etc
- Emergence of new IXPs, first benefits of initiatives promoting peering