‘La Terre est Ronde’: Some Challenges and Contradictions in the Quest for Content Locality

Innocent Ndubuisi-Obi Jr (He/Him)

IEFT GAIA
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The content locality problem

“For example, over 50% of the top domains in Brazil and India are hosted in the United States, […] About half of Kenyan paths to the top domains traverse the United States and Great Britain (but the same half does not traverse both countries). Much of this phenomenon is due to “tromboning”, whereby an Internet path starts and ends in the same country, yet transits an intermediate country; […] Infrastructure alone is not enough. ISPs in respective regions need better incentives to interconnect with one another to ensure that local traffic stays local.”

Impacts of Tromboning

Step 1: Congestion on ISP PNI link causes ISP traffic to connect to Cloudflare via transit
Step 2: Transit provider sends traffic to US before returning to Cloudflare

Source: https://blog.cloudflare.com/two-weeks-later-finding-and-eliminating-long-tail-latencies/
Takeaway I

Tromboning is a significant issue in the Majority World.
The promise of peering: A ‘Flat’ Internet

Figure 2. Stages of Internet Ecosystem Development

Localized traffic 30% 70% 80%

IXP Stage 1
IXP Stage 2
IXP Stage 3

Local ISPs
Local content
Regional ISPs
International content


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Internet flattening refers to a reduction in the number of intermediary organizations on Internet paths. The Internet becomes flatter when a major content provider expands its own network to bypass transit providers and connect directly with eyeball networks. Internet flattening is routinely conflated with the trend towards more peering. Indeed, peering relationships are commonly established to bypass transit providers and thus reduce the number of organizations on end-to-end paths.

The promise of peering: A ‘Flat’ Internet

1. CDNs might want to lower costs and encourage direct and settlement-free traffic exchange.
2. ISP with lots of eyeballs may want to connect directly to other large ISPs.
3. Transit networks may want to sell services to ISPs.

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Figure 5. African IXPs: Years Founded (Source: Af-IX, 2020)
Figure 6. Number of Connected Networks (Source: IXP surveys, IXP websites, 2020)

Takeaway II

Peering at IXPs can keep traffic local.
Caches + PoPs at IXPs. Win!?
ISP: CAN WE PLEASE GET A CACHE?

CONTENT PROVIDERS:

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GOOGLE:

It's a no from me
So, let’s just share a cache?

OpenCDN is a **shared infrastructure initiative** that helps CDNs to reach Brazilian Internet users with low delay and high quality. It does that lowering the barriers to the CDNs to install their own cache servers in shared infrastructures, that are connected to a growing number of IX.br's IXPs.
Cache games

REQUEST FOR PROPOSAL

Request for proposals from Internet Peering Communities in Africa for supplementary funding toward Internet Transit connectivity and capability to be used for downloading content onto CDN Cache(s) connected to the IXP, for the benefit of the participating Peers.

Background

At the end of 2018, there were 45 IXPs located in 40 cities across 33 countries in Africa. Many of these IXPs were established within the last decade and have demonstrated significant growth during this period in connecting traditional operators. The next phase of IXP growth will require even more innovative approaches to attract non-traditional operators and in particular content producers who are unaware of their value proposition in the Internet interconnection ecosystem.

As a way forward, IXP operators will need to enhance their level of collaboration and cooperation with their members, partners and community as a whole, to address some of the barriers that may inhibit content creation and localization.

In this regard, the Internet Society in partnership with Facebook are aiming to support at least five internet peering communities (coordinated through IXP representatives) in Africa with supplementary funding for Internet Transit connectivity to be used to connect and serve ANY CDN Cache(s) connected to the IXP.
Cache games

• Off-nets exist but many networks do not have enough eyeballs to warrant an edge cache

• Recent proposals to share cache infrastructure

• However, when caches are behind a peer’s network there is instability which requires incentive alignment

• We identify two types of games
Problem A: The Inter-ISP Cache Sharing Game
Problem B: The Inter-IX Cache Sharing Game
Coordination and cooperation is still difficult even in the presence of IXPs. The ‘content problem’ is also relational.
The reality of peering

ISPs connect to an IXPs without having physical presence at their switching infrastructure

- Its very common
- Drive IXP growth
- Very contentious

<table>
<thead>
<tr>
<th>IXP</th>
<th>Reseller RP latency</th>
<th>Geographical RP latency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Remote lower</td>
<td>Transit lower</td>
</tr>
<tr>
<td>PTT-SP</td>
<td>8,886 (74.2%)</td>
<td>3,085 (25.8%)</td>
</tr>
<tr>
<td>LINX</td>
<td>10,342 (77.7%)</td>
<td>2,973 (22.3%)</td>
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<tr>
<td>AMS-IX</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NAPAfrica</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PTT-RJ</td>
<td>1,929 (64.9%)</td>
<td>1,045 (35.1%)</td>
</tr>
<tr>
<td>PTT-CE</td>
<td>3,014 (71.7%)</td>
<td>1,190 (28.3%)</td>
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<tr>
<td>Eq-Ash</td>
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<td>Eq-Chi</td>
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</tbody>
</table>

Table 6: Latency comparison between remote peering or transit, showing the number of prefixes with lower latency. For Reseller RP, in four IXPs, at least 64.9% of the prefixes had lower latency via Reseller RP routes than via transit. For Geographical RP, seven of eight IXPs had at least 57.6% of prefixes with lower latency via remote peering routes than via transit.

Remote NAP Africa Ports

In addition to Network Platforms’ peering at NAPAfrica, JINX, DINX, CINX, LINX, AMS-IX and DE-CIX we offer our clients the option to remote peer to any of these peering exchanges without having to invest in infrastructure costs in these locations.

SEACOM introduces NAPAfrica remote peering service

By Staff Writer

SEACOM introduces NAPAfrica remote peering service
What is going on behind the scenes?

Decisions, Decisions!

1. If transit, then:
   send packet_{transit}
else peering:
   if local then:
     send packet_{local}
   else remote
     send packet_{remote}

2. We know, partially:
   latency(\textcolor{red}{\textbullet}, \textcolor{green}{\textbullet})
we don’t know,:
   latency(\textcolor{red}{\textbullet}, \textcolor{green}{\textbullet})

* Routes exchange via peering with a route server or with peers at an IX
Takeaway IV

Wait, so what does this mean?
Vantage points and our measures

> State-of-the-art measurement are developed around Western networks
> What does this mean at the level of content traffic for the Global CDNs?
> What does this mean for the story of ‘local content’? Is ‘cheaper’ now synonymous for ‘local’?
Takeaway V

You can’t fix what you can’t measure.
Flatland
A romance of many dimensions

With Illustrations by the Author, A SQUARE
(Edwin A. Abbott 1838-1926)

To
The Inhabitants of SPACE IN GENERAL
And H. C. IN PARTICULAR
This Work is Dedicated
By a Humble Native of Flatland
In the Hope that
Even as he was Initiated into the Mysteries
Of THREE Dimensions
Having been previously conversant
With ONLY TWO
So the Citizens of that Celestial Region
May aspire yet higher and higher
To the Secrets of FOUR FIVE OR EVEN SIX Dimensions
Thereby contributing
To the Enlargement of THE IMAGINATION
And the possible Development
Of that most rare and excellent Gift of MODESTY
Among the Superior Races
Of SOLID HUMANITY

Source: https://www.math.ksu.edu/~cjbalm/570s14/flatland-edited.pdf
view from a peer in Sphereland

view from a peer in Flatland
1. Of the Nature of Flatland

I CALL our world Flatland, not because we call it so, but to make its nature clearer to you, my happy readers, who are privileged to live in Space. Imagine a vast sheet of paper on which straight Lines, Triangles, Squares, Pentagons, Hexagons, and other figures, instead of remaining fixed in their places, move freely about, on or in the surface, but without the power of rising above or sinking below it, very much like shadows - only hard and with luminous edges - and you will then have a pretty correct notion of my country and countrymen. Alas, a few years ago, I should have said "my universe": but now my mind has been opened to higher views of things.
Thanks for listening! Thoughts?