AONOG
Angola Network Operators Group

AOPF

Angola Interconnection Landscape

18 November 2020 – Darwin Costa

Agenda

- Recap from 2019

- Who are we & team

- National subsea systems & new announced

- The current Interconnection Ecosystem

- The effect of Pandemic

- Growth of Internet in Angola

- Challenges & how to tackle it

- Q&A

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Last slide from 2019

1. We will change the name APF to AOPF due to the existing "Asian Peering Forum"

2. For 2020 we will need to enlarge our PC members

3. AOPF / AONOG 2020 up to 3 or 4 days

4. (2020 Place tbd) – WE ARE ALL DIGITAL NOW ☺!

5. New board structure to be presented in 2020 via the existing mailing – lists – stay tuned!

New Logo

Who are we?

Angolan **P**eering **F**orum & **A**ngolan **N**etwork **O**perators are a group of skilled individuals who are willing to contribute for a better national internet environment

- Why are we doing this?

- How do we intended to create value for the community?

- Which discussions channels are available today to share experiences?

aonog-members@nogalliance.org

Who are we?

Where are our participants coming from?
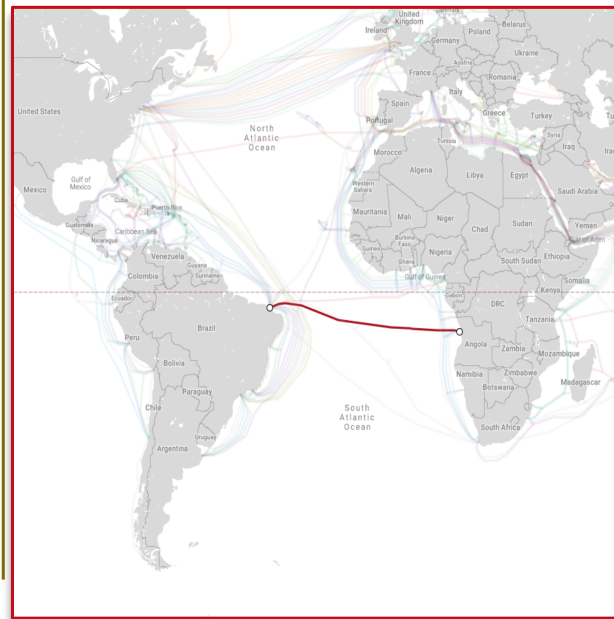

Registrations by country

National subsea systems – designed capacity 2020

SAT-3/WASC
40Gbit/s
Launched: Apr/2002

SACS
40Tbps
Launched: Sep/2018

WACS
14Tbps
Launched: May/2012

Source: https://www.submarinecablemap.com

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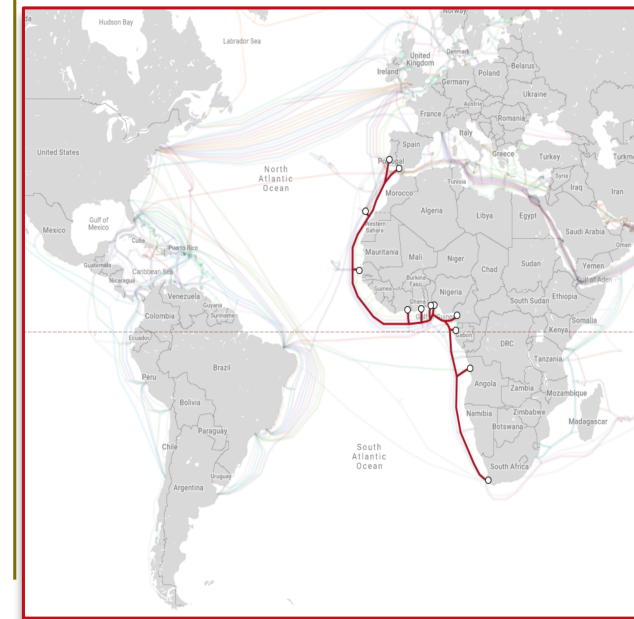
New announced Subsea Cables in the African Region
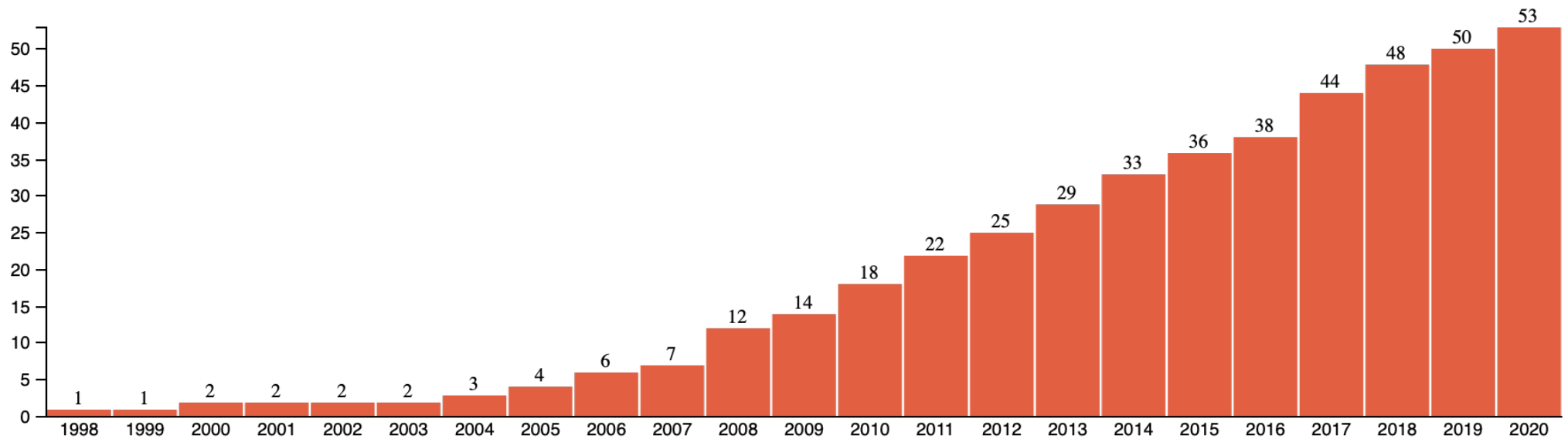
What's the status quo on the current interconnection ecosystem

ASN issued cumulative per year in Angola

Source: https://stats.afrinic.net/country/#

How many Internet Exchange Points?
2019

Angonix:

Launched: 2015
Connected Members: 19
Site: Angonap
(Angola Cables)
Peak traffic: ~14Gbps

AngolaIXP:

Launched: 2006
Connected Members: 20
Site: Angola Telecom
Peak traffic: ~1Gbps

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How many Internet Exchange Points?
2020

Angonix:

Launched: 2015
Connected Members: 25
+6 new networks
Site: Angonap
(Angola Cables)
Peak traffic: ~16Gbps
+2Gbps

AngolaIXP:

Launched: 2006
Connected Members: 20
Site: Angola Telecom
+ITA new DC
Peak traffic: ~1Gbps

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How many "Registered" Datacenters?
2019>>>2020

I. **Multipla**

II. **ITA Luanda**

III. **Angonap (Angola Cables)**

No changes

Angonap

ITA

Multipla

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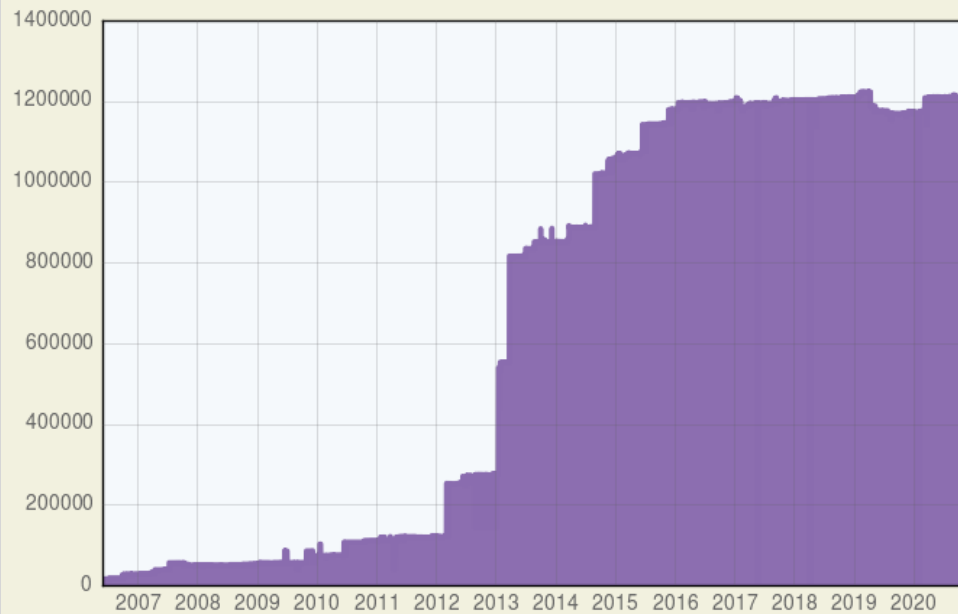
Growth of Internet in Angola

Growth of Internet in Angola
Number of Unique IPv4 addresses (Jun 2006 - Nov 2020)
Source: BGP Data

Growth of Internet in Angola
Number of Prefixes (Jun 2006 - Nov 2020)
Source: BGP Data
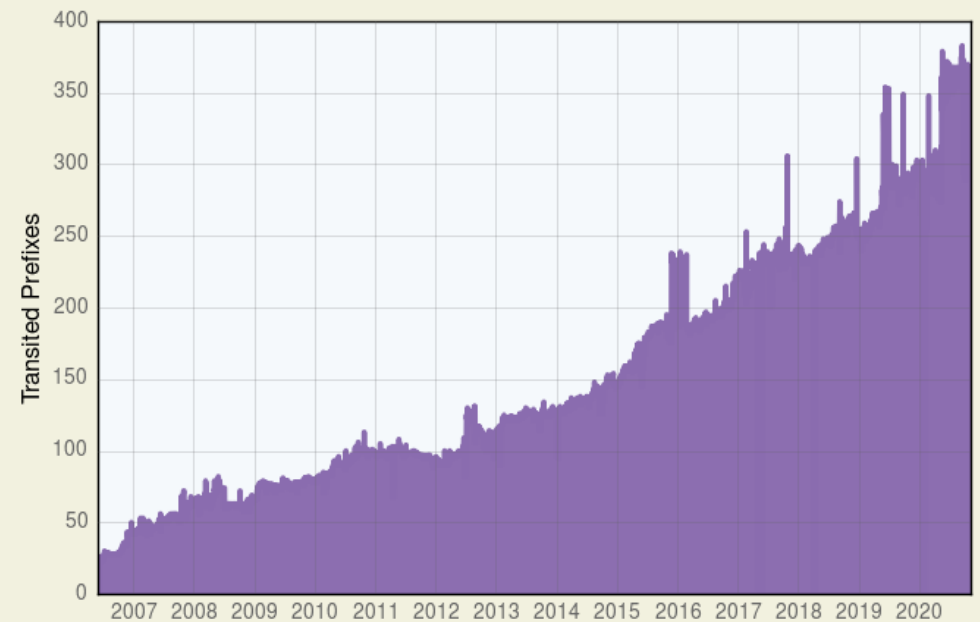
Source: DYN / Oracle

The effect of the Pandemic

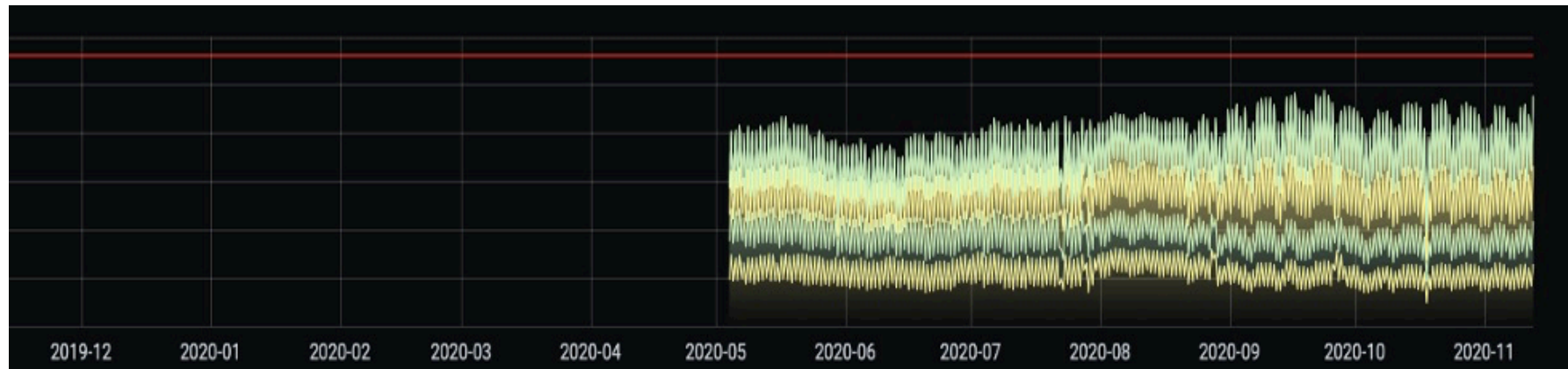# Unknow network traffic graph

Due to the lockdown this network saw an increase of 50% traffic on their backbone

Another unknow network traffic graph

Due to the lockdown this network saw an increase of 40% traffic on their backbone

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Angola IXP

Angola-IXP Detail

	Current	Average	Maximum	Total In
▪ *** IXP-ACS *** Inbound	0.00	21.43 k	7.10 M	83.08 GB
▪ *** IXP-AT *** Inbound	156.28 M	196.89 M	599.91 M	740.01 TB
▪ *** IXP-BNI *** Inbound	127.76	145.18	2.22 k	562.89 MB
▪ *** IXP-CMC *** Inbound	4.27 M	1.06 M	5.51 M	4.11 TB
▪ *** IXP-CMC *** Inbound	119.30	34.25 M	591.99 M	132.81 TB
▪ *** IXP-CNTI *** Inbound	4.63 M	1.11 M	7.22 M	4.32 TB
▪ *** IXP-DNSA *** Inbound	6.16 k	157.83 k	870.13 k	611.93 GB
▪ *** IXP-ITA *** Inbound	0.00	493.63	756.22	1.91 GB
▪ *** IXP-ITN *** Inbound	0.00	0.00	0.00	0 bytes
▪ *** IXP-KEVE *** Inbound	319.76 k	387.75 k	1.55 M	1.5 TB
▪ *** IXP-MOVC *** Inbound	596.30	352.79 k	4.28 M	1.37 TB
▪ *** IXP-MST *** Inbound	39.73 M	19.44 M	48.75 M	75.36 TB
▪ *** IXP-MTL *** Inbound	338.26	3.83 M	9.23 M	14.84 TB
▪ *** IXP-NTO *** Inbound	0.00	0.00	0.00	0 bytes

Angonix

Peak happened during week 43 – October 2020

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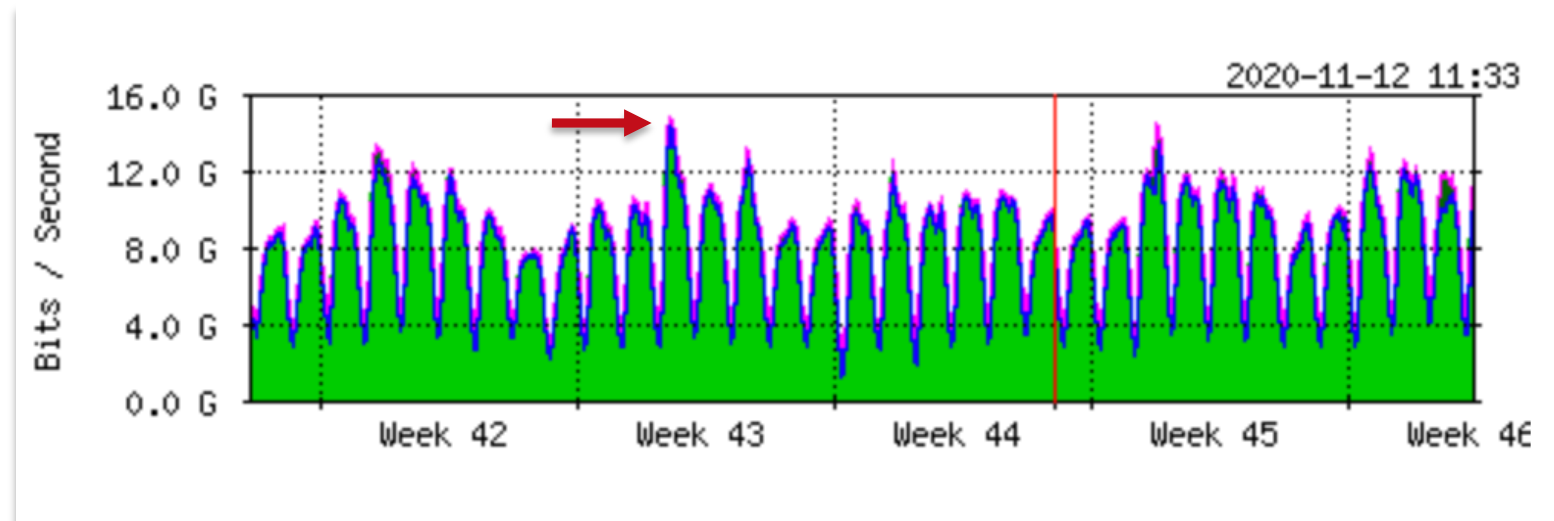
Challenges & how to tackle them

IPv4 Exhaustion over time (Africa)

Source:

IPv6 issued cumulative per year (/32s) in (AO)

Source: https://stats.afrinic.net/ipv4/exhaustion/#
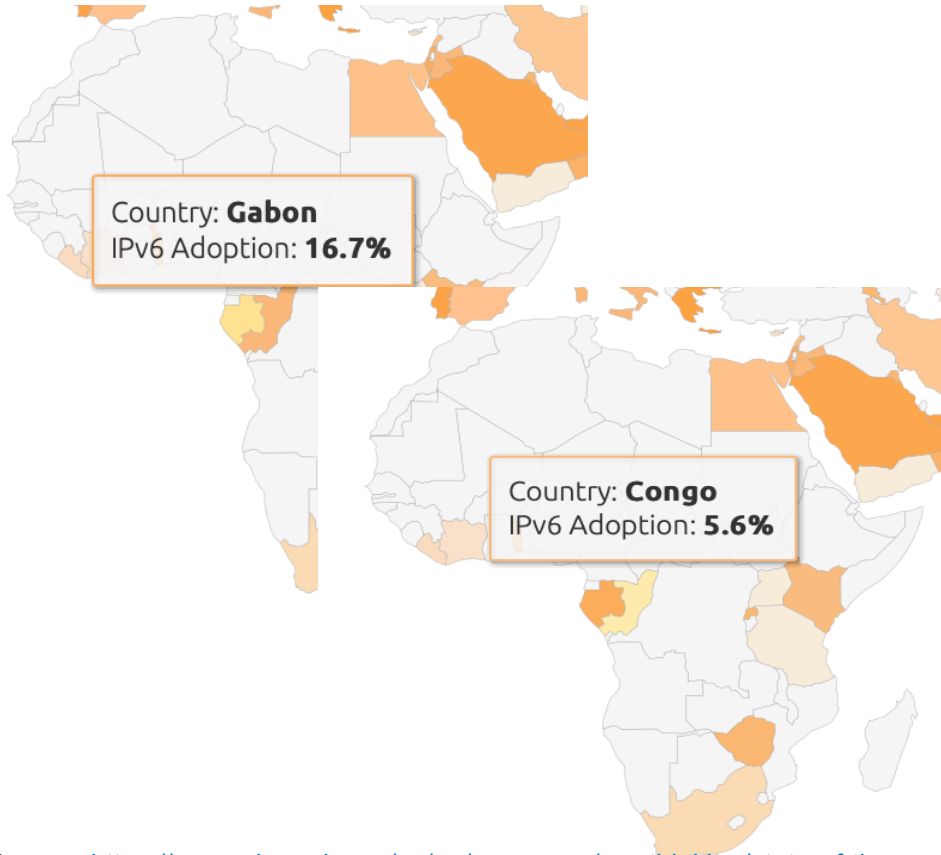
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IPv6 Adoption (AO)

Country: **Gabon**
IPv6 Adoption: **16.7%**

Country: **Congo**
IPv6 Adoption: **5.6%**

Angola
IPv6 Adoption: **0%**
Latency / impact: **0ms / 0%**
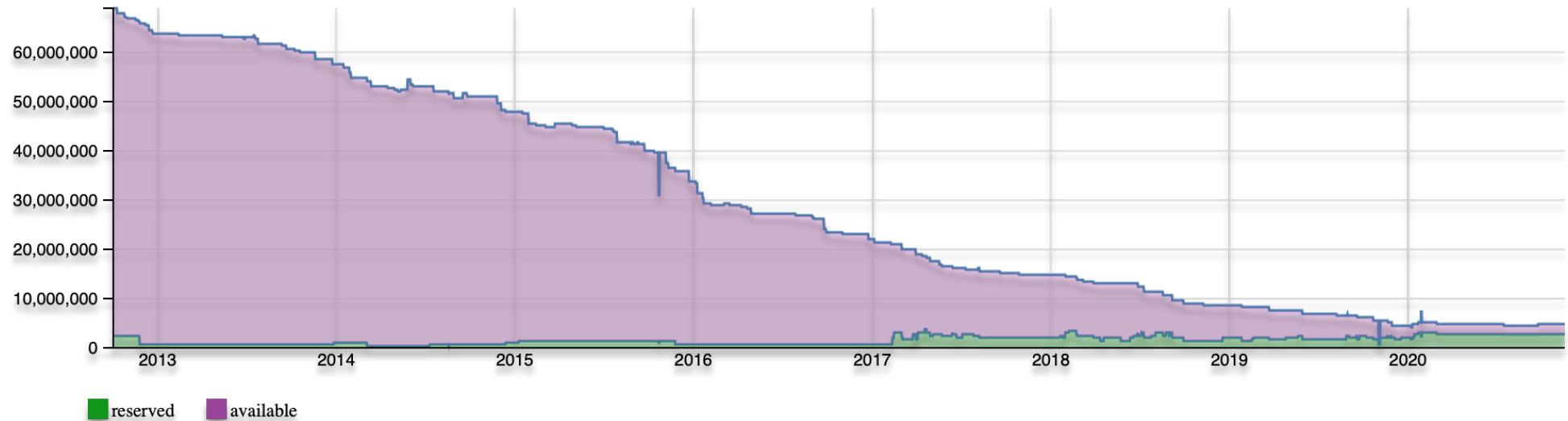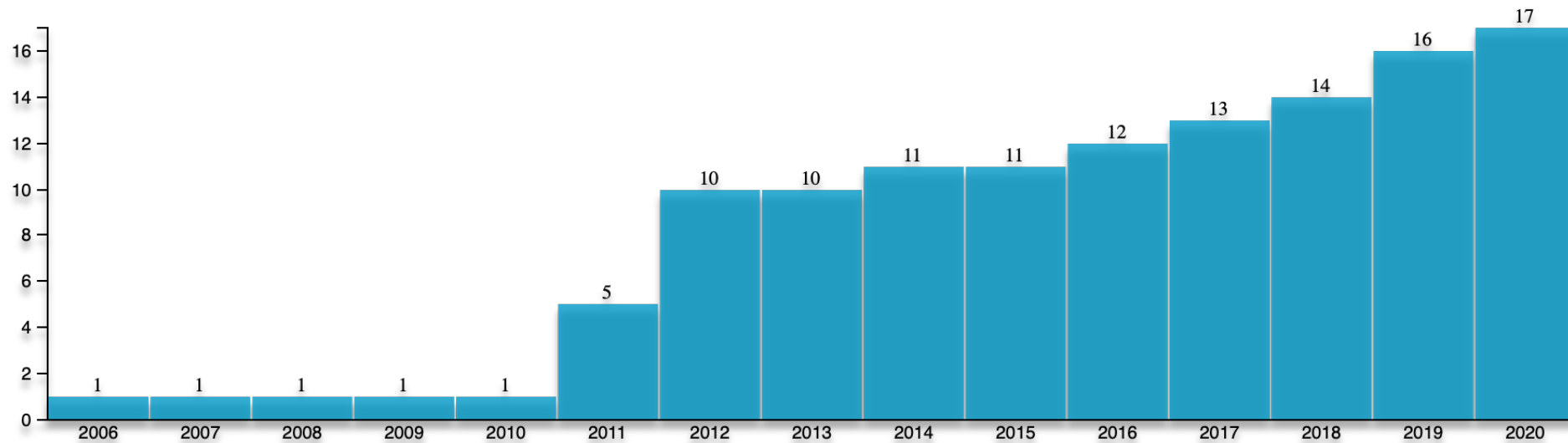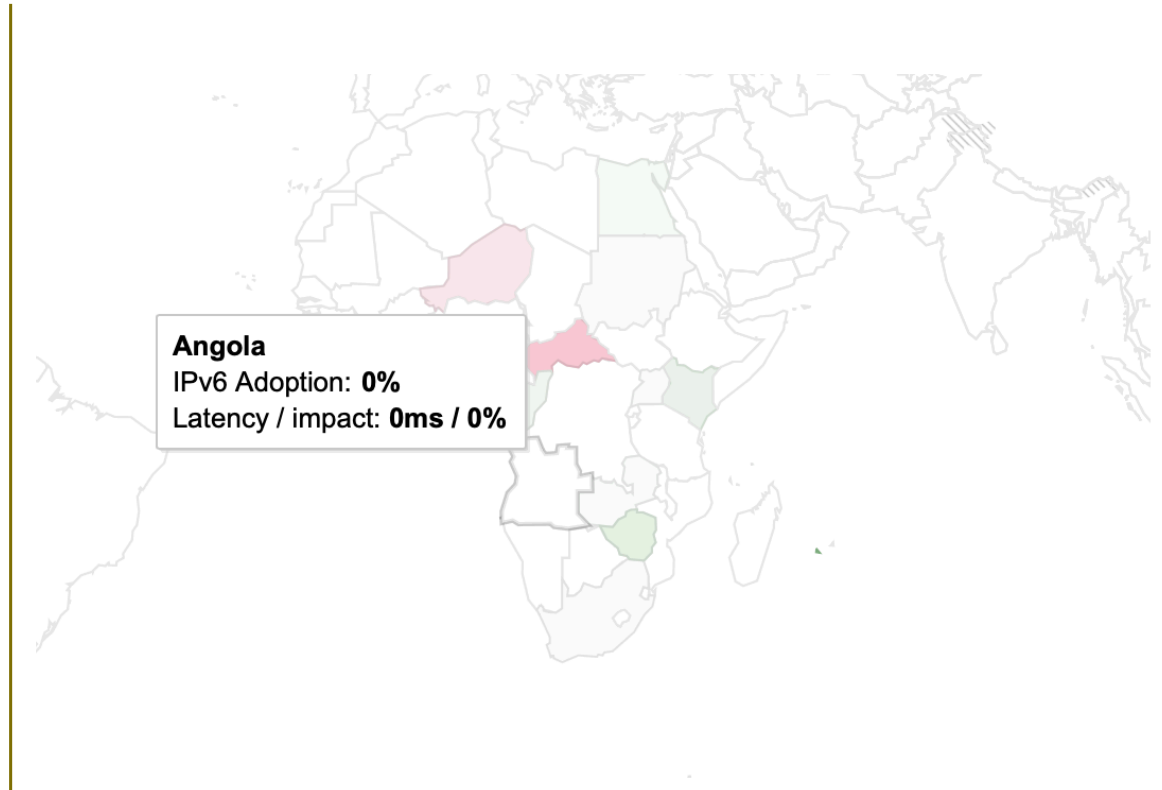
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Traffic Engineering issue

How to reach Banco BAI from LAD Network (1)

```
microsoft.ixp.joburg (196.60.8.133)  55.854 ms  59.484 ms  56.727 ms
ae22-0.icr01.jnb21.ntwk.msn.net (104.44.237.227)  56.724 ms  57.278 ms  56.263 ms
be-100-0.ibr01.jnb21.ntwk.msn.net (104.44.20.77)  188.776 ms  189.374 ms  188.910 ms
be-13-0.ibr01.mrs20.ntwk.msn.net (104.44.19.98)  189.154 ms  190.561 ms  188.717 ms
be-10-0.ibr01.gva20.ntwk.msn.net (104.44.19.220)  189.171 ms  189.025 ms  189.093 ms
be-3-0.ibr01.zrh20.ntwk.msn.net (104.44.18.46)  190.610 ms  188.743 ms  189.110 ms
be-6-0.ibr01.fra21.ntwk.msn.net (104.44.18.79)  188.836 ms  189.037 ms  188.672 ms
be-8-0.ibr01.ams30.ntwk.msn.net (104.44.19.234)  188.703 ms  188.999 ms  188.730 ms
be-4-0.ibr03.ams06.ntwk.msn.net (104.44.18.185)  188.772 ms  192.402 ms  189.039 ms
ae141-0.icr03.ams06.ntwk.msn.net (104.44.21.176)  188.123 ms  188.196 ms  187.798 ms
* * *
* * *
* * *
```

187ms 😦

How to reach Banco BAI from LAD trough TV Cabo

```
1  192.168.100.1 (192.168.100.1)  7.554 ms  3.522 ms  5.927 ms
2  cust254-137.127.154.tvcabo.ao (154.127.137.254)  16.870 ms  23.312 ms  10.076 ms
3  lad-int-cs01.tvcabo.ao (196.202.252.126)  6.873 ms  4.333 ms  4.409 ms
4  lad-cr1.tvcabo.ao (196.202.252.5)  6.846 ms  4.633 ms  4.502 ms
5  lad-cr1.tvcabo.ao (196.202.252.1)  7.715 ms  5.416 ms  5.901 ms
6  197.149.148.69 (197.149.148.69)  6.242 ms  5.083 ms  5.808 ms
7  102.130.68.111 (102.130.68.111)  8.278 ms  7.127 ms  12.729 ms
8  170.238.232.149 (170.238.232.149)  73.299 ms  67.711 ms  73.377 ms
9  170.238.232.185 (170.238.232.185)  132.576 ms  138.044 ms  132.400 ms
10 198.32.124.188 (198.32.124.188)  132.694 ms  132.104 ms  131.526 ms
11 ae47-0.ear02.mia.ntwk.msn.net (104.44.40.198)  134.677 ms  *  140.704 ms
12 be-20-0.ibr02.mia.ntwk.msn.net (104.44.11.36)  191.685 ms  195.281 ms  191.092 ms
13 be-5-0.ibr02.atl30.ntwk.msn.net (104.44.28.105)  191.425 ms  190.648 ms  192.158 ms
14 be-6-0.ibr02.bn6.ntwk.msn.net (104.44.17.232)  194.467 ms  191.857 ms  192.452 ms
15 be-2-0.ibr04.bl20.ntwk.msn.net (104.44.19.153)  192.840 ms  193.245 ms  190.665 ms
16 104.44.28.54 (104.44.28.54)  192.241 ms  200.885 ms  190.840 ms
17 be-7-0.ibr02.lon22.ntwk.msn.net (104.44.18.155)  327.304 ms  190.649 ms  289.981 ms
18 be-1-0.ibr02.lon24.ntwk.msn.net (104.44.16.56)  193.865 ms  194.417 ms  193.608 ms
19 104.44.16.3 (104.44.16.3)  199.619 ms  190.622 ms  194.428 ms
20 be-6-0.ibr06.ams06.ntwk.msn.net (104.44.18.191)  193.686 ms  194.348 ms  190.972 ms
21 ae163-0.icr02.ams06.ntwk.msn.net (104.44.21.198)  202.044 ms  191.739 ms  203.431 ms
22 * * *
23 * * *
24 * * *
25 * * *
26 * * *
```

203ms 😦

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Traffic Engineering issue (1) – News websites

www.angop.ao
hosted by MSTelcom (AS17400) via TV Cabo

www.platinaline.com
hosted by Oso Grande IP Services LLC via Tv Cabo

```
traceroute to www.angop.ao (196.29.207.5), 64 hops max, 72 byte packets
 1  192.168.100.1 (192.168.100.1)  10.735 ms  4.293 ms  2.622 ms
 2  cust254-137.127.154.tvcabo.ao (154.127.137.254)  6.314 ms  5.556 ms  7.192 ms
 3  lad-int-cs01.tvcabo.ao (196.202.252.126)  5.091 ms  4.931 ms  4.337 ms
 4  lad-cr1.tvcabo.ao (196.202.252.5)  5.245 ms  4.575 ms  7.380 ms
 5  lad-cr1.tvcabo.ao (196.202.252.1)  6.288 ms  5.386 ms  5.229 ms
 6  196.223.1.11 (196.223.1.11)  6.662 ms  5.287 ms  6.142 ms
 7  196.29.198.17 (196.29.198.17)  10.095 ms  5.863 ms  6.494 ms
 8  41.221.249.2 (41.221.249.2)  7.376 ms  6.523 ms  6.952 ms
 9  41.221.249.181 (41.221.249.181)  7.620 ms  6.458 ms  6.671 ms
10  196.29.207.5 (196.29.207.5)  8.391 ms  14.893 ms  10.155 ms
```

```
traceroute to www.platinaline.com (129.121.9.86), 64 hops max, 72 byte packets
 1  192.168.100.1 (192.168.100.1)  6.804 ms  3.098 ms  2.862 ms
 2  cust254-137.127.154.tvcabo.ao (154.127.137.254)  6.637 ms  6.522 ms  6.283 ms
 3  lad-int-cs01.tvcabo.ao (196.202.252.126)  7.236 ms  4.522 ms  4.379 ms
 4  lad-cr1.tvcabo.ao (196.202.252.5)  5.432 ms  5.102 ms  4.436 ms
 5  lad-cr1.tvcabo.ao (196.202.252.1)  6.669 ms  5.218 ms  6.195 ms
 6  197.149.148.69 (197.149.148.69)  6.623 ms  5.360 ms  5.069 ms
 7  102.130.68.111 (102.130.68.111)  8.443 ms  8.128 ms  8.774 ms
 8  170.238.232.149 (170.238.232.149)  70.868 ms  68.406 ms  68.480 ms
 9  170.238.232.185 (170.238.232.185)  132.719 ms  144.518 ms  134.571 ms
10  hu0-2-0-4.rcr51.bct01.atlas.cogentco.com (38.142.193.25)  131.356 ms  132.739 ms  130.454 ms
11  be3455.ccr22.mia01.atlas.cogentco.com (154.54.85.129)  135.306 ms  132.160 ms  133.139 ms
12  be3570.ccr42.iah01.atlas.cogentco.com (154.54.84.1)  164.557 ms  160.302 ms  160.021 ms
13  be2443.ccr32.dfw01.atlas.cogentco.com (154.54.44.230)  165.974 ms  164.416 ms  164.943 ms
14  be2561.rcr21.b010621-0.dfw01.atlas.cogentco.com (154.54.6.74)  165.766 ms  171.156 ms  165.975 ms
15  38.32.13.210 (38.32.13.210)  167.415 ms  169.571 ms  165.979 ms
16  server.platinaline.com (129.121.9.86)  169.571 ms  164.195 ms  165.232 ms
```

165ms

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Traffic Engineering – How it should be

BNA (National Bank of Angola) trough Tv Cabo
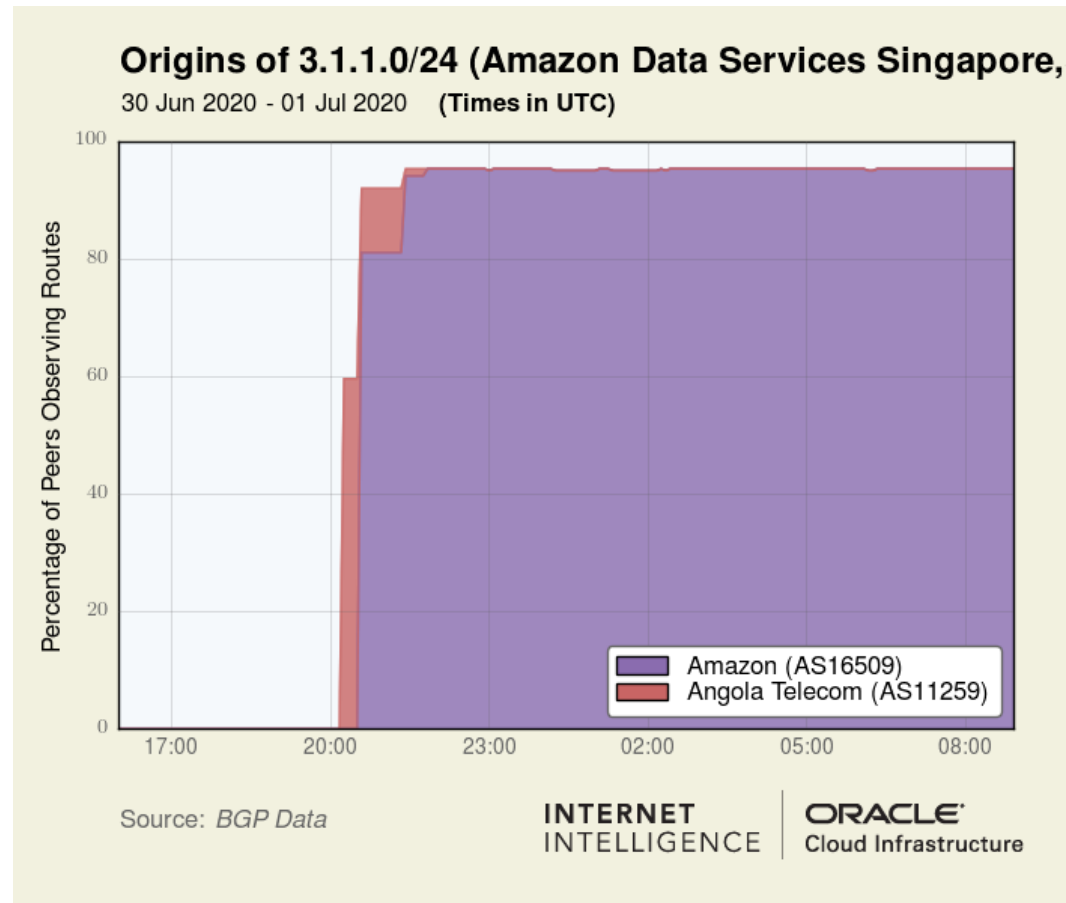
```
jneto@ir1-2 ~ $ traceroute www.bna.ao
traceroute to www.bna.ao (196.43.223.202), 64 hops max, 52 byte packets
 1  192.168.100.1 (192.168.100.1)  4.828 ms  5.264 ms  2.840 ms
 2  cust254-137.127.154.tvcabo.ao (154.127.137.254)  7.290 ms  5.825 ms  5.981 ms
 3  lad-int-cs01.tvcabo.ao (196.202.252.126)  5.496 ms  4.484 ms  4.438 ms
 4  lad-cr1.tvcabo.ao (196.202.252.5)  6.560 ms  5.073 ms  7.518 ms
 5  10.10.10.22 (10.10.10.22)  5.336 ms  4.574 ms  5.063 ms
 6  196.202.252.21 (196.202.252.21)  5.768 ms  4.968 ms  7.125 ms
 7  lad-cr1.tvcabo.ao (196.202.252.1)  6.427 ms  5.919 ms  5.731 ms
 8  197.149.148.69 (197.149.148.69)  6.721 ms  5.544 ms  5.594 ms
 9  197.149.151.234 (197.149.151.234)  6.800 ms  6.074 ms  8.355 ms
10  angonix-ge1.bna.ao (196.11.234.33)  7.043 ms  6.369 ms  6.651 ms
11  196.43.223.4 (196.43.223.4)  7.542 ms  6.518 ms  6.530 ms
12  * * *
```

Caixa Angola trough Tv Cabo

```
traceroute to www.caixaangola.ao (196.43.197.25), 64 hops max, 72 byte packets
 1  192.168.100.1 (192.168.100.1)  11.129 ms  2.468 ms  2.426 ms
 2  cust254-137.127.154.tvcabo.ao (154.127.137.254)  7.465 ms  5.992 ms  6.896 ms
 3  lad-int-cs01.tvcabo.ao (196.202.252.126)  58.248 ms  4.326 ms  4.242 ms
 4  lad-cr1.tvcabo.ao (196.202.252.5)  6.855 ms  5.066 ms  4.325 ms
 5  lad-cr1.tvcabo.ao (196.202.252.1)  15.071 ms  11.237 ms  5.326 ms
 6  196.11.234.13 (196.11.234.13)  7.212 ms  7.496 ms  5.912 ms
 7  customer.ipworld.network (169.239.132.34)  9.875 ms  6.100 ms  6.196 ms
 8  * * *
```

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Why MANRS matters?

Origins of 3.1.1.0/24 (Amazon Data Services Singapore,
30 Jun 2020 - 01 Jul 2020   **(Times in UTC)**

Legend:
- Amazon (AS16509)
- Angola Telecom (AS11259)

Y-axis: Percentage of Peers Observing Routes (0 to 100)
X-axis: 17:00, 20:00, 23:00, 02:00, 05:00, 08:00

Source: *BGP Data*

INTERNET INTELLIGENCE | ORACLE Cloud Infrastructure

CDN(s) in country

Content Delivery Networks physically hosted in Angola

Where are they located?

Content Providers Data Centers – Current and Planned

Amazon Web Service
Facebook
Google
Microsoft

Future Current

TeleGeography
AUTHORITATIVE TELECOM DATA

Carlsbad, CA | Washington, DC | Exeter, UK | Singapore | www.telegeography.com | info@telegeography.com

Source: https://www2.telegeography.com
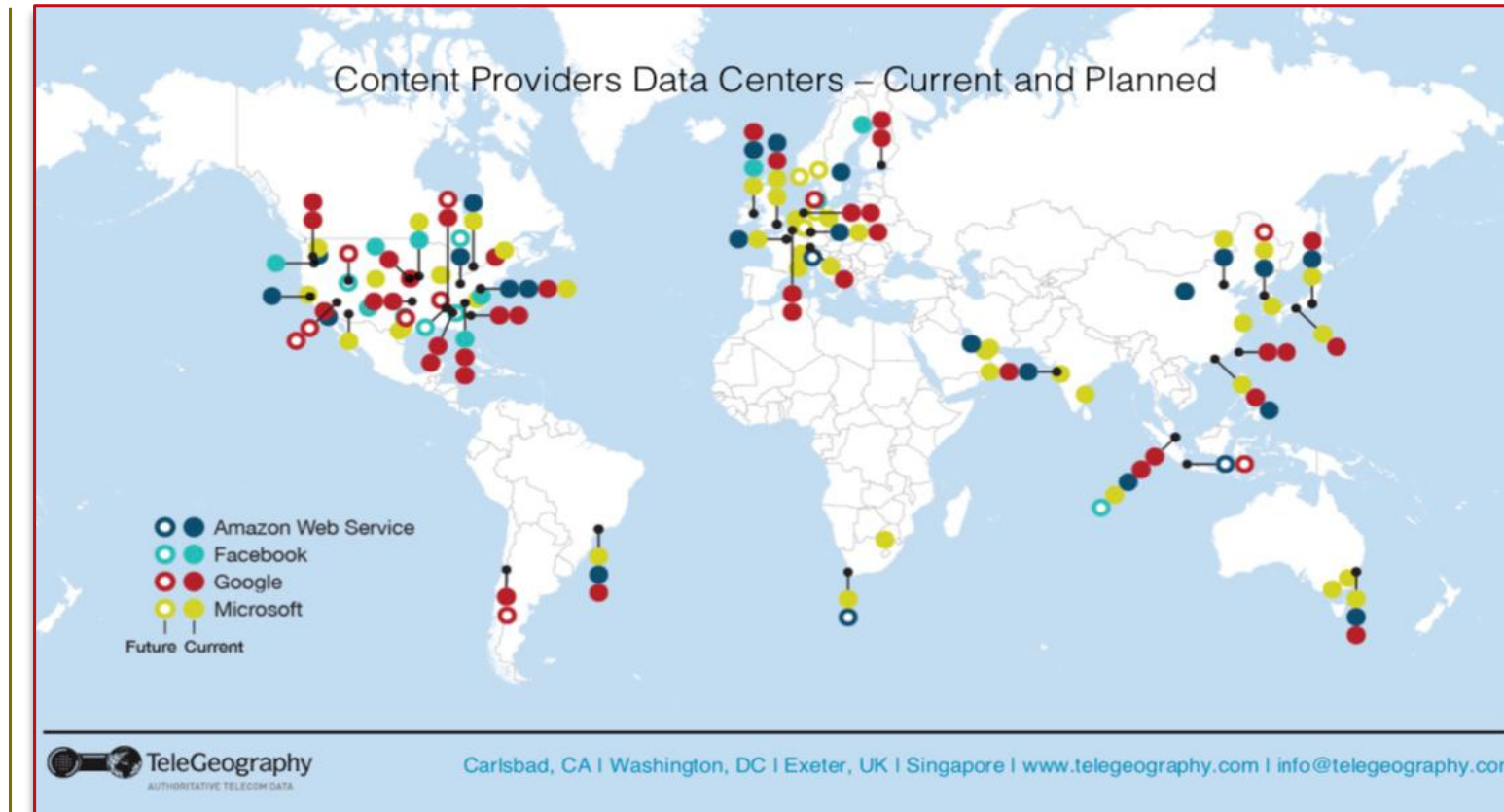
Some important links to visit

- www.pch.net

- www.bgp.he.net

- www.bgpview.io

- www.peeringdb.com

- www2.telegeography.com

- www.datacentermap.com

Mailing lists:

- aonog-members@nogalliance.org

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Thank you! Obrigado!

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