



Angola Interconnection Landscape

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BIG thank you to all our sponsors



Brand Ambassadors e Protocolo



KUBINGA



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AAPSI
Associação Angolana de Provedores de Serviços de Internet



Who's that guy

Personal Information



Expertise

- Masters in Internet Business
- Bachelor Degree at Saxion Applied Science - Netherlands



Experience

- **Angonix** - 3 years
- **Angola Cables** - 7 years
- **DE-CIX International** - Present



Volunteering

- **AAPSI** Consulting Board
- Program Committee Global Peering Forum **(GPF) 2019**
- Program Committee **(AFPIF) 2020 - 2022**
- Board Member **APF/AONOG** (Angolan Peering Forum / Angolan Network Operators Group)

Agenda

- APF / AONOG
- Angola general information
- National subsea systems
- The current Interconnection Ecosystem
- Angolan IP-Addressing Evolution
- Challenges & how to tackle it
- The role of APF & AONOG
- Q&A

Who are we?

The logo for APF & AONOG, featuring the text 'APF & AONOG' in yellow and white on a red and black background.

Angolan Peering Forum & Angolan Network Operators are a group of skilled individuals who are willing to contribute for a better national internet environment

- Why are 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

National subsea systems – designed capacity

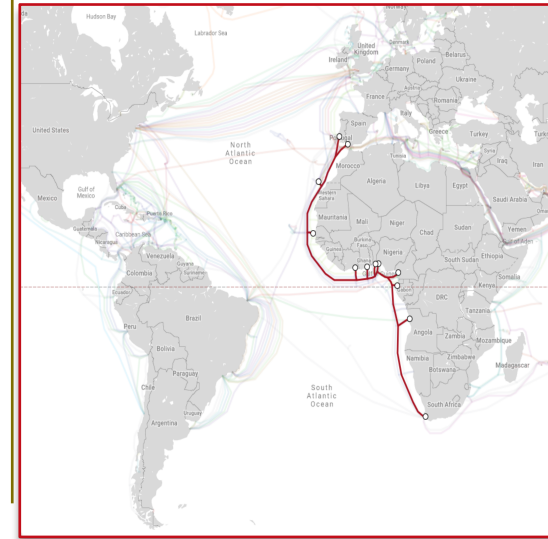
SAT-3/WASC
40Gbit/s
Launched: Apr/2002



SACS
40Tbps
Launched: Sep/2018



WACS
14Tbps
Launched: May/2012



Source: <https://www.submarinecablemap.com>

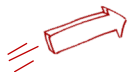
Have we seen any impact after the activation of WACS & SACS?



Price /Mbit went dramatically down



Keeping local traffic – local



Faster Internet access with low latency & better quality



Six years ago, within weeks of Cloudflare launching, we passed a major milestone: serving [one billion web requests](#) across our network every month. Since then, our traffic has grown 10,000x, and we now see over a billion web requests every month just from the country of Angola — located on the western coast of southern Africa and three times the geographic size of California. This led us on a journey to deploy our newest data center in **Luanda**, the capital city, shaving 150ms in latency off every request.



Random opinion



Random opinion

1. End-users experience?
2. What about the other provinces?

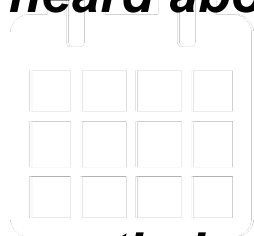


What's the status quo on the current interconnection ecosystem

Status on the current interconnection ecosystem?

How many of us

... **heard about** peering.db?



...datacenters site?

...MANRS?

... **run their own LG?**

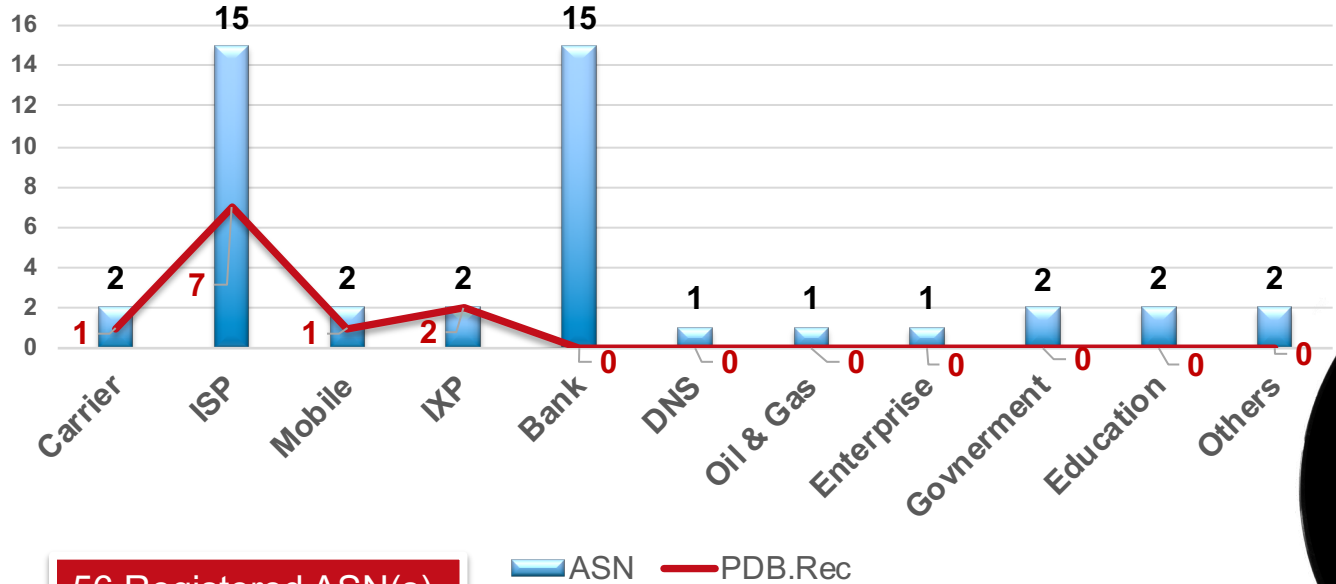
... **maintain an Afrinic database?**

... **intend to implement RPKI?**

... **intend to implement IPv6?**



ASN's vs. Peering.db records



56 Registered ASN(s)
11 with Peering.db records



ASN's vs. Top4 on African continent

Correlação população vs número de ASN(s):

Country	Population	ASN's
Africa do Sul	56.720.000	567
Costa do Marfim	24.290.000	271
Nigéria	190.000.000	210
Angola	29.000.000	56

Nota: Os dados sobre a população são números não absolutos e os mais recentes. Data do apanhado populacional até 2017.



How many Internet Exchange Providers?



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



Source: www.pch.net / www.angonix.net / www.angola-ixp.ao

How many “Registered” Datacenters?



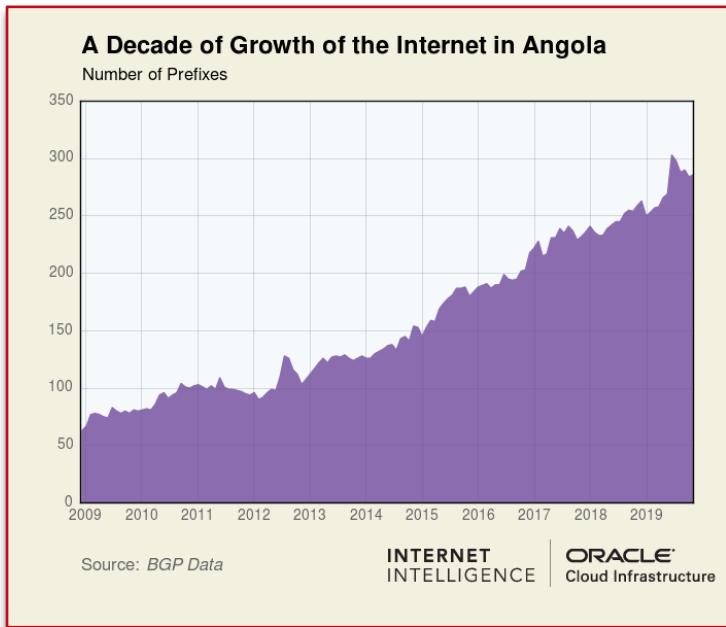
Source: www.datacentermap.com

- I. Multipla
- II. ITA Luanda
- III. Angonap (Angola Cables)

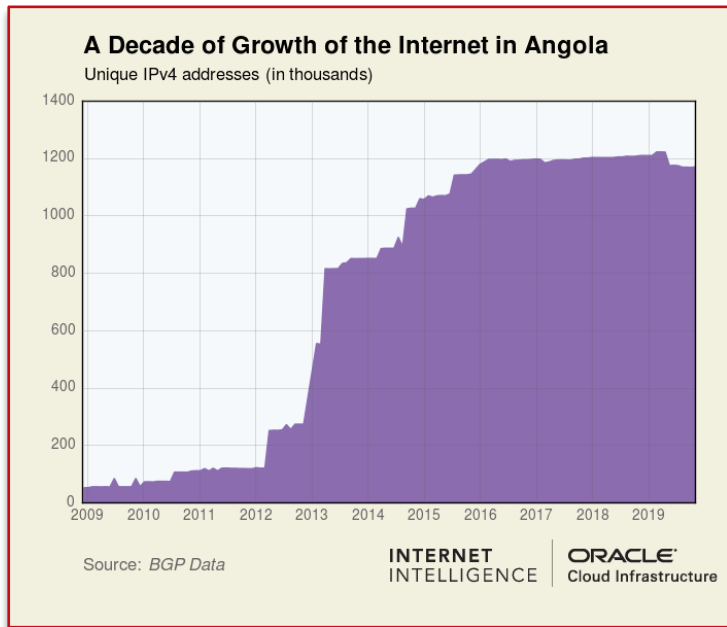


Looking back at a decade of growth of the Internet in Angola

Number of Prefixes

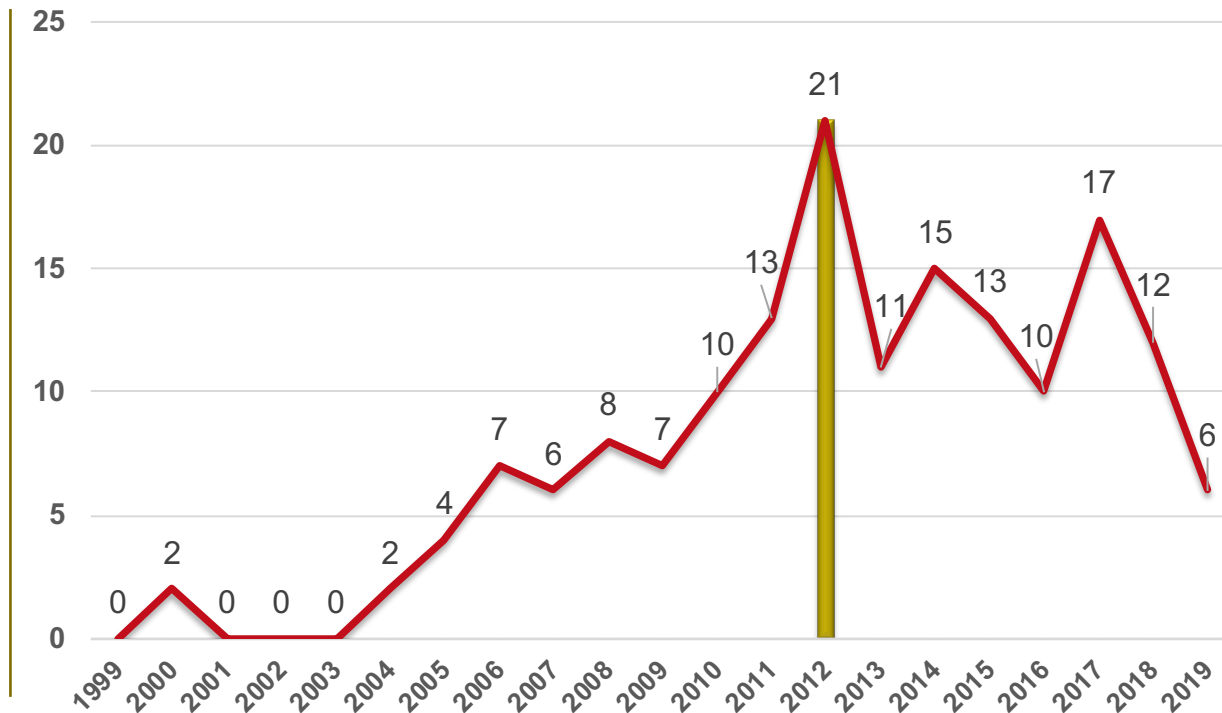


Unique IPv4 addresses (in 1.000)



Source: DYN / Oracle

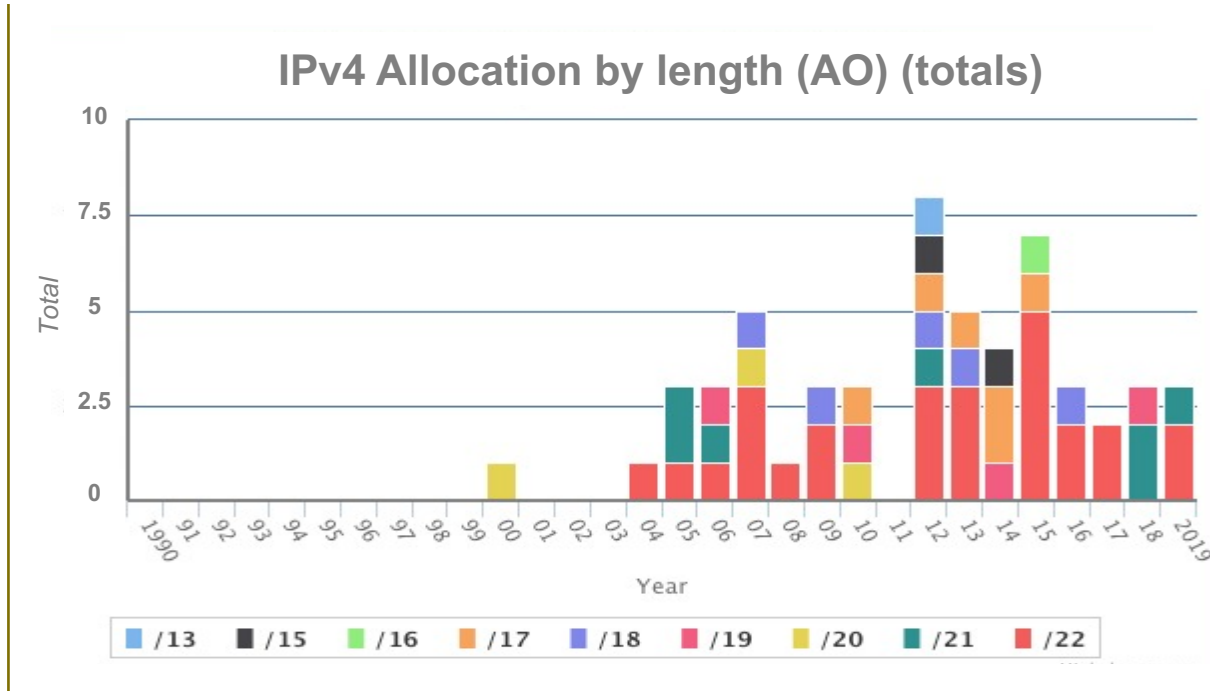
Evolution of Angolan IP-addressing



Source: <http://ftp.afrinic.net/stats/afrinic/>



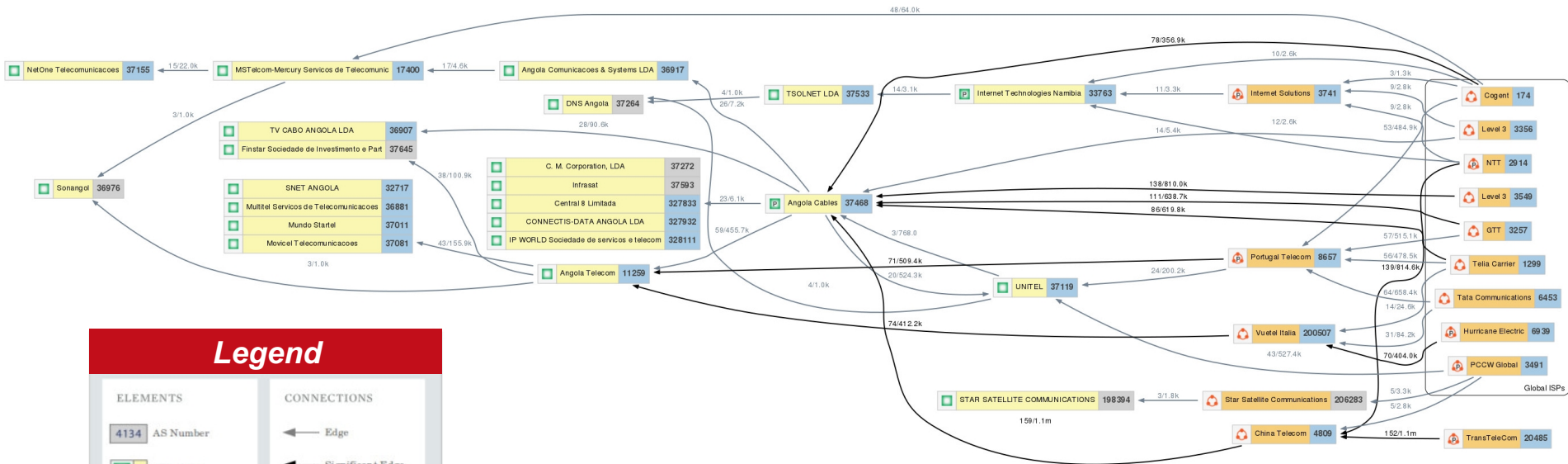
Evolution of Angolan IP-addressing



Source: www.afrinic.net



Overview of Angolan IP network topology

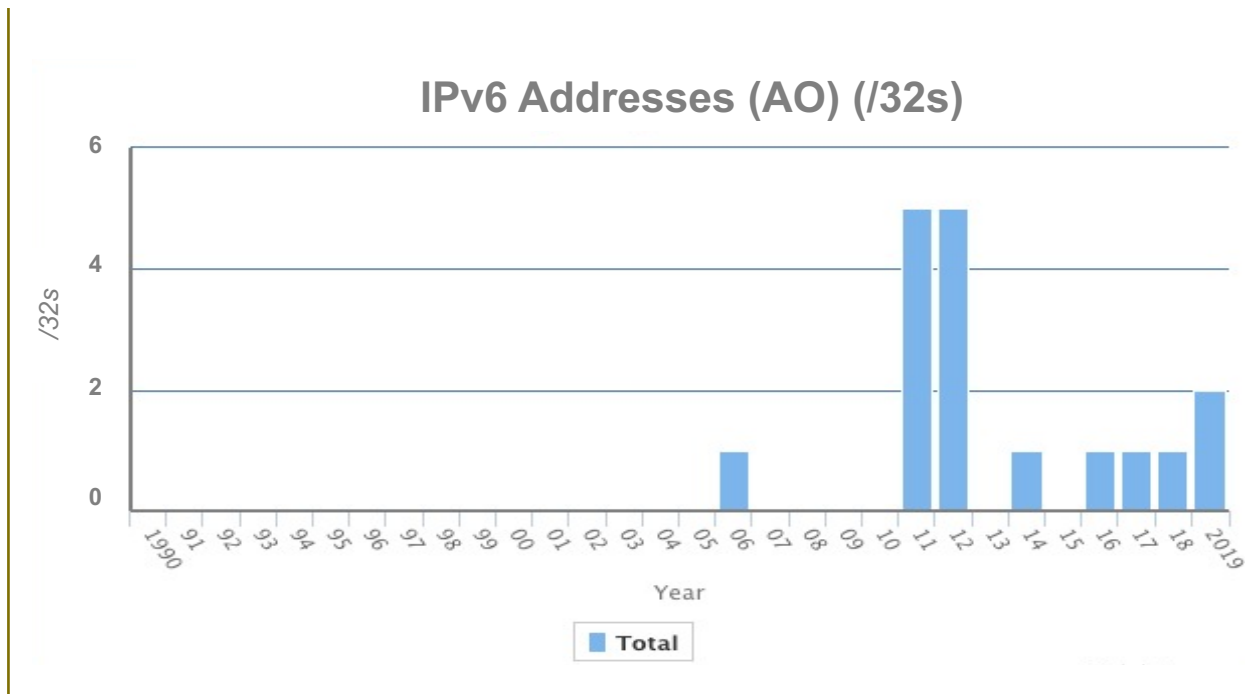


Source: DYN / Oracle



Challenges & how to tackle them

IPv6 Addresses Allocation (AO)

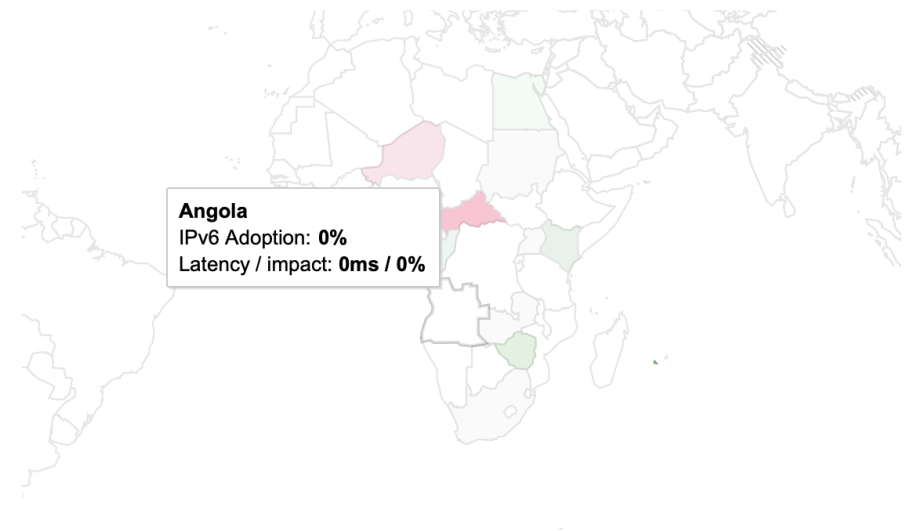


Source: www.afrinic.net

IPv6 Usage (AO)

ASN	AS Name	IPv6 Capable	IPv6 Preferred	Samples
AS36907	TVCaboAngola	0.00%	0.00%	628
AS37119	unitel-AS	0.00%	0.00%	605
AS37645	ZAP-Angola	0.00%	0.00%	403
AS37081	movicel-as	0.00%	0.00%	143
AS11259	ANGOLATELECOM	0.00%	0.00%	52
AS37155	NETONE	0.00%	0.00%	19
AS17400	MSTELCOM	0.00%	0.00%	14
AS33763	Paratus-Telecom	0.00%	0.00%	13
AS37366	BNA	0.00%	0.00%	4
AS36917	ACS	0.00%	0.00%	3
AS36881	MULTITEL	0.00%	0.00%	2
AS37593	Infrasat	0.00%	0.00%	1
AS327932	CONNECTIS-DATA-ANGOLA	0.00%	0.00%	1
AS37468	ANGOLA-CABLES	0.00%	0.00%	1
AS17400	MSTELCOM	0	0	14
AS33763	Paratus-Telecom	0	0	13
AS36881	MULTITEL	0	0	2
AS36917	ACS	0	0	3
AS37155	NETONE	0	0	19
AS37366	BNA	0	0	4
AS37468	ANGOLA-CABLES	0	0	1
AS37593	Infrasat	0	0	1
AS327932	CONNECTIS-DATA-ANGOLA	0	0	1

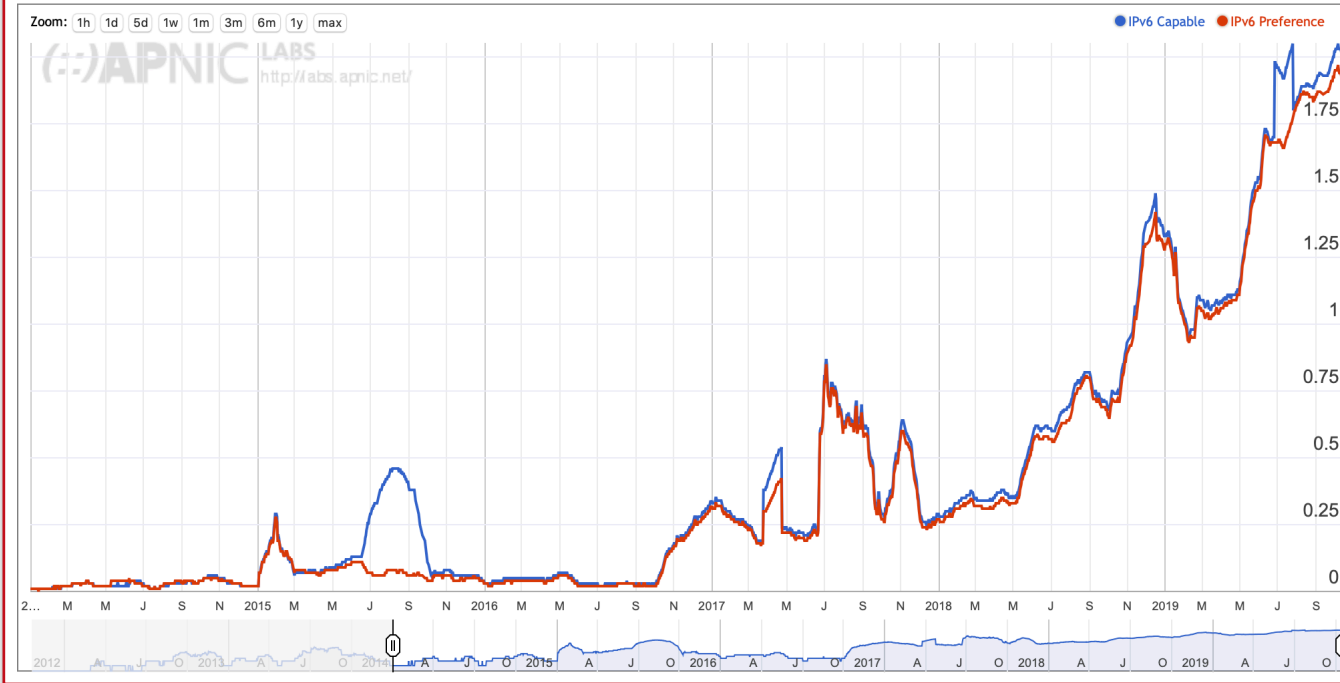
Adoção do IPv6 por país



Source: : www.google.com/intl/pt-BR/ipv6/statistics.html#tab=per-country-ipv6-adoption

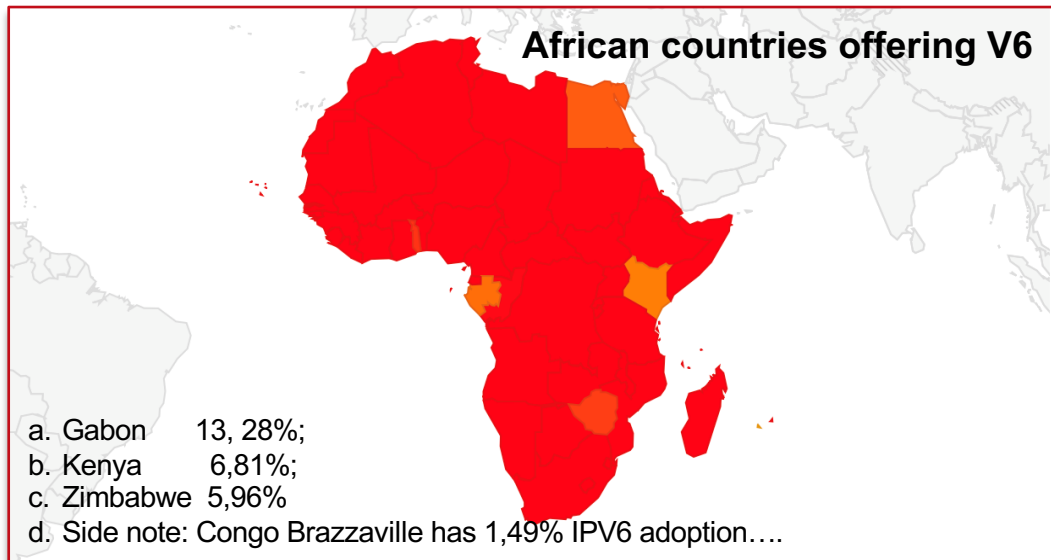
IPv6 for when?

Use of IPv6 for Africa (XB)



It's not a trend.
It's happening right now!

IPv6 for when?



Source: <https://www.google.com/intl/pt-BR/ipv6/statistics.html#tab=per-country-ipv6-adoption>

GVA Main Driver in Gabon: 99.9% of our v6 traffic comes from B2C

ASN	AS Name	IPv6 Capable	IPv6 Preferred	Samples
AS16058	Gabon-Telecom	0.01%	0.00%	43,143
AS37616	Airtel	0.03%	0.03%	13,415
AS36924	GVA-Canalbox	90.93%	90.03%	9,482

Traffic Engineering issue

tracert www.giulianaflores.com.br (Content hosted by AZION CDN)

Rastreado a rota para 271193b.h2.azioncdn.net [169.239.132.198]

com no máximo 30 saltos:

```
1  3 ms  4 ms  4 ms 172.20.10.1
2 2784 ms 59 ms 35 ms 10.16.41.129
3  *    688 ms 34 ms 10.16.41.138
4  *    529 ms 34 ms ipf-41-210-243-218.movinel3g.co.ao [41.210.243.218]
5  30 ms 28 ms 30 ms ipf-41-210-241-46.movinel3g.co.ao [41.210.241.46]
6  27 ms 29 ms 26 ms ipf-41-210-241-49.movinel3g.co.ao [41.210.241.49]
7  70 ms 36 ms 32 ms ipf-41-210-240-105.movinel3g.co.ao [41.210.240.105]
8  73 ms 32 ms 40 ms 197.216.102.13
9  *    3435 ms 47 ms 41.74.240.121
10 *    804 ms 46 ms 192.168.162.17
11 *    756 ms 167 ms 197.149.151.45
12 *    2860 ms 404 ms pe1-nc012.ang.sgn.as37468.angolacables.ao [185.148.112.13]
13 *    3748 ms 459 ms pe1-nc013.ang.lua.as37468.angolacables.ao [197.149.149.145]
14 369 ms 611 ms 304 ms pe1-ne011.ang.lua.as37468.angolacables.ao [197.149.151.3]
15 524 ms 608 ms 307 ms 197.149.148.29
16 3373 ms 606 ms 305 ms azion.ipworld.network [169.239.132.198]
```

 **Movitel Network (AS37081)**

 **Angola Telecom Network (AS11259) – Missing rDNS**

 **Angola Cables Network (AS37468)**

 **IPWorld Networks (AS328111)**
>>> ~300ms travels the world..

Traffic Engineering issue (1)

Unitel

```
Last login: Sun Jul 9 11:22:25 on ttys002
Darwins-MacBook-Pro-2:~ DarwinCosta$ traceroute www.angola2learn.co.ao
traceroute to www.angola2learn.co.ao (104.255.216.35), 64 hops max, 52 byte packets
 1 172.20.10.1 (172.20.10.1) 6.265 ms 2.663 ms 2.914 ms
 2 * * *
 3 10.172.5.195 (10.172.5.195) 57.131 ms 37.773 ms 41.420 ms
 4 41.78.17.17 (41.78.17.17) 42.421 ms 25.497 ms 25.627 ms
 5 unitel.pos0-1-1.cr01.ldn05.pccwbtn.net (63.218.239.6) 27.862 ms
   unitel.pos0-1-0.cr01.ldn05.pccwbtn.net (63.218.239.10) 27.672 ms
   unitel.pos0-1-1.cr01.ldn05.pccwbtn.net (63.218.239.6) 25.204 ms
 6 pos0-1-0.cr01.ldn05.pccwbtn.net (63.218.239.9) 166.809 ms 170.112 ms 155.650 ms
 7 tenge0-0-0-23.br02.frf06.pccwbtn.net (63.218.232.61) 170.664 ms 172.400 ms 301.865 m
 8 63-218-233-6.static.pccwglobal.net (63.218.233.6) 226.977 ms 296.600 ms 181.298 ms
 9 mskn08.transtelecom.net (217.150.59.250) 324.412 ms 345.713 ms 296.066 ms
10 chinatelecom-gw.transtelecom.net (217.150.59.249) 207.727 ms 300.911 ms 297.825 ms
11 * * *
12 * * *
13 * * *
14 5.10.136.58 (5.10.136.58) 263.959 ms 228.648 ms 243.169 ms
15 104.255.216.6 (104.255.216.6) 267.691 ms 439.064 ms 319.149 ms
16 104.255.216.35 (104.255.216.35) 230.439 ms 245.366 ms 232.684 ms
Darwins-MacBook-Pro-2:~ DarwinCosta$
```

Movicel

```
Last login: Mon Jul 10 07:55:52 on ttys002
Darwins-MacBook-Pro-2:~ DarwinCosta$ traceroute www.angola2learn.co.ao
traceroute to www.angola2learn.co.ao (104.255.216.35), 64 hops max, 52 byte pack
ets
 1 172.20.10.1 (172.20.10.1) 8.760 ms 1.914 ms 2.857 ms
 2 10.16.96.25 (10.16.96.25) 161.150 ms 143.793 ms 64.826 ms
 3 10.16.96.34 (10.16.96.34) 41.670 ms 81.085 ms
   10.16.96.26 (10.16.96.26) 146.414 ms
 4 10.16.0.161 (10.16.0.161) 93.314 ms
   10.16.0.165 (10.16.0.165) 65.554 ms
   10.16.0.161 (10.16.0.161) 39.555 ms
 5 ipf-41-210-243-218.movinet3g.co.ao (41.210.243.218) 35.023 ms 42.024 ms 4
4.046 ms
 6 ipf-41-210-240-66.movinet3g.co.ao (41.210.240.66) 43.668 ms 39.896 ms 41.
292 ms
 7 ipf-41-210-240-181.movinet3g.co.ao (41.210.240.181) 39.214 ms 79.428 ms 4
3.292 ms
 8 ipf-41-210-240-151.movinet3g.co.ao (41.210.240.151) 36.348 ms 34.987 ms 3
8.720 ms
 9 angonix.nucomtech.com (196.11.234.5) 61.207 ms 31.372 ms 33.437 ms
10 104.255.216.6 (104.255.216.6) 36.403 ms 38.742 ms 41.423 ms
11 104.255.216.35 (104.255.216.35) 33.118 ms 32.262 ms 41.294 ms
Darwins-MacBook-Pro-2:~ DarwinCosta$
```

Traffic Engineering issue (2)

ITA

traceroute to 1.1.1.1 (1.1.1.1), 30 hops max, 60 byte packets

1 ge0-2-14.cr1.lda9.ao.afrisp.net (196.216.59.9) 0.162 ms 0.156 ms 0.150 ms

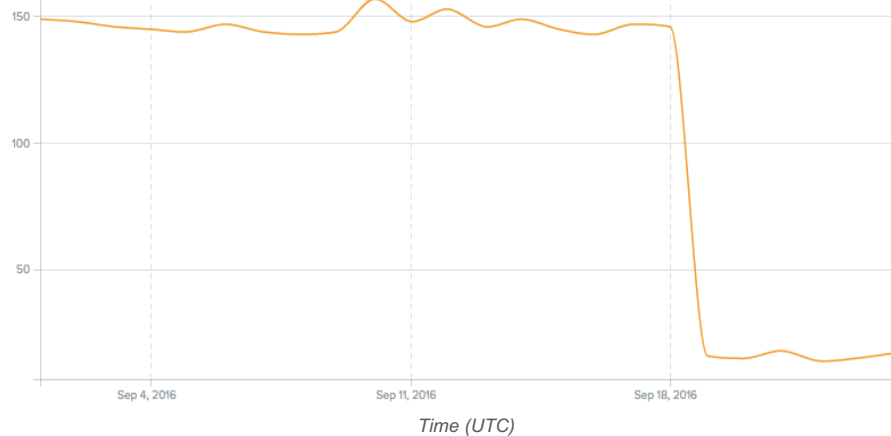
2 tenge0-3-0.cr1.lda41.ao.afrisp.net (197.234.113.133) 0.926 ms 1.006 ms 1.103 ms

3 tenge0-3-0.cr1.lda41.ao.afrisp.net (197.234.113.133) 0.400 ms 0.415 ms 0.416 ms

4 one.one.one.one (1.1.1.1) 62.782 ms 62.815 ms 63.588 ms

After implementation < de 5ms

50th percentile (ms)



Existing Looking Glasses

- What is a Looking Glass?
- Which Companies have one locally?
- Can the end-user benefit from a public Looking Glass?



AS37468 Looking Glass

Type of Query	Additional parameters	Node
<input checked="" type="radio"/> bgp <input type="radio"/> ping <input type="radio"/> trace	<input type="text"/>	AO-Luanda
<input type="text" value="IPv4"/>		
<input type="button" value="Submit"/> <input type="button" value="Reset"/>		

Angonix - BIRD Looking Glass

bgp summary | prefix info | neighbor info

Route Server

rs1.angonix.net (IPv4)

```
> sh ip bgp summary
RS-Client peers: 17
```

Neighbor	AS	Date	Time	Status	PrfxRcvd (Best)/ErrCode
-	42	2019-05-09	08:44:14	up	40(40)
-	37645	2019-04-26	22:19:09	up	13(0)
-	49544	2019-02-11	11:08:58	up	1(1)
-	327691	2019-04-18	10:37:46	up	1(1)
-	327833	2019-06-01	08:23:55	down	Connect: Connection timed out
-	327932	2018-11-21	17:36:16	up	3(3)
-	328111	2019-04-01	17:01:56	up	6(6)
-	328154	2019-05-24	23:19:11	up	5(5)
-	28329	2019-05-28	20:43:40	up	1(1)
-	3856	2019-05-09	09:00:48	up	1(1)
-	25818	2019-02-12	11:40:43	up	9(9)
-	26415	2019-05-23	18:55:52	up	2(2)
-	36907	2018-10-02	17:35:28	up	79(78)
-	37119	2018-12-06	00:58:51	up	38(37)
-	37468	2019-04-26	12:49:06	up	2443(2377)
-	37603	2019-05-14	15:46:14	up	1(1)
-	37645	2018-11-07	01:02:54	up	13(13)

Total number of neighbors: 17

Source: <http://lg.angonix.net> / <https://lg.angolacables.co.ao>

Alice Looking Glass – DE-CIX



DE CIX

Go to: [Established](#) [Down](#)

BGP SESSIONS ESTABLISHED

Neighbor	ASN	State	Last State Change	Description	Received	Accepted	Filtered	Exported
206.82.104.197	37468	up	2 days	Angola Cables	3520	2580	940	108717

Content Delivery Networks physically hosted in Angola



facebook®

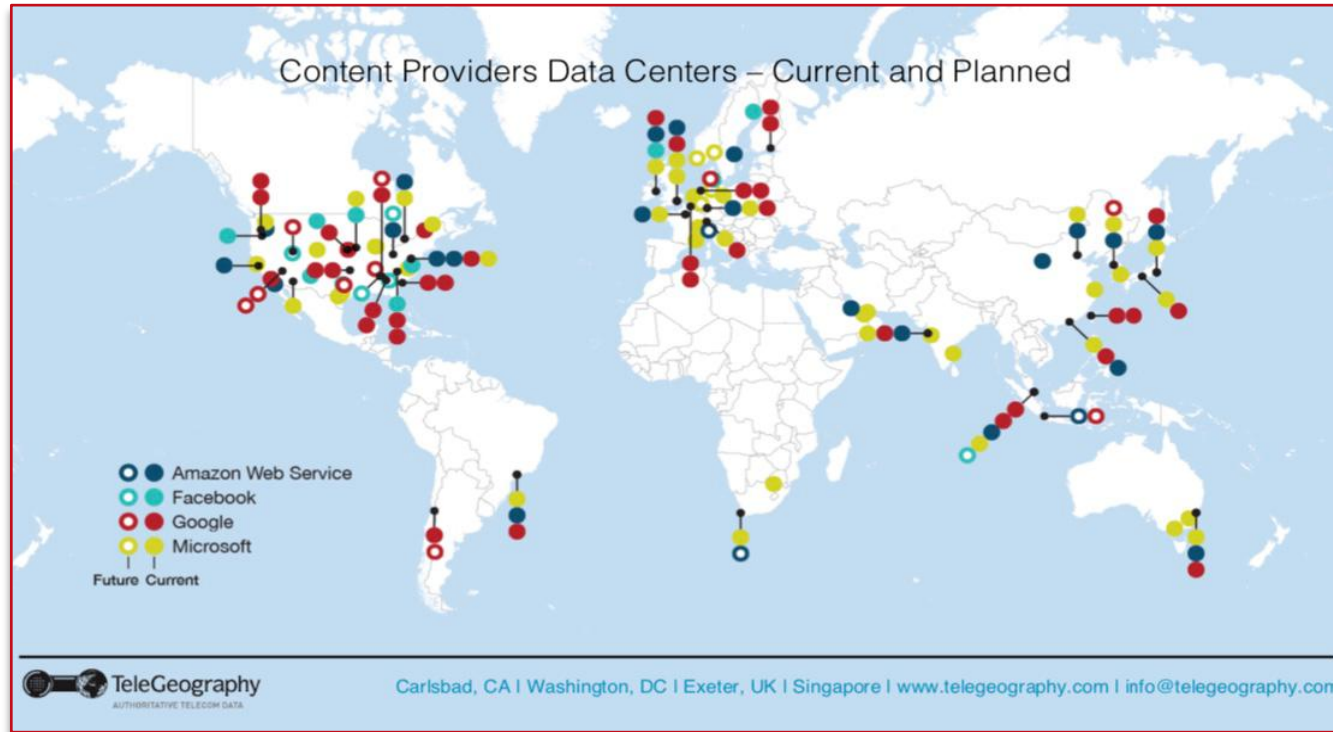


Google

AZION

NETFLIX

Where are they located?



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

Next for APF / AONOG

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

New Logo



Q&A





ANGOLAN PEERING FORUM

Thank you! Obrigado!

darwin.costa@de-cix.net