

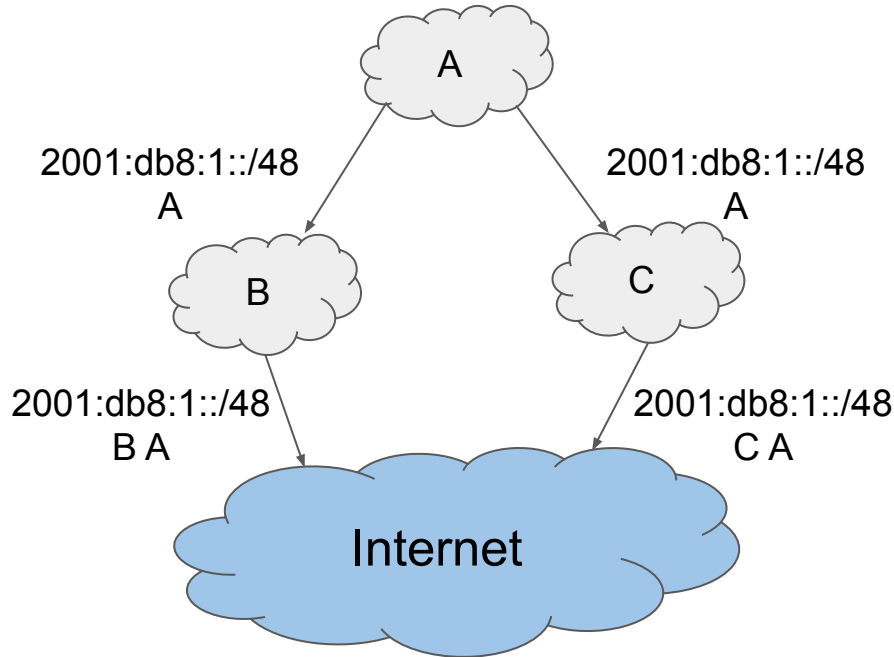
LIVE INTRAREDE 2025 — 5 ANOS

Ferramentas essenciais para *troubleshooting* de roteamento

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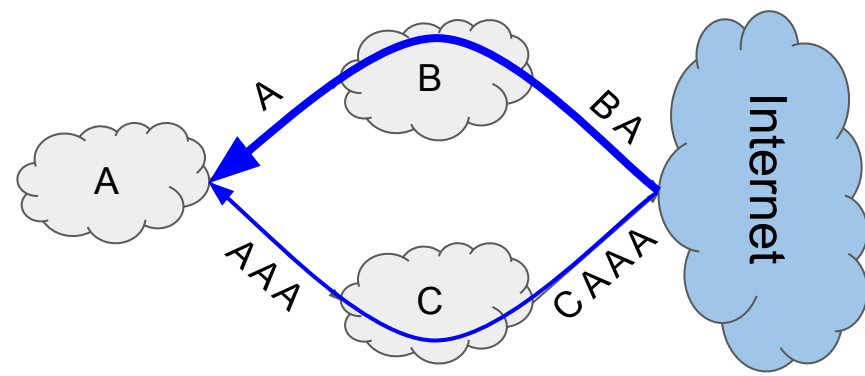
Protocolo BGP é a “cola” que une a Internet e que os ASes usam para trocar informações de alcance

Critérios para escolha da melhor rota

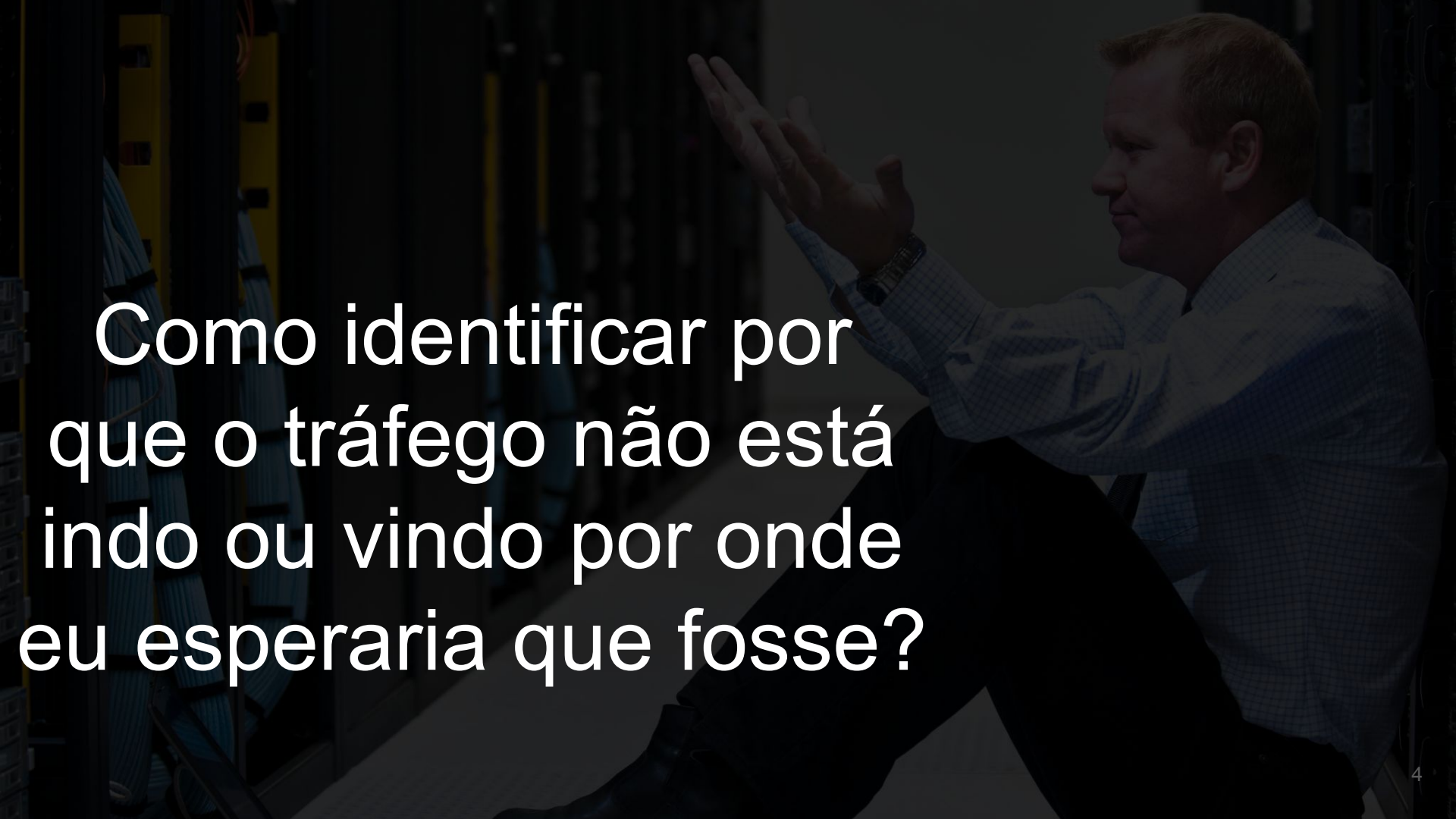


0. Prefixo mais específico (LPM protocolo IP)
1. Preferência local
2. Menor caminho
3. Menor tipo de origem (IGP < EGP < incompleto)
4. Menor MED
5. eBGP sobre iBGP
6. Menor IGP para o próximo hop BGP
7. Rota mais antiga
8. Menor ID do roteador BGP
9. Menor endereço do vizinho

ASes constantemente realizam engenharia de tráfego através da manipulação dos seus anúncios para reduzir custos, eliminar congestionamentos ou melhorar desempenho da troca de tráfego



- ASes **decidem** por qual rota enviar o tráfego
- Buscam **influenciar** por onde receber o tráfego
- ASes **decidem** quando propagam a rota ou não



Como identificar por
que o tráfego não está
indo ou vindo por onde
eu esperaria que fosse?

Duas perspectivas para *troubleshooting*

Plano de controle (BGP)



Plano de dados (IP)



Duas perspectivas para *troubleshooting*

Plano de controle (BGP)



HURRICANE ELECTRIC
INTERNET SERVICES



RIPE
RIS



Plano de dados (IP)

ISP.Tools



HURRICANE ELECTRIC
INTERNET SERVICES



RIPE
Atlas

Looking glasses são um **espelho**, isto é, mostram as rotas que estão sendo recebidas por um roteador

IX.br
Looking Glass

ROUTE SERVERS

IX.br São Paulo/SP

rs2.saopaulo.sp.ix.br (IPv4)
multibird 2.14

rs2.saopaulo.sp.ix.br (IPv6)
multibird 2.14

IX.br
Looking Glass

SEARCH ON ALL ROUTE SERVERS

DID YOU KNOW?

You can search for

- Prefixes
- Peers by entering their name
- ASNs by prefixing them with 'AS'
- Communities by prefixing them with '#'

Just start typing!

IX.br São Paulo/SP	IX.br Campina Grande/PB	IX.br João Pessoa/PB	IX.br Recife/PE
IX.br Rio de Janeiro/RJ	IX.br Campinas/SP	IX.br Lajeado/RS	IX.br Rio Branco/AC
IX.br Fortaleza/CE	IX.br Campo Grande/MS	IX.br Londrina/PR	IX.br Salvador/BA
IX.br Aracaju/SE	IX.br Caxias do Sul/RS	IX.br Maceió/AL	IX.br Santa Maria/RS
IX.br Belém/PA	IX.br Cuiabá/MT	IX.br Manaus/AM	IX.br São José do Rio Preto/SP
IX.br Belo Horizonte/MG	IX.br Curitiba/PR	IX.br Maringá/PR	IX.br São Luís/MA
IX.br Boa Vista/RR	IX.br Feira de Santana/BA	IX.br Natal/RN	IX.br Teresina/PI
IX.br Brasília/DF	IX.br Florianópolis/SC	IX.br Palmas/TO	IX.br Vitória/ES
IX.br Caruaru/PE	IX.br Foz do Iguaçu/PR	IX.br Porto Alegre/RS	
IX.br Cascavel/PR	IX.br Goiânia/GO	IX.br Porto Velho/RO	

rs2.saopaulo.sp.ix.br (IPv4)
multibird 2.14

rs2.saopaulo.sp.ix.br (IPv6)
multibird 2.14

<https://lg.ix.br>

Looking glasses são um **espelho**, isto é, mostram as rotas que estão sendo recebidas por um roteador

rs2.saopaulo.sp.ix.br (IPv6)

Filter by Neighbor, ASN or Description

BGP SESSIONS ESTABLISHED

Neighbor	ASN	State	Uptime	Description
2001:12f8::210:69	999	up	2 months	CO
2001:12f8::189	1251	up	4 days	Fa
2001:12f8::4	1916	up	10 days	RT
2001:12f8::221:17	1916	up	2 months	RT
2001:12f8::221:65	2635	up	19 days	W
2001:12f8::15	2688	up	3 months	AT
2001:12f8::223:131	2906	up	19 days	N
2001:12f8::220:83	2906	up	2 months	N
2001:12f8::217:185	2906	up	3 months	N
2001:12f8::223:20	2906	up	2 months	N
2001:12f8::222:23	3300	up	11 days	BT GILB
2001:12f8::213:143	3303	up	2 days	Swisscom

rs2.saopaulo.sp.ix.br (IPv6) » RNP

2001:12f8::4 2001:12f8::221:17

Filter by Network

Go to: Accepted

ROUTES ACCEPTED

Showing all of 123 routes

	Network	Next Hop	AS Path
📍	2001:12d0::/32	2001:12f8::4 fe80::7a50:7c0b:c739:75c8	1916 28571
📍	2001:12d8::/32	2001:12f8::4 fe80::7a50:7c0b:c739:75c8	1916 1251
📍★	2001:12f0:200::/42	2001:12f8::4 fe80::7a50:7c0b:c739:75c8	1916
📍	2001:12f0:33f::/48	2001:12f8::4 fe80::7a50:7c0b:c739:75c8	1916
📍★	2001:12f0:400::/42	2001:12f8::4 fe80::7a50:7c0b:c739:75c8	1916
📍★	2001:12f0:500::/42	2001:12f8::4 fe80::7a50:7c0b:c739:75c8	1916

Looking glasses são um **espelho**, isto é, mostram as rotas que estão sendo recebidas por um roteador

ROUTES FILTERED

	Network	Next Hop	AS Path
● ★ ●	2801:12a::/48 Invalid on RPKI	2001:12f8::222:70 fe80::564b:8c06:a488:32b8	52320 19429
● ★	2801:16:3800::/48 Bogon ASN	2001:12f8::222:70 fe80::564b:8c06:a488:32b8	52320 262186 64512
● ★ ●	2801:16a:8::/45 Invalid on RPKI	2001:12f8::222:70 fe80::564b:8c06:a488:32b8	52320 19429 269937
● ★ ●	2801:16a::/45 Invalid on RPKI	2001:12f8::222:70 fe80::564b:8c06:a488:32b8	52320 19429 269937
● ★ ●	2803:1a00:150f::/48 Bogon ASN Invalid on RPKI	2001:12f8::222:70 fe80::564b:8c06:a488:32b8	52320 262186 262186 64512
● ★ ●	2803:1a00:151c::/48 Bogon ASN Invalid on RPKI	2001:12f8::222:70 fe80::564b:8c06:a488:32b8	52320 262186 262186 64512

API disponível para automações

https://lg.ix.br/api/v1/routeservers/SP-rs2-v6/neighbors/AS1916_2001_12f8_4/routes/received

https://lg.ix.br/api/v1/routeservers/SP-rs2-v6/neighbors/AS1916_2001_12f8_4/routes/filtered

<https://lg.ix.br/api/v1/lookup/prefix?q=2001:12d0::/32>

Looking glasses são um **espelho**, isto é, mostram as rotas que estão sendo recebidas por um roteador

**HURRICANE ELECTRIC**
INTERNET SERVICES

Quick Links
BGP Toolkit Home
BGP Prefix Report
BGP Peer Report
Super Traceroute
Super Looking Glass
Exchange Report
Bogon Routes
World Report
Multi Origin Routes
DNS Report
Top Host Report
Internet Statistics
Looking Glass
Network Tools App
Free IPv6 Tunnel
IPv6 Certification
IPv6 Progress
Going Native
Contribute Data
Credits
Contact Us

Super Looking Glass **Terminal**

Perform Query! **Exact Match** **+ Shorter** **+ Longer** **+ Brief** **+ Text** **+ Exclude** **All ASNs** **Select a neighbor to query directly**
Type a Prefix
Perform Query! **Exact Match** **+ Shorter** **+ Longer** **+ Brief** **+ Text** **+ Exclude** **All ASNs** **Select a neighbor to query directly**
All ASNs **Select a neighbor to query directly**
3,692 neighbors, representing 1,180 unique ASNs, 73
Near Realtime BGP data may be delayed

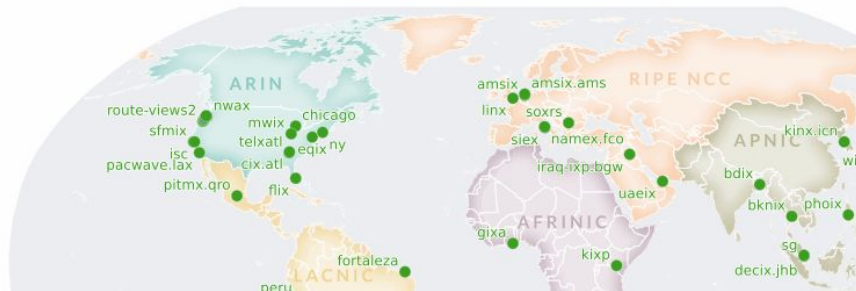
Super Looking Glass **Terminal**

Perform Query! **Exact Match** **+ Shorter** **+ Longer** **+ Brief** **+ Text** **+ Exclude** **All ASNs** **Select a neighbor to query directly**
783 Paths observed

Neighbor	2001:12f8::253 (AS26162) Learned from: route-views2.saopaulo
Nexthop	2001:12f8::220:3
Prefix	2001:12d0::/32
AS Path	28571
Origin	IGP
RPKI validation	UNKNOWN No VRP Covers the Route Prefix
MED	20
Communities	26162:28571 26162:64661 26162:64671 26162:64685 26162:64686
Large Communities	26162:0:28571 26162:0:65011 26162:100:1 26162:200:1
Last Updated	07/06/2025, 09:04:25 (0w03d02h)

<https://bgp.he.net/super-lg>

Coletores de rota oferecem uma **visão histórica** dos dados para entender mudanças de comportamento



Index of /route-views2.saopaulo/bgpdata

<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
Parent Directory	-	-	-
2018.04/	2018-04-20 20:48	-	-
2018.05/	2018-05-24 15:53	-	-
2018.06/	2018-06-14 20:56	-	-

Index of /route-views2.saopaulo/bgpdata/2025.06/RIBS

<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
Parent Directory	-	-	-
rib.20250601.0000.bz2	2025-06-01 00:00	63M	
rib.20250601.0200.bz2	2025-06-01 02:00	65M	
rib.20250601.0400.bz2	2025-06-01 04:00	65M	
rib.20250601.0600.bz2	2025-06-01 06:00	65M	
rib.20250601.0800.bz2	2025-06-01 08:00	65M	
rib.20250601.1000.bz2	2025-06-01 10:00	65M	



BGPScanner pode ser usado como parser
<https://gitlab.com/lsolario/bgpscanner>

E também podem ser aliados para *troubleshooting*

ROUTE
VIEW
6447

Looking Glass

ROUTE
VIEW
6447

Looking Glass

Type of Query : BGP
Address family : IPv6
Router : route-views.fortaleza
Query parameters: summary
Timestamp : 2025-06-10T19:08:38Z
Command : show bgp ipv6 unicast summary

TYPE OF QUERY

ADDITIONAL PARAMETERS

NODE

☐ bgp
☒ bgp regexp
☐ rpki prefix
☐ rpki ASN

route-views.fortaleza

IPv6

route-views.fortaleza.routeviews.org> show bgp ipv6
BGP router identifier 45.68.72.184, local AS number 6447
BGP table version 401790250
RIB entries 516467, using 63 MiB of memory
Peers 23, using 546 KiB of memory

Neighbor	V	AS	MsgRcvd	MsgSent	Up/Down	State	Prefixes	Local	Origin	Age	Next Hop	Metric	LocPrf	Weight	Path
2001:12f8:0:9::39	4	263945	6674916	23	0:0:0	Established	0	0	0	0	2001:12f8:0:9::2	2	0	0	1916 28571 i
2001:12f8:0:9::53	4	32934	484488	47	0:0:0	Established	0	0	0	0	2001:12f8:0:9::2	2	0	0	1916 1251 i
2001:12f8:0:9::88	4	53202	10374461	6	0:0:0	Established	0	0	0	0	2001:12f8:0:9::2	2	0	0	1916 1251 i
2001:12f8:0:9::106	4	32934	485842	47	0:0:0	Established	0	0	0	0	2001:12f8:0:9::2	2	0	0	1916 1251 i
2001:12f8:0:9::128	4	52320	124653705	47	0:0:0	Established	0	0	0	0	2001:12f8:0:9::2	2	0	0	1916 1251 i
2001:12f8:0:9::137	4	13335	491462	47	0:0:0	Established	0	0	0	0	2001:12f8:0:9::2	2	0	0	1916 1251 i
2001:12f8:0:9::149	4	28191	158514	13	0:0:0	Established	0	0	0	0	2001:12f8:0:9::2	2	0	0	1916 i
2001:12f8:0:9::187	4	28624	32212587	236193	0:0:0	Established	0	0	0	0	2001:12f8:0:9::2	2	0	0	1916 i

Network

Next Hop

Metric

LocPrf

Weight

Path

N*

2001:12d0::/32

2001:12f8:0:9::2

2

0

1916 28571 i

N*

2001:12f8:0:9::2

2

0

1916 28571 i

N*>

2001:12d8::/32

2001:12f8:0:9::2

2

0

1916 1251 i

N*=

2001:12f8:0:9::2

2

0

1916 1251 i

V*>

2001:12f0::/36

2001:12f8:0:9::2

2

0

1916 i

03w2d01h 85992 0 Oops Networks

E também podem ser aliados para *troubleshooting*

Demo

Subscriptions to the stream are sent as a JSON object with various filter parameters. You can adjust the parameters and see the messages that are streamed on the right.

```
{
  "prefix": "2001:12d0::/32",
  "path": null,
  "type": "UPDATE",
  "require": null,
  "moreSpecific": true,
  "lessSpecific": true,
  "host": "null (all)",
  "peer": null,
  "socketOptions": {
    "includeRaw": false,
    "acknowledge": true
  }
}
```

Live RIS BGP messages

 Paused 589 matching messages ~0 kbit/s ⓘ

```
// Received at 16:24:24 (2 seconds ago)
{
  "timestamp": 1749583462.08,
  "peer": "2001:7f8:d:ff::226",
  "peer_asn": "24482",
  "id": "2001:7f8:d:ff::226-01",
  "host": "rrc07.ripe.net",
  "type": "UPDATE",
  "path": [24482, 2914, 16509],
  "community": [[2914, 410], [100], [24482, 12000], [24482, 12000], [24482, 64602]],
  "origin": "IGP",
  "med": 120,
  "announcements": [
    {
      "next_hop": "2001:7f8:d:ff::226",
      "prefixes": [
        "2605:9c0:c18::/32"
      ]
    }
  ],
  "withdrawals": []
}
```

```
import json
import websocket

ws = websocket.WebSocket()
ws.connect("wss://ris-live.ripe.net/v1/ws/?client=py-example-1")

params = {
    "moreSpecific": True,
    "host": "rrc21",
    "socketOptions": {
        "includeRaw": True
    }
}

ws.send(json.dumps({
    "type": "ris_subscribe",
    "data": params
}))

for data in ws:
    parsed = json.loads(data)
    print(parsed["type"], parsed["data"])
```

<https://ris-live.ripe.net/>

Existem **diversas** outras **ferramentas** com dados de roteamento e *looking glasses* que podem ser úteis



<https://lookingglass.lumen.com/>

<https://lg.he.net/>

<https://lg.de-cix.net/>

<https://lg.ams-ix.net/>

<http://looking.cabase.org.ar/>

<https://lg.br.digital/>

<https://lg.nocclaro.com.br/>

https://wiki.brasilpeeringforum.org/w/Looking_Glass

Duas perspectivas para *troubleshooting*

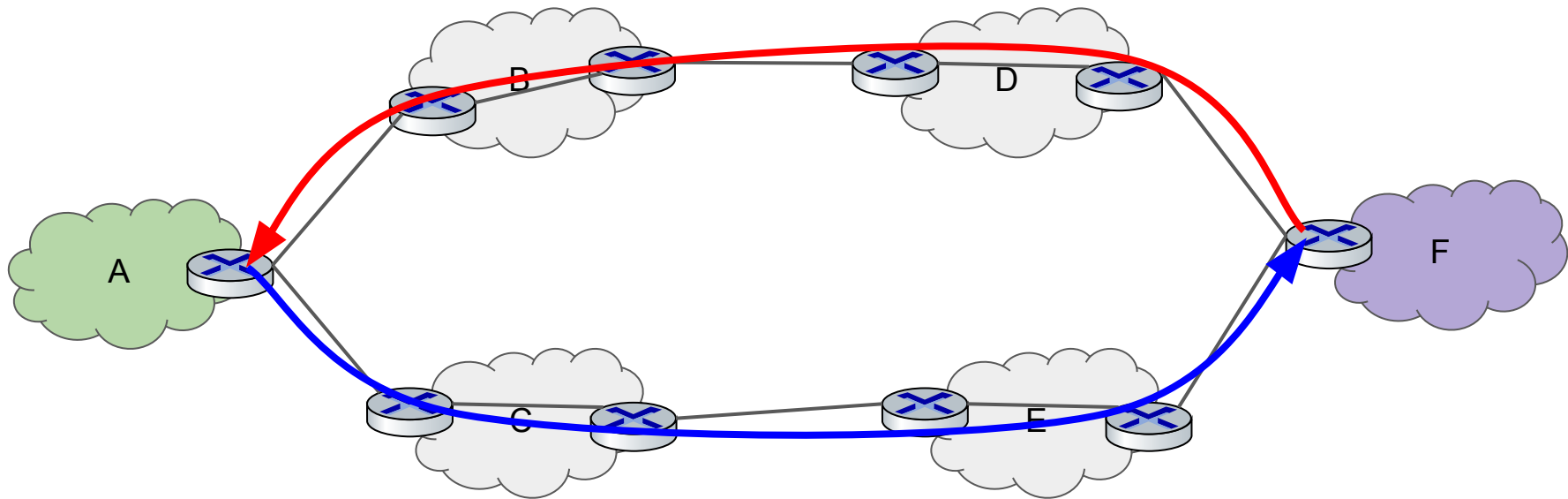
Plano de controle (BGP)



Plano de dados (IP)

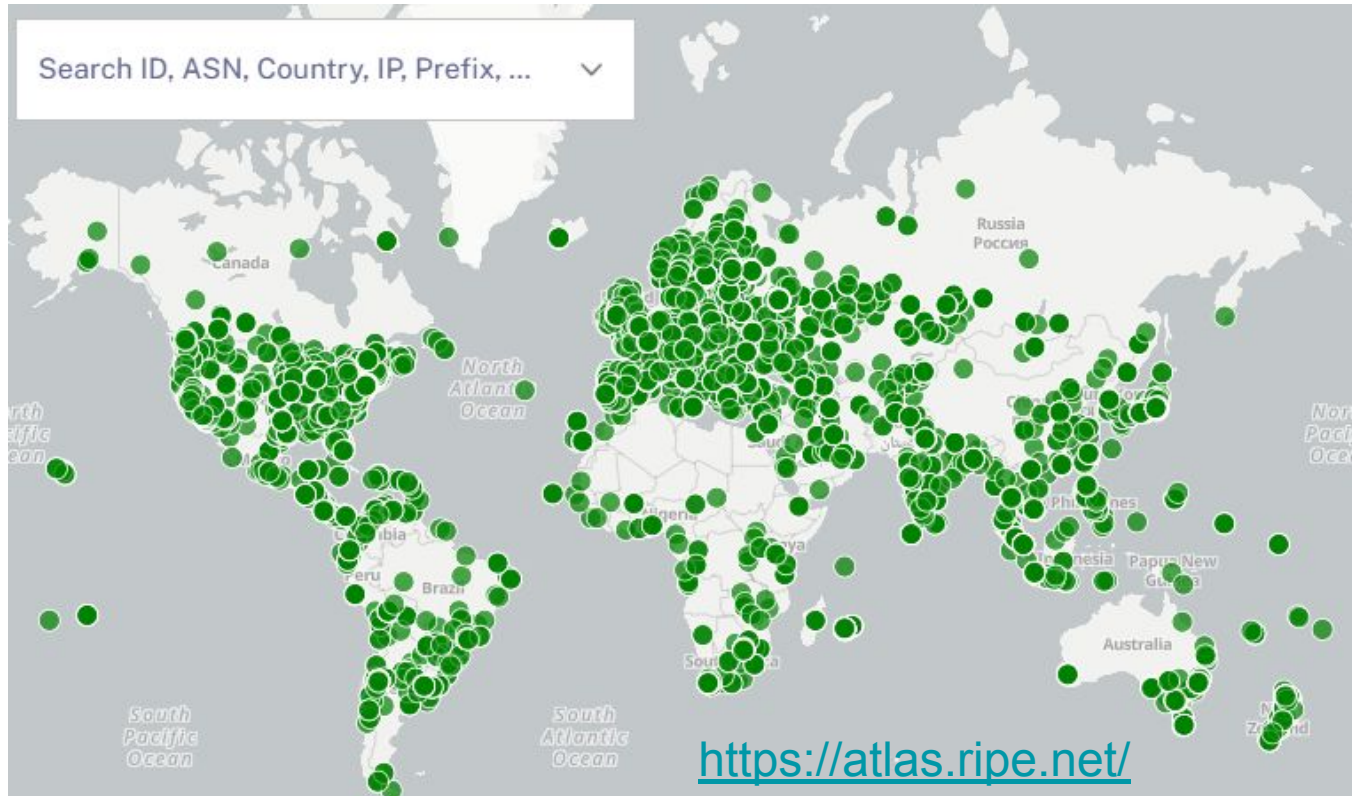


Por que medir **também** a partir de outros ASes?



Caminhos podem ser **assimétricos**. Ao medir do nosso AS aprendemos apenas o caminho de ida!

RIPE Atlas é um projeto que oferece *probes* em diversos ASes para realização de *medições ativas*



RIPE Atlas é um projeto que oferece *probes* em diversos ASes para realização de *medições ativas*

Measurement Form

Use this form to create (and optionally schedule) a new measurement, or to configure an API call to do the same.

Step 1: Definitions

Please select the type of measurement you want to create.

TRACEROUTE

PING

TRACEROUTE

IPv4

IPv6

Target (Required)

nic.br

Description

Traceroute measurement to nic.br

Step 2: Probe Selection

SEARCH ON MAP

RANDOM BY... ▾

IDS LIST

REUSE FROM EXISTING MEASUREMENT

Probe Selection ⓧ

Probe: 62

Probe: 64

Probe: 75

Probe: 10

Probe: 20

Probe: 35

Probe: 10

Probe: 10

Probe: 60

Probe: 1010907 LV ⓧ

Probe: 65699 TL ⓧ

Probe: 1010439 PE ⓧ

Probe: 7532 DJ ⓧ

Probe: 33144 ZW ⓧ

Step 3: Timing

Please select if this is a one-off (vs. periodic) measurement and start and end times (if needed). All times are displayed in your local time (but submitted in UTC).

This is a One-off: ☐

Start Time:

ASAP

End Time:

Never

18

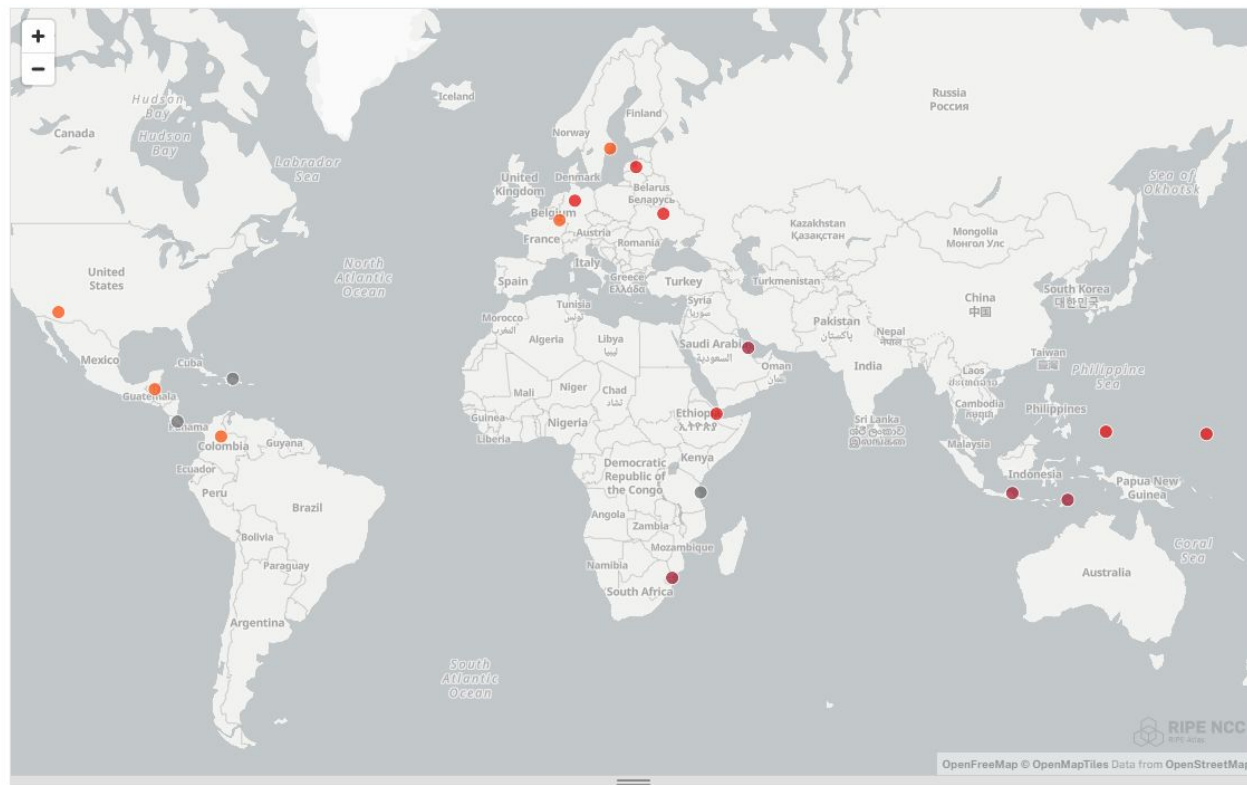
RIPE Atlas é um projeto que oferece *probes* em diversos ASes para realização de *medições ativas*

Probe	ASN	Country All	Time (UTC)	Min RTT	Hops	Success	Traceroute
1010595	271927	CO					
35556	263824	BZ					
↓ 6571	200129	LU					
1002591	6167	US					
16520	64449	SE					
1010907	26383	LV					
65494	3320	DE					
1010713	214379	UA					
↓ 7532	30990	DJ					
↓ 7455	17893	PW					
↓ 7448	139759	FM					
↓ 7545	149697	ID					
13725	37100	MZ					
65699	151605	TL					
62071	5416	BH					

Traceroute for Probe [7532](#)

Hop	IP Address	Reverse DNS	ASN	RTT 1	RTT 2	RTT 3
1	*	*	*	*	*	*
2	2001:41a8:10:2::1b5		6762	94,482 ms	76,43 ms	76,214 ms
3	2001:41a8:5200::1	spa1-loop0-v6.spa.seabone.net	6762	279,278 ms	262,708 ms	262,747 ms
4	2001:41a8:5200:2::2d2		6762	262,116 ms	262,155 ms	262,359 ms
5	*	*	*	*	*	*
6	*	*	*	*	*	*
7	*	*	*	*	*	*
8	2001:1291:0:15::b	et-4-2-0-0.edge-c.spo511.algartelem.com.br	16735	265,323 ms	265,375 ms	265,345 ms
9	2001:1291:1200:1d::b		16735	265,303 ms	265,179 ms	264,931 ms
10	2001:12ff:1::178	et-0-1-5-0.core1.jd.registro.br	22548	253,183 ms	253,175 ms	253,301 ms
11	2001:12ff:2:1::249	ae0-0.ar3.nu.registro.br	22548	255,371 ms	255,571 ms	255,207 ms
12	2001:12ff:0:4::6	nic.br	22548	252,895 ms	252,966 ms	252,913 ms

RIPE Atlas é um projeto que oferece *probes* em diversos ASes para realização de *medições ativas*



Result summary (latest, as of 2025-06-10 22:03:05 UTC):

15 probes reached their target.

2 probes did not.

1 probe did not report (yet).

Min RTT: 150,648

Mean RTT: 256,267

<https://atlas.ripe.net/measurements/108748137>

Plataforma oferece *API*

Resultados podem ser baixados em *json*

ISP Tools é uma ferramenta brasileira para realizar medições ativas a partir de ISPs brasileiros

ISP.Tools Nodes

250

Top 10 Estados BR

1. São Paulo (51)
2. Minas Gerais (35)
3. Santa Catarina (28)
4. Rio Grande do Sul (20)
5. Bahia (19)
6. Goiás (12)
7. Ceará (11)
8. Paraná (11)
9. Rio de Janeiro (11)
10. Alagoas (7)

TRACEROUTE

Origem

Universidade Federal do Rio Grande do Sul (Porto Alegre)

IP/Host Destino

nic.br

Testar

Hop	IP Address	Host Name	Tempo (ms)
1	172.17.0.1		1ms
2	200.132.1.2		1ms
3	200.19.246.6		1ms
4	177.52.38.24		1ms
5	*	*	unreachable
6	187.72.132.73		18ms
7	200.160.0.178		16ms
8	200.160.0.250		16ms
9	200.160.4.6		16ms
FIM			

<http://isp.tools/>

Looking glasses também são usados para medir!

**Router:**

Bangkok - TH

Query:

Traceroute

FQDN or IP Address:

- ☐ Your current IP Address: 2804:60:
☐ Specify an IP Address (IPv4 or IPv6):
☒ Specify FQDN nic.br

Submit

Reset

Query Results:

Router: Bangkok - TH

Command: traceroute ipv6 nic.br

Disclaimer: Traceroute is a useful tool for determining the route a packet takes, but it should not be used as an accurate measure of network performance. For more information please view the [Traceroute Disclaimer](#).

Tracing the route to 2001:12ff:0:4::6

```
1 ae-4.r23.kslrml02.my.bb.gin.ntt.net (2001:218:0:2000::13d) 32 msec 25 msec 25 msec
2 ae-8.r25.sngpsi07.sg.bb.gin.ntt.net (2001:218:0:2000::5) [MPLS: Labels 683286/2 Exp 0] 30
3 * * *
4 * * *
5 ae-5.r26.sttlwa01.us.bb.gin.ntt.net (2001:218:0:2000::199) [MPLS: Labels 107418/2 Exp 0] 1
6 ae-11.r22.nwrknj03.us.bb.gin.ntt.net (2001:418:0:2000::331) [MPLS: Labels 923420/2 Exp 0]
7 ae-1.a00.saplbr02.br.bb.gin.ntt.net (2001:418:0:2000::3e) 351 msec 357 msec 349 msec
8 ae1-3798.gw1.nu.registro.br (2804:8f8:0:5000::13d) 357 msec 362 msec 359 msec
9 et-0-1-5-0.core1.nu.registro.br (2001:12ff:1::160) 358 msec 353 msec 353 msec
10 ae0-0.ar3.jd.registro.br (2001:12ff:2:1::250) 357 msec 356 msec
    ae0-0.ar3.nu.registro.br (2001:12ff:2:1::249) 354 msec
11 NIC.BR (2001:12ff:0:4::6) 359 msec 371 msec 367 msec
```

Em resumo...



Perguntas?

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Lembre que o protocolo BGP permite que os outros ASes tomem suas decisões de roteamento e que elas **nem sempre serão o que esperamos**



Looking glasses e coletores de rota nos fornecem evidências do que está acontecendo no plano de controle e **como as rotas são propagadas**



Lembre que os **caminhos** de ida e volta podem ser **assimétricos**. Realizar medições ativas (*traceroutes*) a partir de outros pontos da Internet nos ajuda a entender **como o tráfego está chegando na nossa rede**