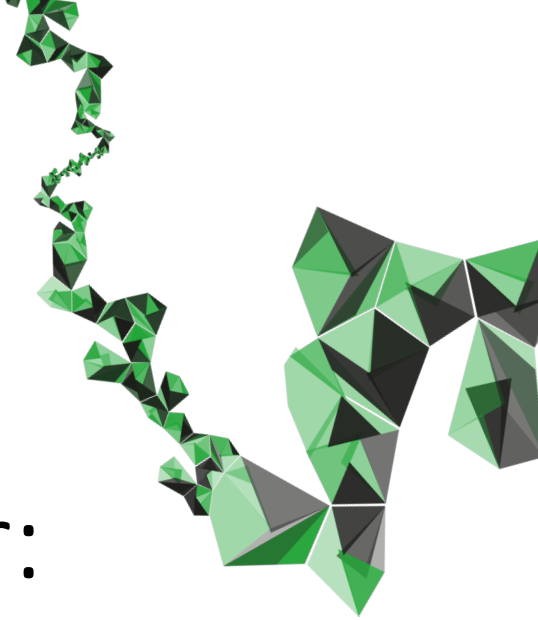




BGP Anycast Tuner: Gerenciamento Intuitivo para Serviços Anycast

Leandro M. Bertholdo,
João M. Ceron, Lisandro Z. Granville,
Giovane C. M. Moura, Cristian Hesselman,
Roland van Rijswijk-Deij

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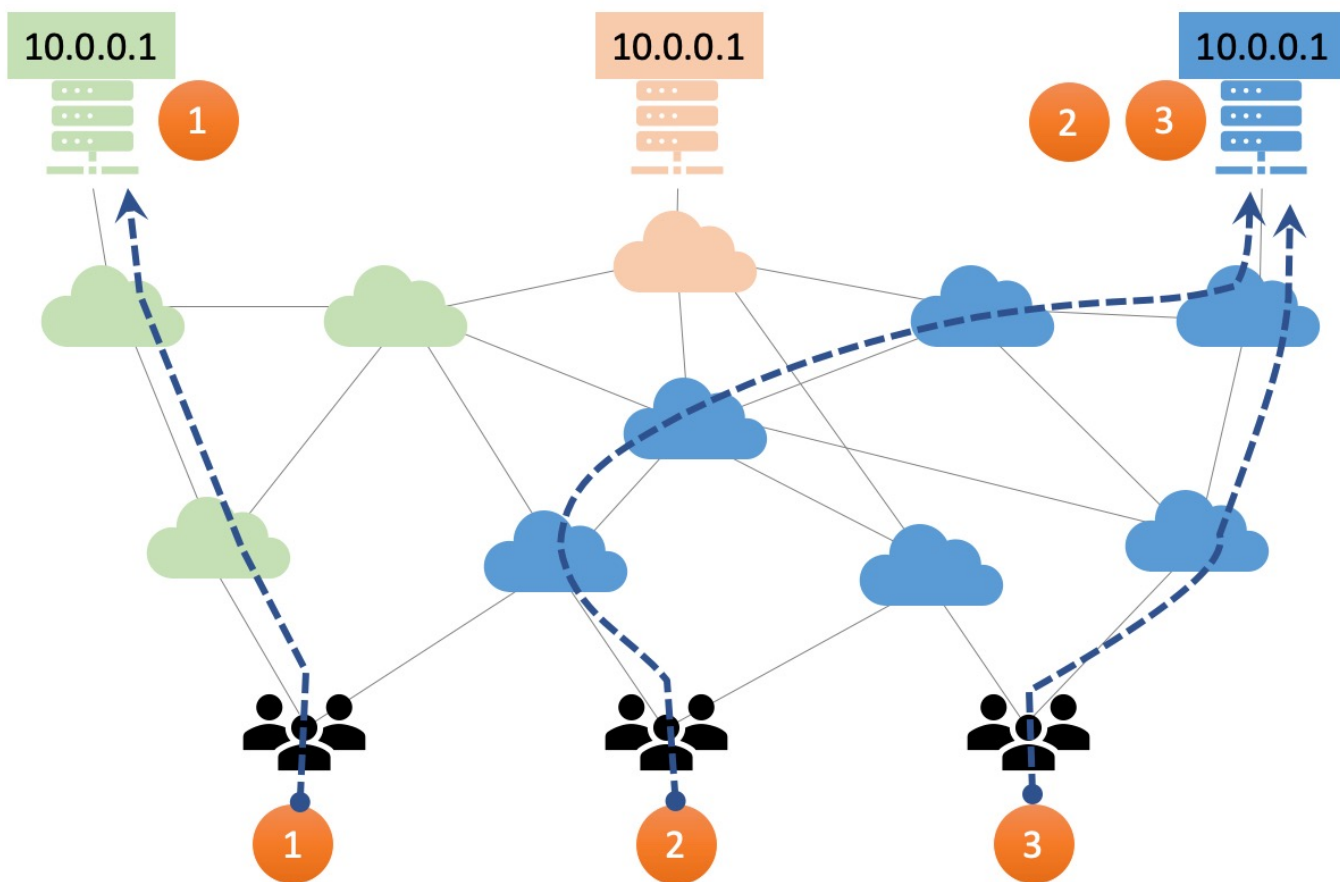
Project Goal



Como prover aos operadores de redes anycast uma melhor gerencia visando auxiliar a mitigação de ataques DDoS



O que é anycast e o conceito de catchment?



Motivação

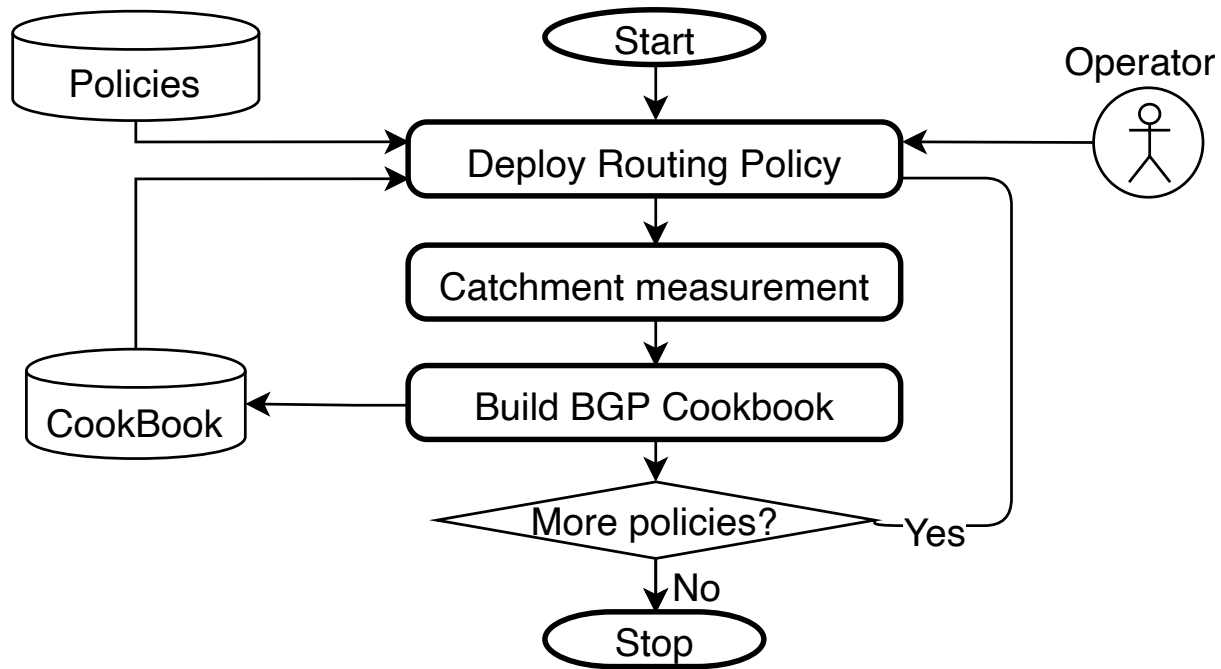
- **O gerenciamento do serviço Anycast é complicado**
 - Distribuição dos clients entre sites
 - Experiência de usuário
 - Desempenho da rede
- **O serviço Anycast está “amarrado” ao BGP**
 - Como observar as mudanças
 - Como prever o comportamento do tráfego e impacto de alterações.
- **A maioria das CDNs usa DNS para balanceamento de clients**
 - **Como balancear o proprio serviço de DNS?**
 - A maioria dos CCTLDs possuem o mesmo prefixo em até 20 sites

Questões

- Como **otimizar o desempenho** dos meus serviços anycast?
 - Como que certificar de que os clientes da Holanda vão para o site da Holanda e não do Canadá
- Como obter um melhor **balanceamento de carga**:
 - Posso transferir o tráfego de um site para outro?
- Como **prever o comportamento** da rede de acordo com a política BGP usada?
 - O que acontece se manipular as políticas BGP piorando determinados caminhos? (ex. Usando preprends ou comunidades BGP)
 - Como quantificar o impacto destas mudanças?
- Quais os requisitos para gerenciar uma rede anycast?

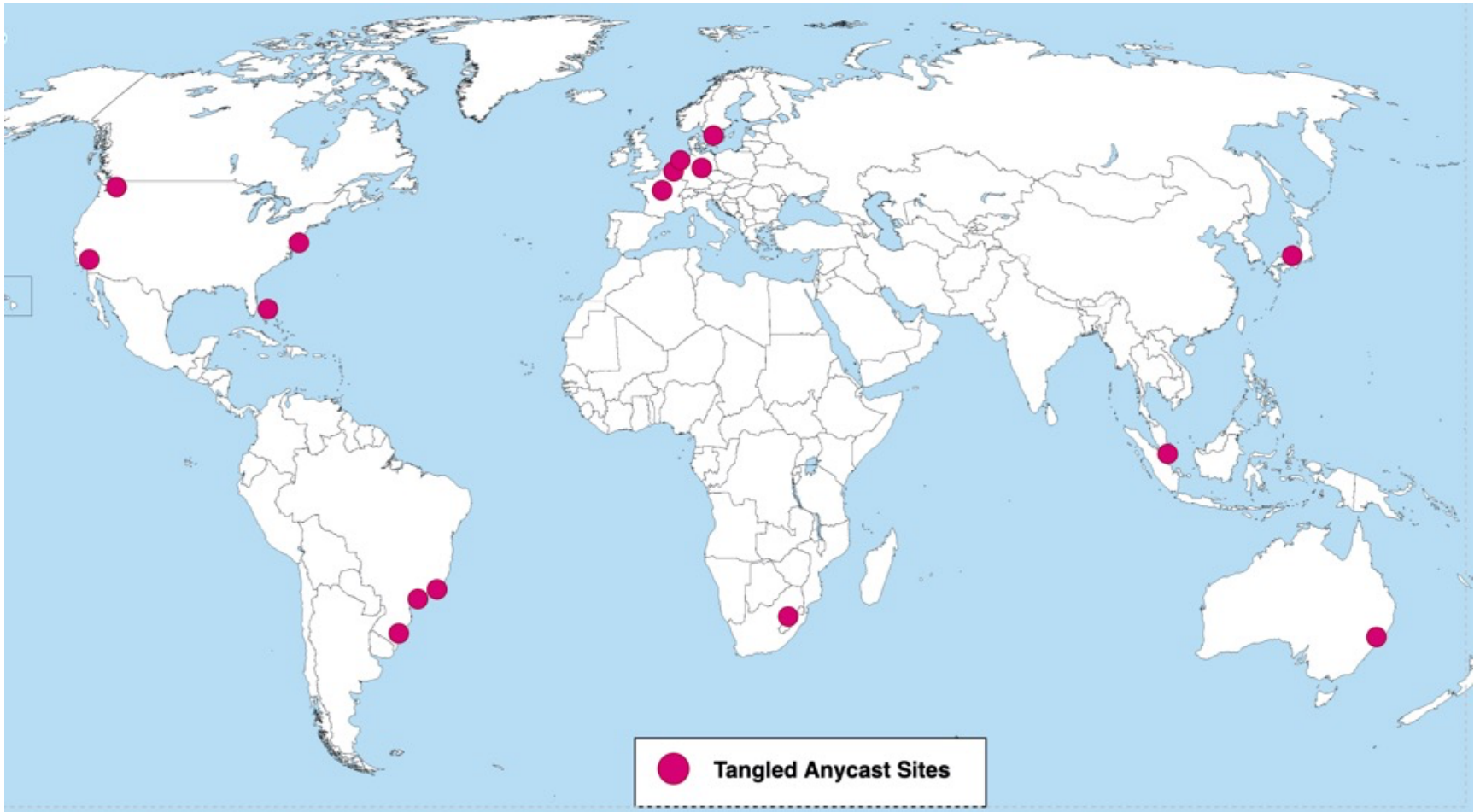
Estabelecendo os requisitos de gerencia

Requirement	Anycast service management tooling...
R1	needs to map site catchments
R2	needs to control site catchments
R3	support several metrics for clients and sites
R4	automatically discover traffic engineering (TE) options
R5	support fast, atomic configuration deployment
R6	have a simple and scalable management interface

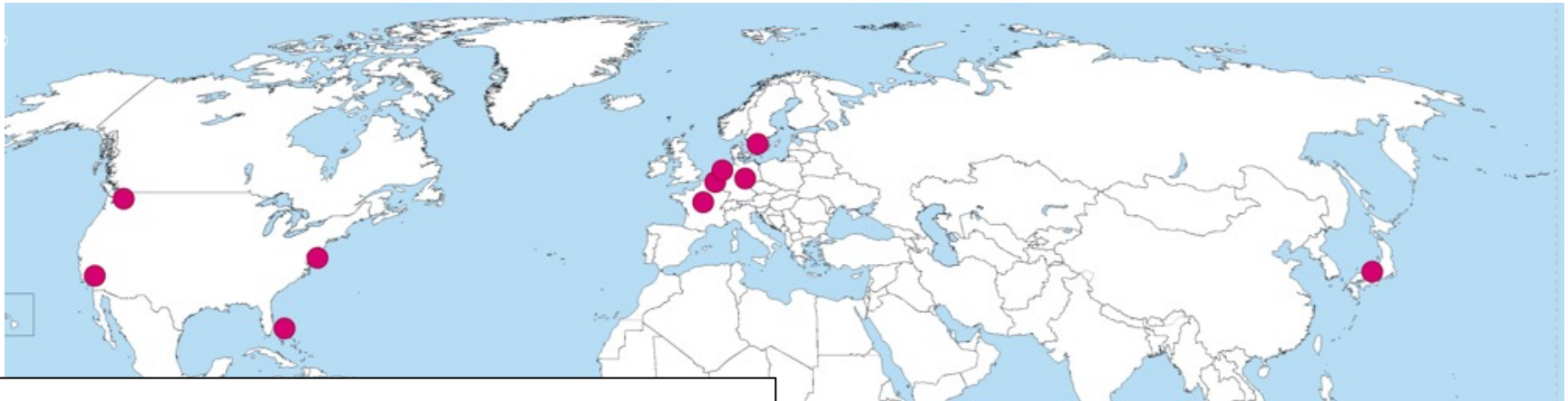


Abordagem

Tangled Testbed



Tangled Testbed



```
inet6num:      2001:610:9000::/40
netname:       UT-ANYCAST-IPV6-TEST-NET
descr:         Universiteit Twente
country:       NL
admin-c:       Ins20-RIPE
tech-c:        Ins20-RIPE
status:        ALLOCATED-BY-LIR
mnt-by:        SN-LIR-MNT
mnt-routes:    UT-DACS-MNT
created:       2019-06-03T14:22:36Z
last-modified: 2019-06-03T14:22:36Z
source:        RIPE
```

```
route:         145.100.118.0/23
descr:         UT-ANYCAST-TEST-NET
origin:        AS1149
mnt-routes:    UT-DACS-MNT
mnt-by:        AS1103-MNT
created:       2019-07-08T09:17:45Z
last-modified: 2019-07-08T09:17:45Z
source:        RIPE
```

Tangled Anycast Sites

Tangled Testbed



TANGLER Servers Prefixes

[Return to server overview](#)

us-mia-anycast01 node configuration

Location: United States, Miami
Monitoring: [Monit](#)

Available prefixes

IP Address	Subnet	Description	Status	Action
2001:610:9000::	24		withdrawn -> withdrawn	Announce
2001:610:9000::	43		withdrawn -> withdrawn	Announce
2001:610:90f4::	48		withdrawn -> withdrawn	Announce
2001:610:90f6::	48		withdrawn -> withdrawn	Announce
145.90.8.0	24	IPv4 Range from SURFnet	withdrawn -> withdrawn	Announce
2001:610:9000::	40		withdrawn -> withdrawn	Announce

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```
→ Tangled tangler-cli.py --status
au-syd-anycast01,2001:19f0:ffff::1,established
au-syd-anycast01,169.254.169.254,established
br-gru-anycast01,2001:12d8:0:4130::1,established
br-gru-anycast01,145.100.119.1,established
br-gru-anycast01,200.136.41.29,established
br-gru-anycast01,198.32.252.98,established
br-gru-anycast01,2001:468:702:1::,established
br-poa-anycast02,2001:12f8:0:6::26:4575,established
br-poa-anycast02,145.100.119.1,established
br-poa-anycast02,2804:da8::c057:3d,established
br-poa-anycast02,177.52.38.113,not established
br-poa-anycast02,177.184.254.161,established
dk-cop-anycast01,193.163.102.194,established
dk-cop-anycast01,2a01:630:0:80::2,not established
fr-par-anycast01,2001:19f0:ffff::1,established
fr-par-anycast01,169.254.169.254,established
jp-hnd-anycast01,203.178.136.16,established
jp-hnd-anycast01,2001:200:0:2::1000:4,not established
nl-arn-anycast01,193.176.144.163,established
nl-arn-anycast01,193.176.144.162,established
nl-arn-anycast01,2a00:d78:0:fd:193:176:144:163,established
nl-arn-anycast01,2a00:d78:0:fd:193:176:144:162,established
nl-ams-anycast01,169.254.169.254,established
nl-ams-anycast01,2001:19f0:ffff::1,established
nl-ens-anycast02,2001:610:1908:FF00::234,established
nl-ens-anycast02,192.87.172.4,established
nl-ens-anycast02,2001:610:1908:FF00::233,established
nl-ens-anycast02,192.87.172.5,established
uk-lnd-anycast02,2001:19f0:ffff::1,established
uk-lnd-anycast02,169.254.169.254,established
us-mia-anycast01,2001:468:700:a::20,established
us-mia-anycast01,198.32.252.96,established
us-was-anycast01,128.9.63.1,established
us-los-anycast01,207.151.17.57,established
us-los-anycast01,2001:1878:18:20::3,established
de-fra-anycast01,169.254.169.254,established
de-fra-anycast01,2001:19f0:ffff::1,established
us-sea-anycast01,2001:19f0:ffff::1,established
us-sea-anycast01,169.254.169.254,established
sg-sin-anycast01,169.254.169.254,established
sg-sin-anycast01,2001:19f0:ffff::1,established
za-jnb-anycast01,2c0f:f738:3802::1,not established
za-jnb-anycast01,196.251.250.1,established
→ Tangled
```

Tangled Testbed

```
→ Tangled tangler-cli.py -t fr-par-anycast01 -A -r 145.100.118.0/23 -P3
CMD=exabgpcli neighbor 169.254.169.254 announce route 145.100.118.0/23 next-hop self as-path [1149 1149 1149 1149 ]

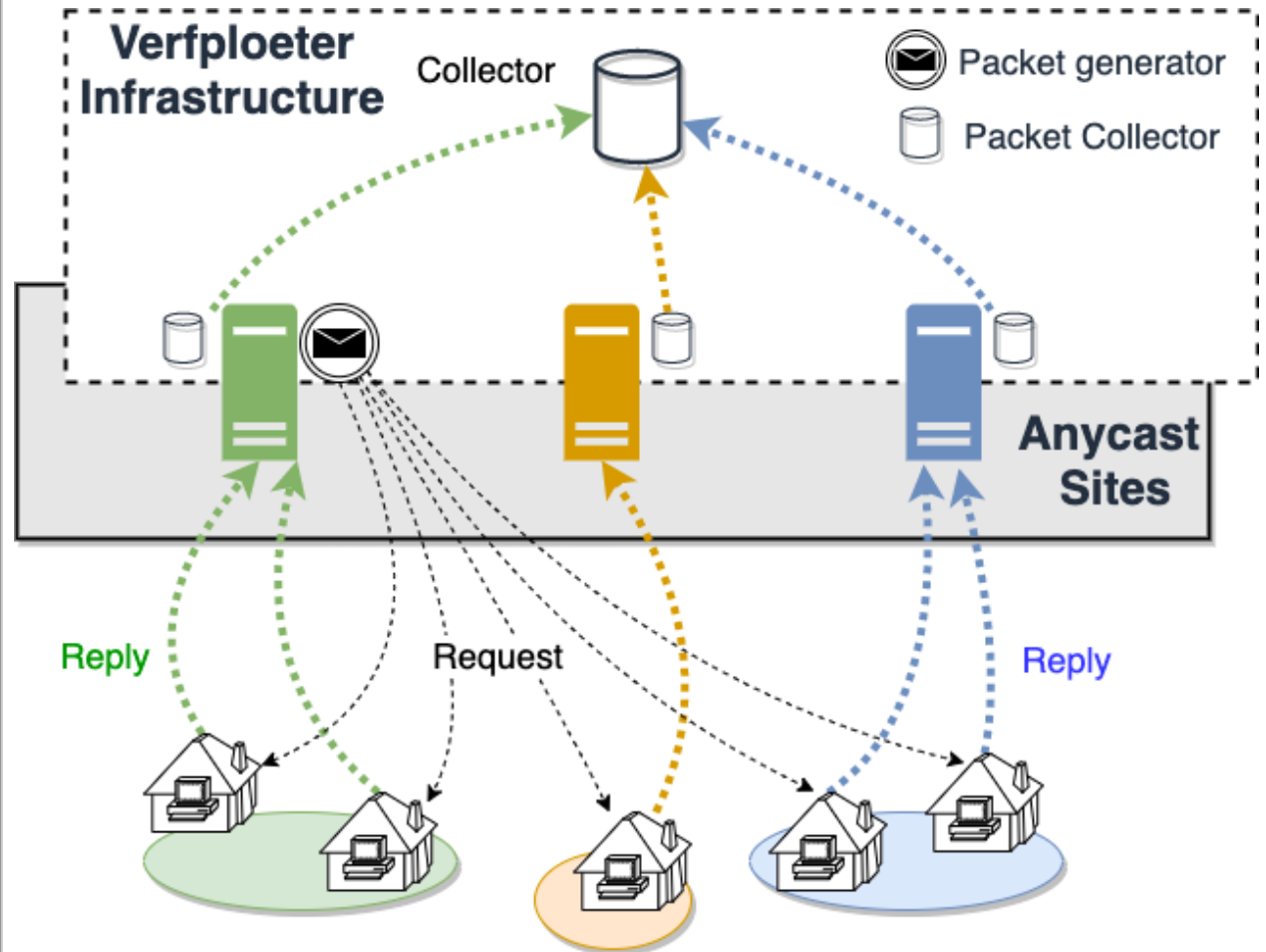
→ Tangled tangler-cli.py -t fr-par-anycast01 -c "annouce route 145.90.8.0/2 next-hop self community 100:666"
CMD=exabgpcli neighbor 169.254.169.254 annouce route 145.90.8.0/2 next-hop self community 100:666
```

```
→ Tangled tangler-cli.py --h
usage: /Users/bertholdo/Tangled/catchment_manipulation/tools/tangler-cli [options]

optional arguments:
  -h, --help            show this help message and exit
  --version             print version and exit
  -d, --debug           print debug messages
  -v                   print verbose messages
  -4                   working on IPv4 neighbor
  -6                   working on IPv6 neighbor
  --status             status of neighbor
  --csv                CSV output
  -a, --announces       active announces
  -t [TARGET], --target [TARGET]
                        target [node|all]
  -c [CMD], --cmd [CMD]
                        cmd to be executed
  -A                   announce routes [-r] to a target [-t] or all nodes/routes (default)
  -P [PREPEND]         number of prepends
  -r [ROUTE]           BGP route to be added
  --key [KEY]          SSH key present on the testbed
  --user [USER]        SSH user used to login on the testbed
  -w                   withdraw routes [-r] from a target [-t] or all nodes/routes (default)
  --nodes-with-announces
                        list the name of nodes with active prefix announcement
```

EXPERIMENTOS & MEDIÇÕES

Medições com Verfploeter



Medições

- Medições

- 15 minutos

- ~4M of redes /24



- catchment

- Distribuição de carga

- Políticas BGP individuais



Experimentos – análise de dados

Medição individual

- 15 minutes
- hitlist +6M
- 1 anuncio BGP

medições regulares

- multiplas medições por dia
- Alterações no anuncio BGP
- Mais de um mes de medições
- Instabilidades em nodos e trânsito

Table info

Table ID	vp-measurements-testbed:datasetTestbed.measurements
Table size	45.54 GB
Number of rows	274,850,861
Created	14 Aug 2019, 14:27:35
Table expiry	Never
Last modified	14 Aug 2019, 16:30:55
Data location	EU

300 millions

Experimentos – análise de dados

Machine configuration

Machine family

General-purpose

Machine types for common workloads, optimised for

Generation

First

Powered by Skylake CPU platform or one of its prede

Machine type

n1-standard-32 (32 vCPU, 120 GB memory)

 vCPU 32 Mem 120

3. joaceron@maquineta: ~/pre-bq (ssh)

1 [|||||100.0%] Tasks: 87, 128 thr; 32 ru

2 [|||||100.0%] Load average: 49.64 27.45

3 [|||||100.0%] Uptime: 00:04:43

4 [|||||100.0%]

5 [|||||100.0%]

6 [|||||100.0%]

7 [|||||100.0%]

8 [|||||100.0%]

9 [|||||100.0%]

10 [|||||100.0%]

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31 [|||||100.0%]

32 [|||||100.0%]

Mem 64.4G/118G

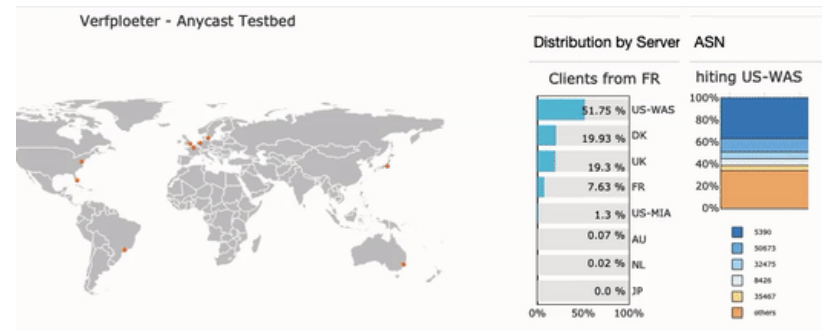
Swp 0K/0K

Configurando BGP, coletando catchment e analisando resultados

- Ferramentas desenvolvidas para:
 - Manipulação do BGP
 - Usado a ferramenta Verfploeter para coletar resultados
 - Outras ferramentas para exportação de dados

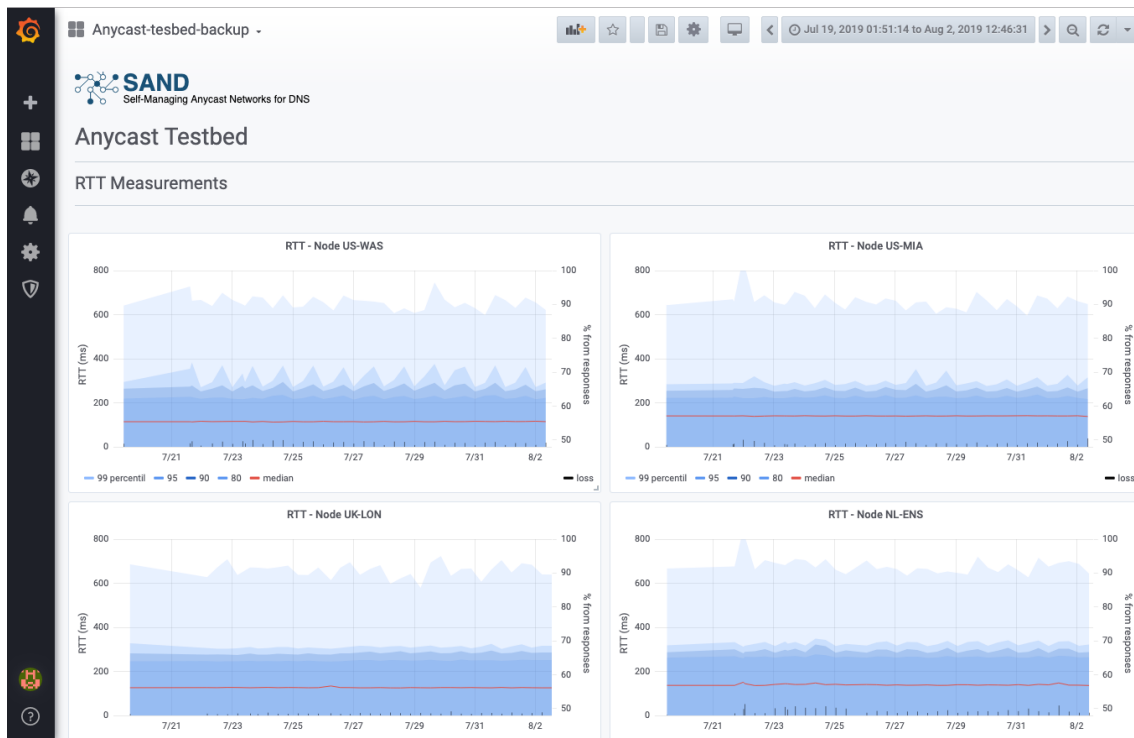


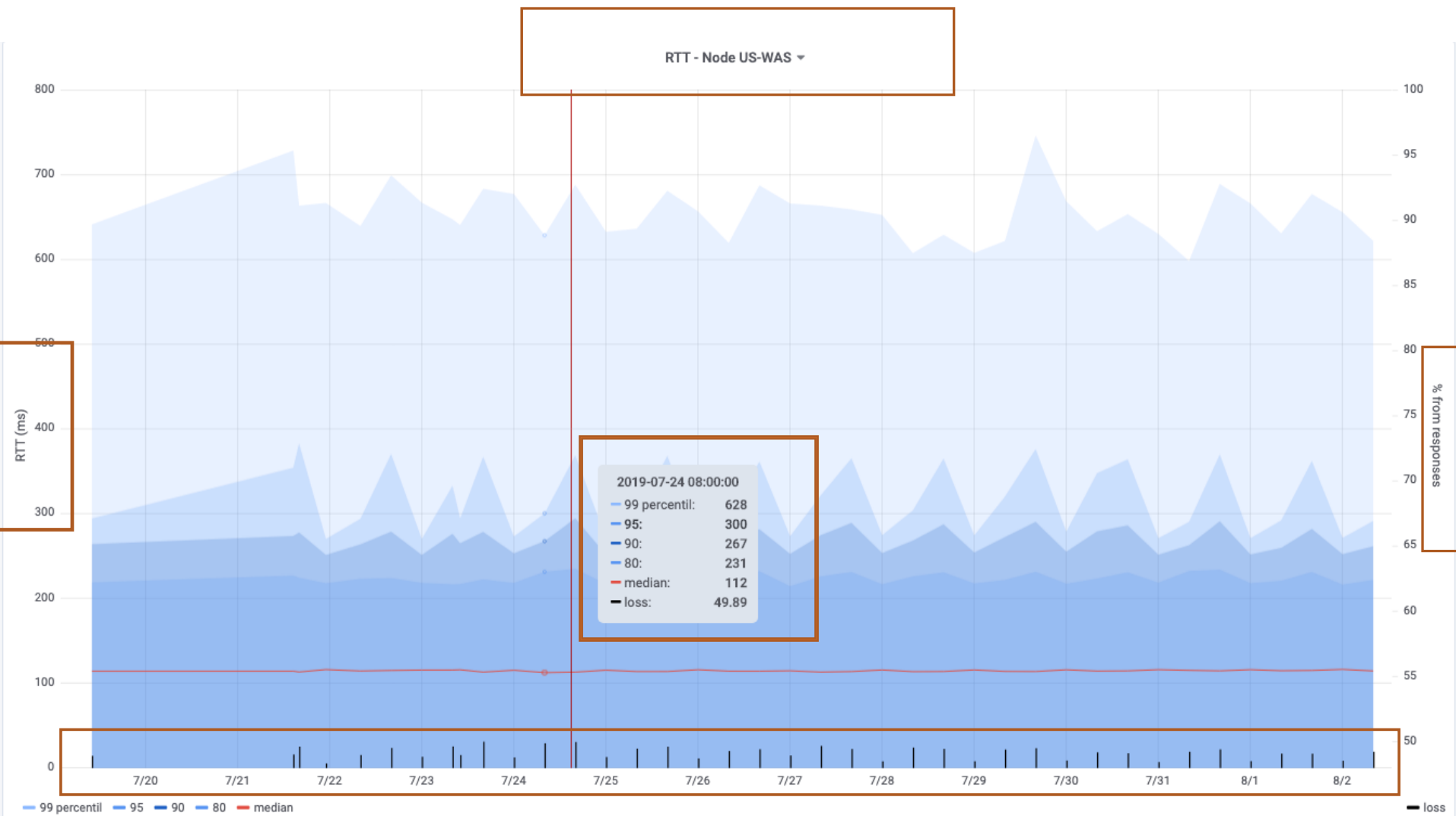
- catchment
- load distribution



Avaliando RTT

- Take-away dos experimentos:
 - Reconhecer a Baseline de carga do serviço Anycast
 - Identificar Performance e parametros de experiencia de usuario





Resultados das medições

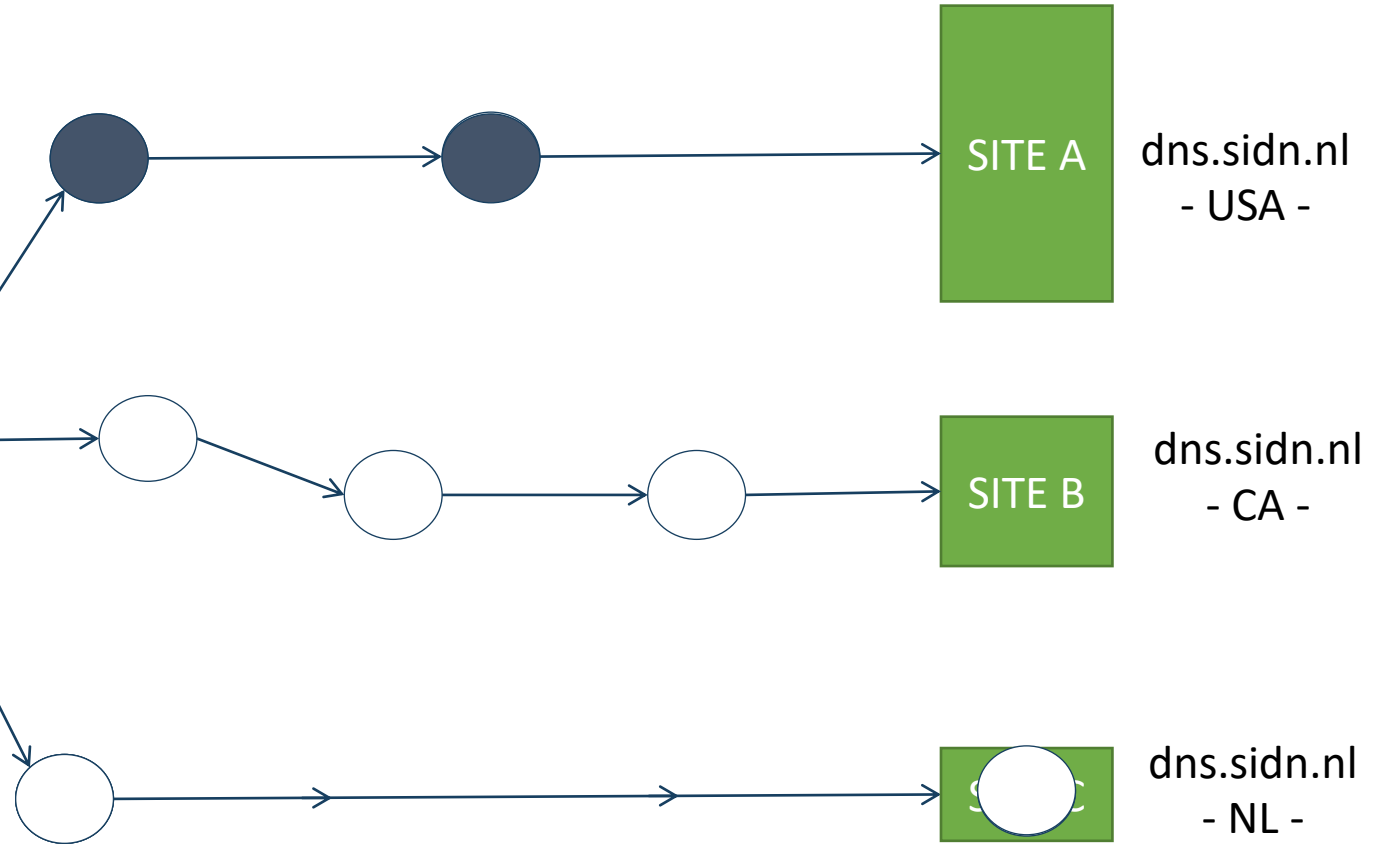
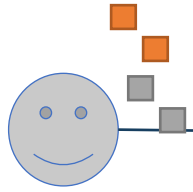
- Monitorar serviço anycast



- Alterar visibilidade dos sites

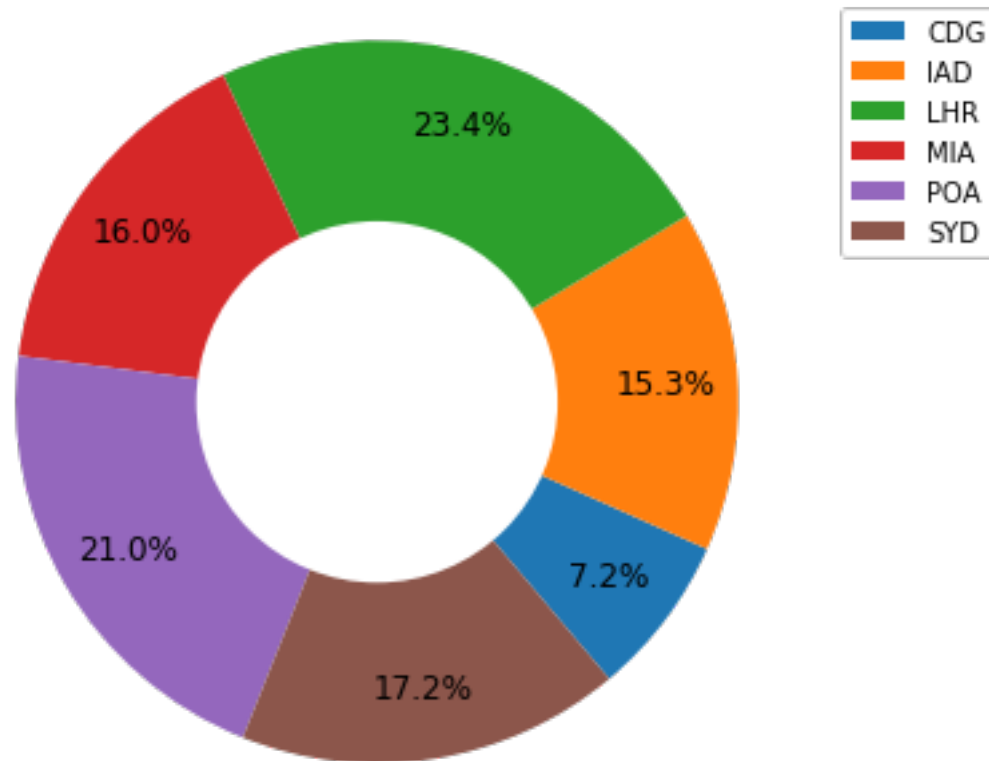
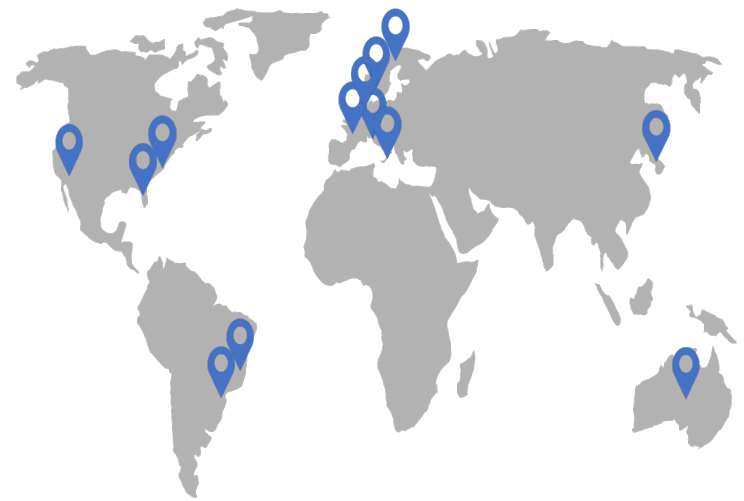
Manipulação dos anuncios BGP

- É possível mover tráfego usando AS-prepend?
- Qual a precisão e granularidade desse controle?
- Quanto tempo leva para implementar essa mudança?
- Como é a visibilidade dos prefixos após a mudança?



Anycast baseline

- Distribution of traffic per site



PREPEND

- BGP best path
 - Avalia muitos parametros

Network	Next Hop	Metric	LocPrf	Weight	Path
192.0.2.0/24	1.1.1.1	20		0	1010 1011 286 4040 i

AS_PATH: Number of AS
to de destination

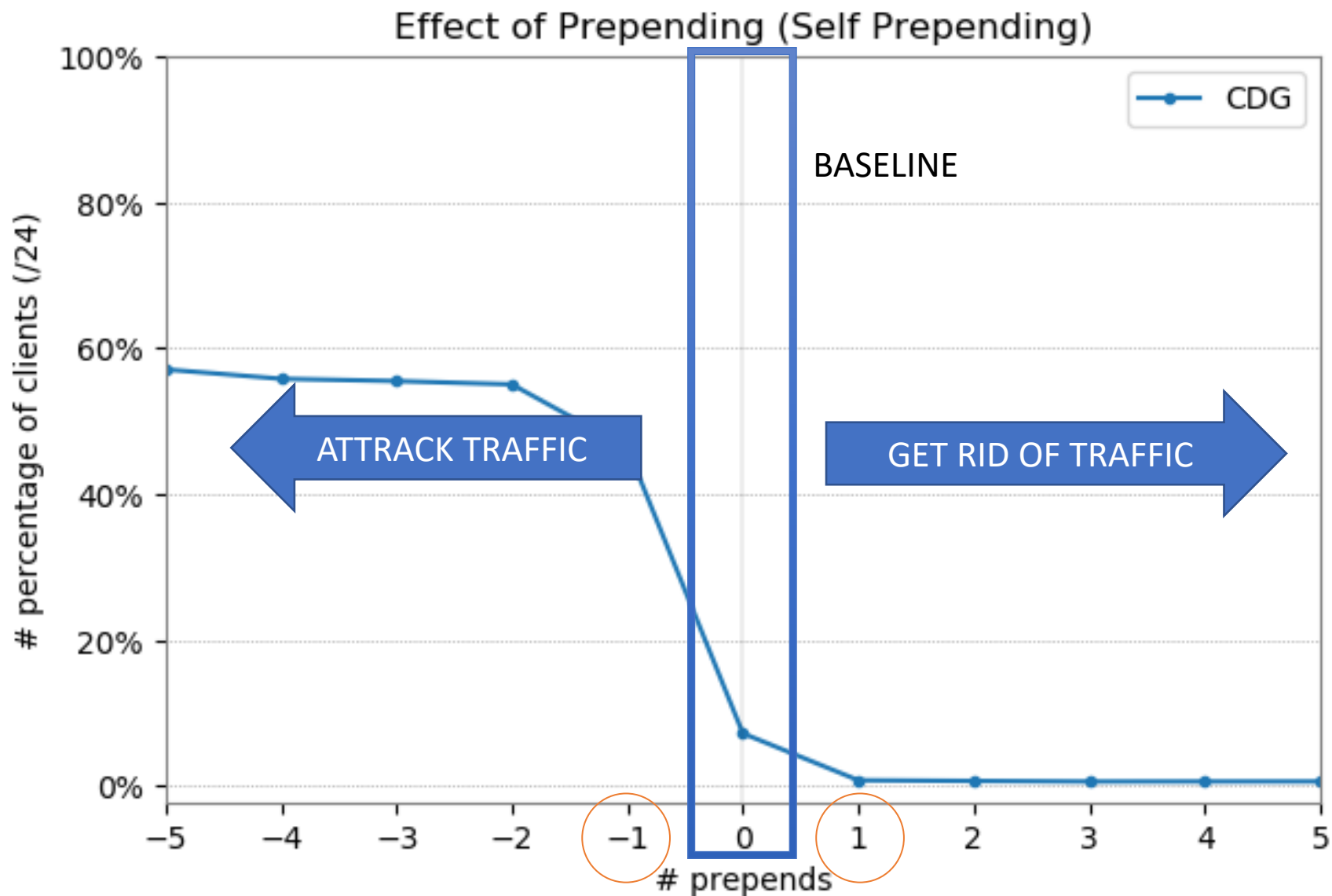
Prepend extend the AS_PATH artificially to decrease the route preference.

AS PATH
1010 1011 286 4040

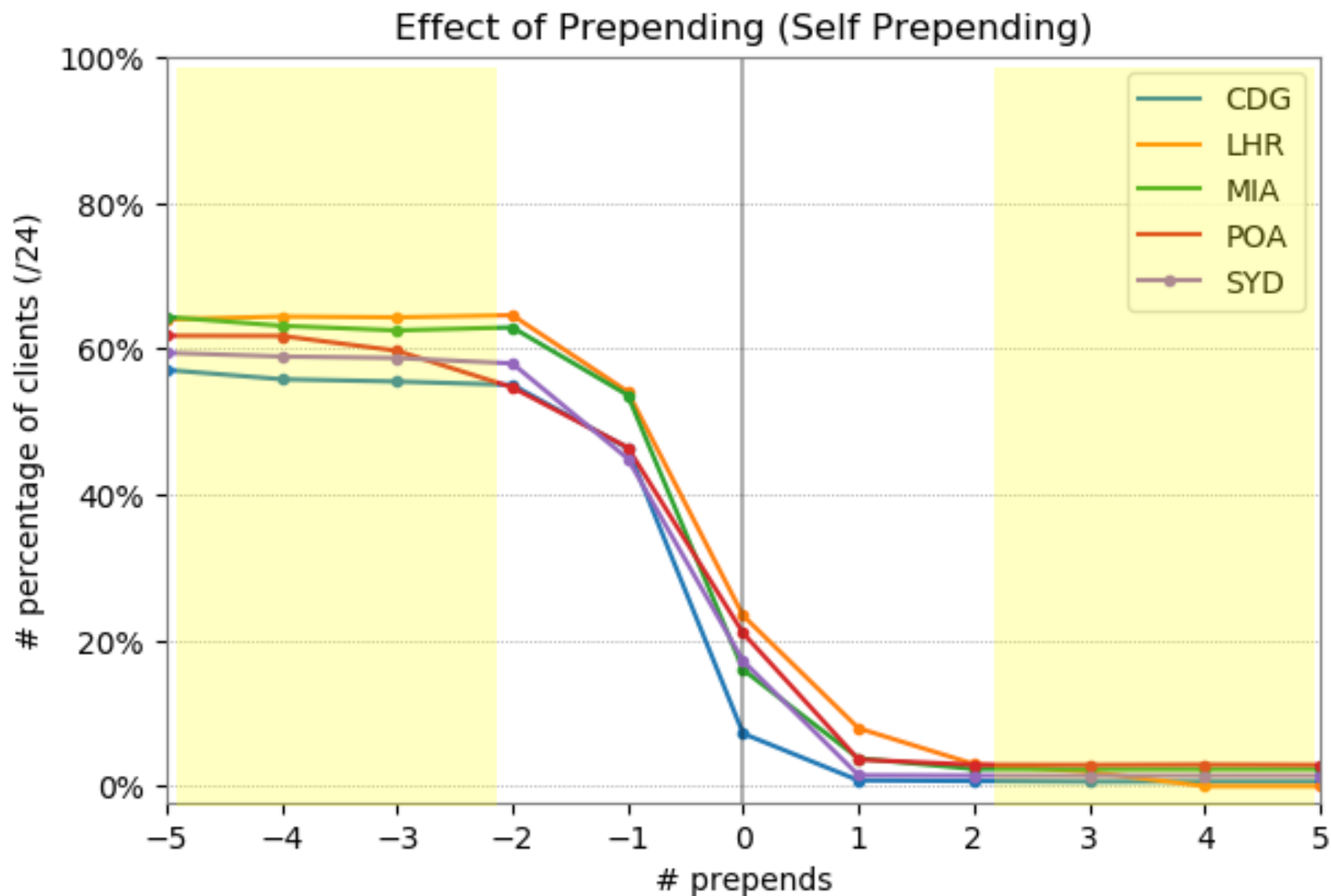
prepending

AS PATH
1010 1010 1010 1011 286 4040

Volume de redes movidas com as-prepend

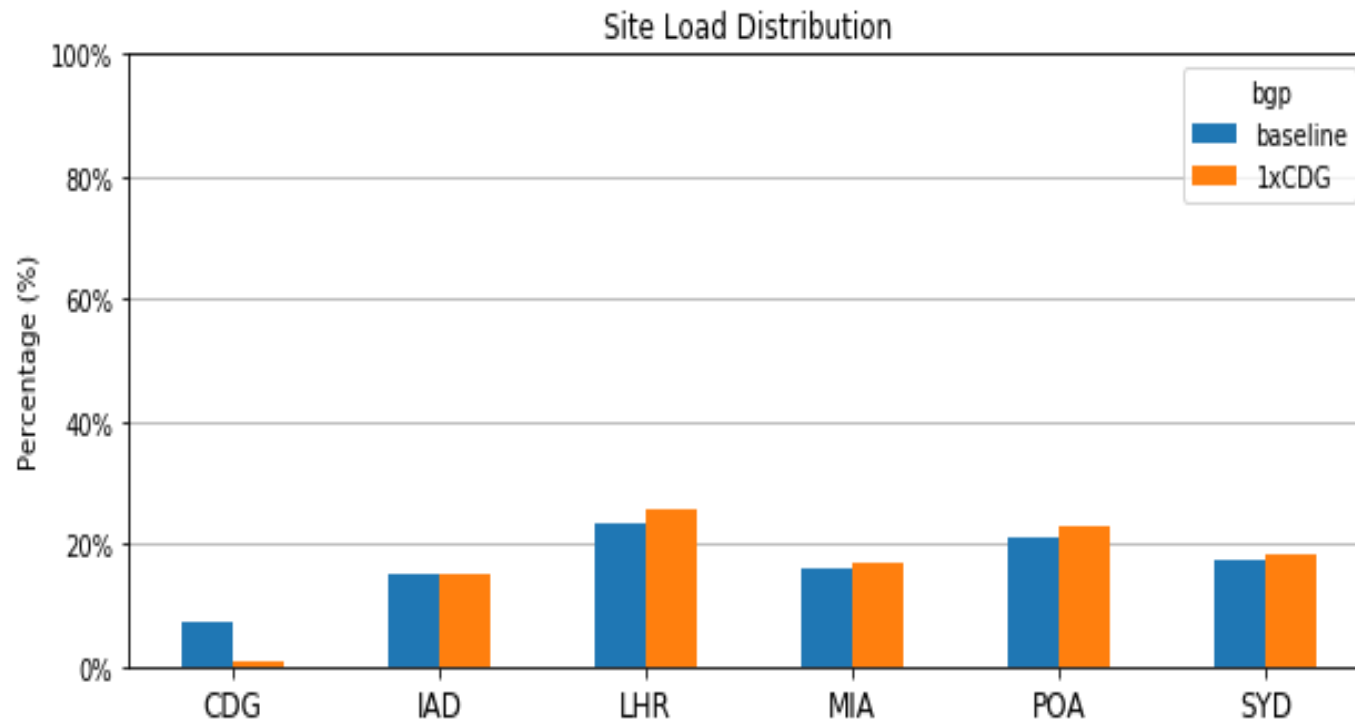


Volume de redes /24 movidas com as-prepend

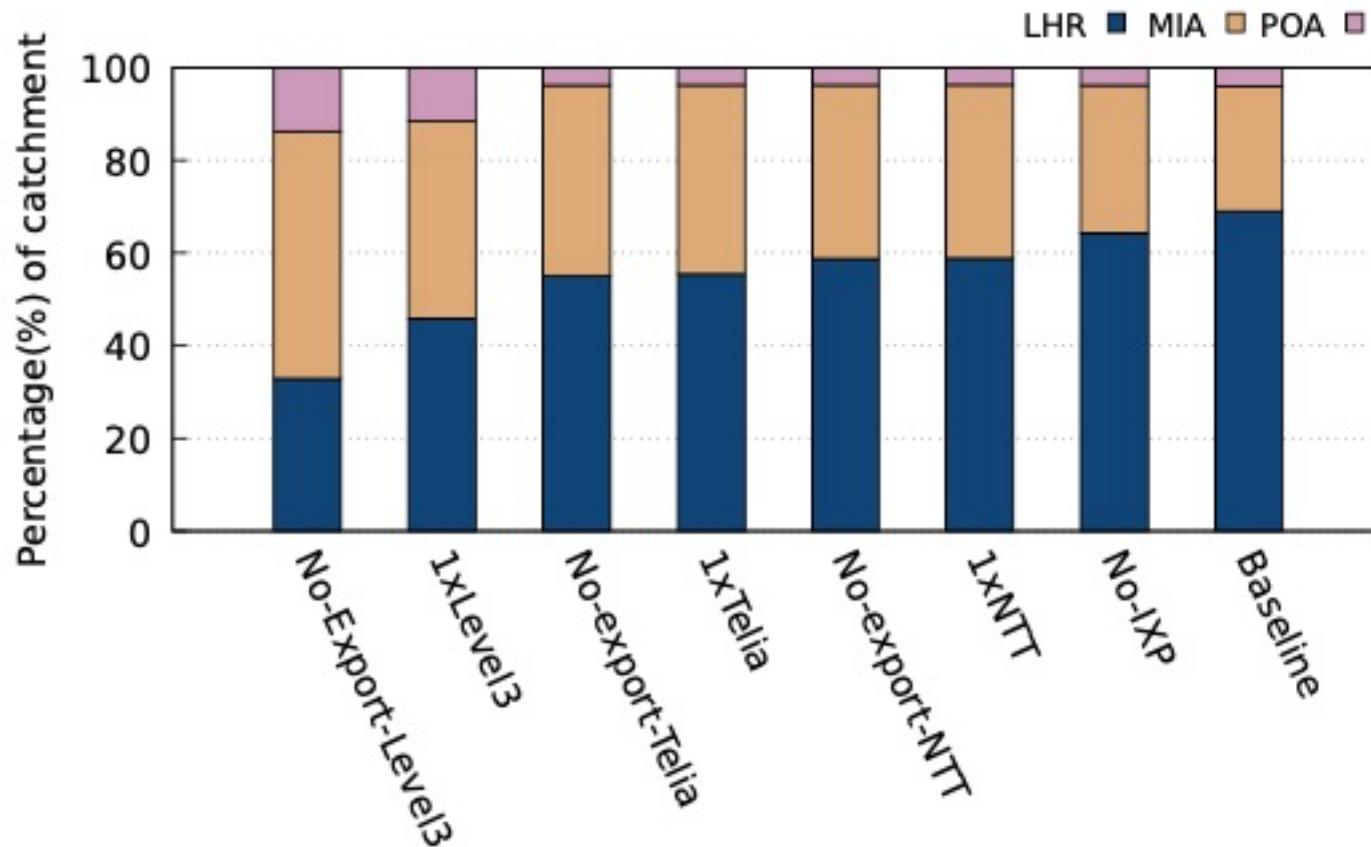


Anycast – 1 as-prepend em Paris (CDG)

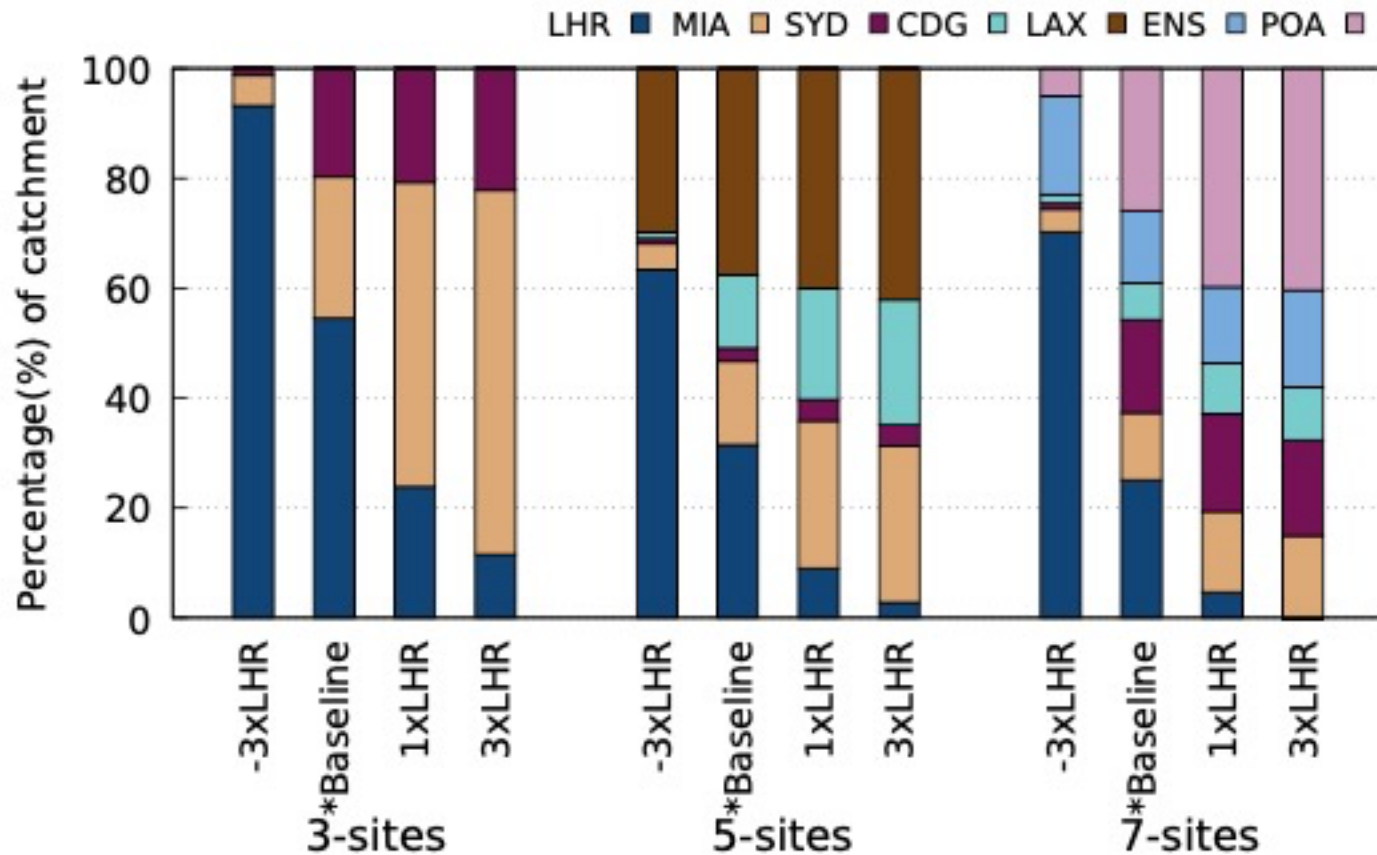
- Distribuição por site



Resultado em uma rede anycast com 3 sites



Comportamento com mais sites



Criando um “Cookbook”

- Milhares de possibilidades
 - Automação é necessária
- Mas o **catchment é estável!!!**
 - Outros trabalhos provaram que não existem grandes variações ao longo do tempo

Criando um “CookBook” de Políticas BGP

Anycast-TE	CDG	IAD	LHR	MIA	POA	SYD
-2xLHR	2.04	15.17	64.58	8.89	8.05	1.26
-1xLHR	2.42	15.03	54.09	12.39	14.55	1.50
2xMIA	7.68	16.15	30.33	2.35	20.39	23.09
2xIAD	7.03	14.62	25.02	16.19	19.73	17.41
Baseline	7.22	15.28	23.38	15.97	20.98	17.16
-1xIAD	4.15	47.38	14.89	9.33	6.78	17.46
-3xSYD	1.47	15.70	10.61	4.10	9.41	58.71
-3xCDG	55.49	15.04	8.86	9.12	10.17	1.31
1xLHR	15.14	17.18	7.94	17.45	22.63	19.65
LHRnoPeer	15.84	20.19	3.03	17.79	23.69	19.47
3xLHR	15.92	21.08	1.97	17.81	23.62	19.60
-5xIAD	0.77	88.11	1.68	3.09	2.19	4.16
LHRnoExp	16.78	21.82	0.00	17.75	24.23	19.42

Políticas BGP

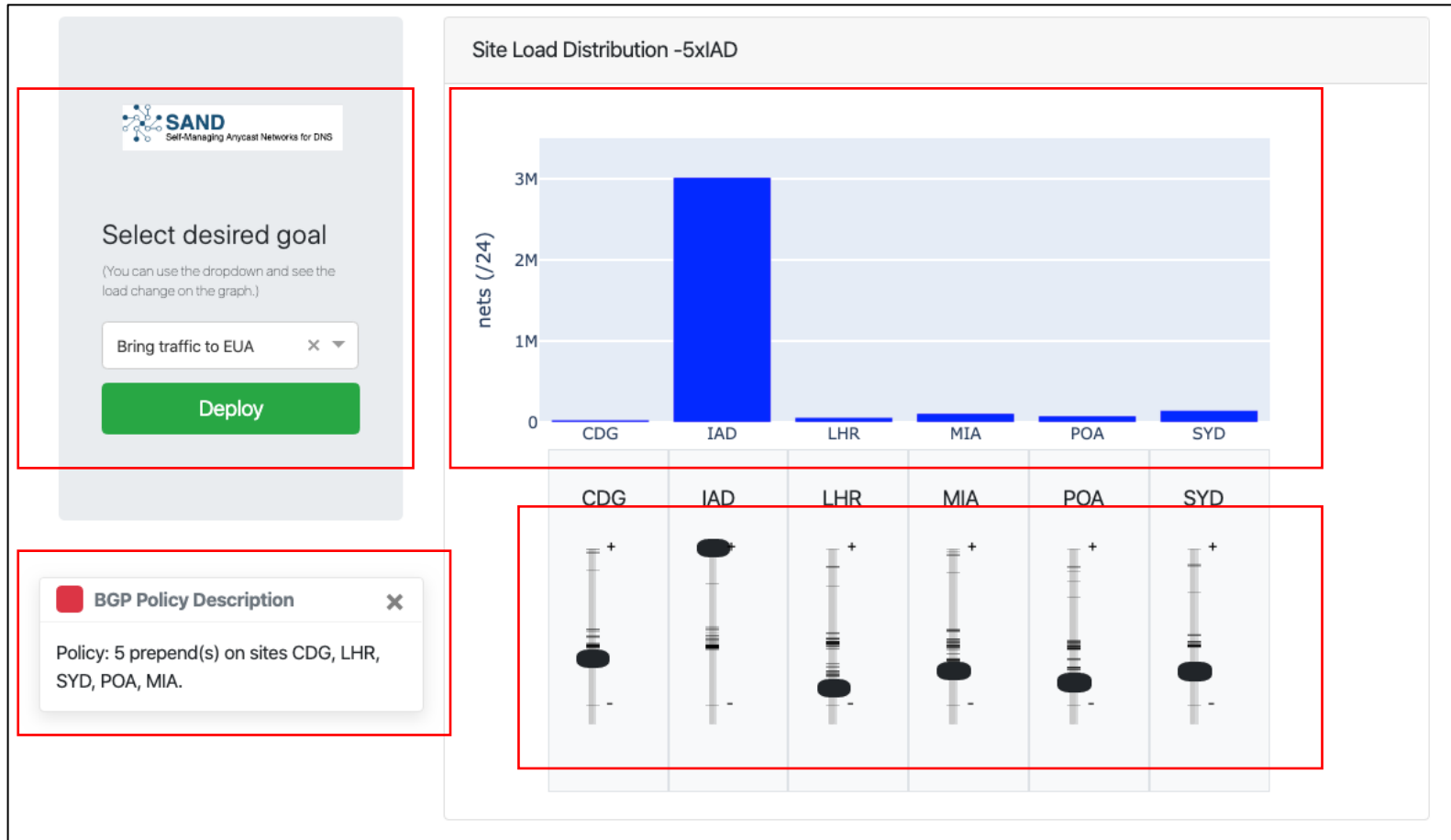
- [Multiples BGP policies](#)

Anycast-TE	CDG	IAD	LHR	MIA	POA	SYD
-2xLHR	2.04	15.17	64.58	8.89	8.05	1.26
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-5xIAD	0.77	88.11	1.68	3.09	2.19	4.16
LHRnoExp	16.78	21.82	0.00	17.75	24.23	19.42

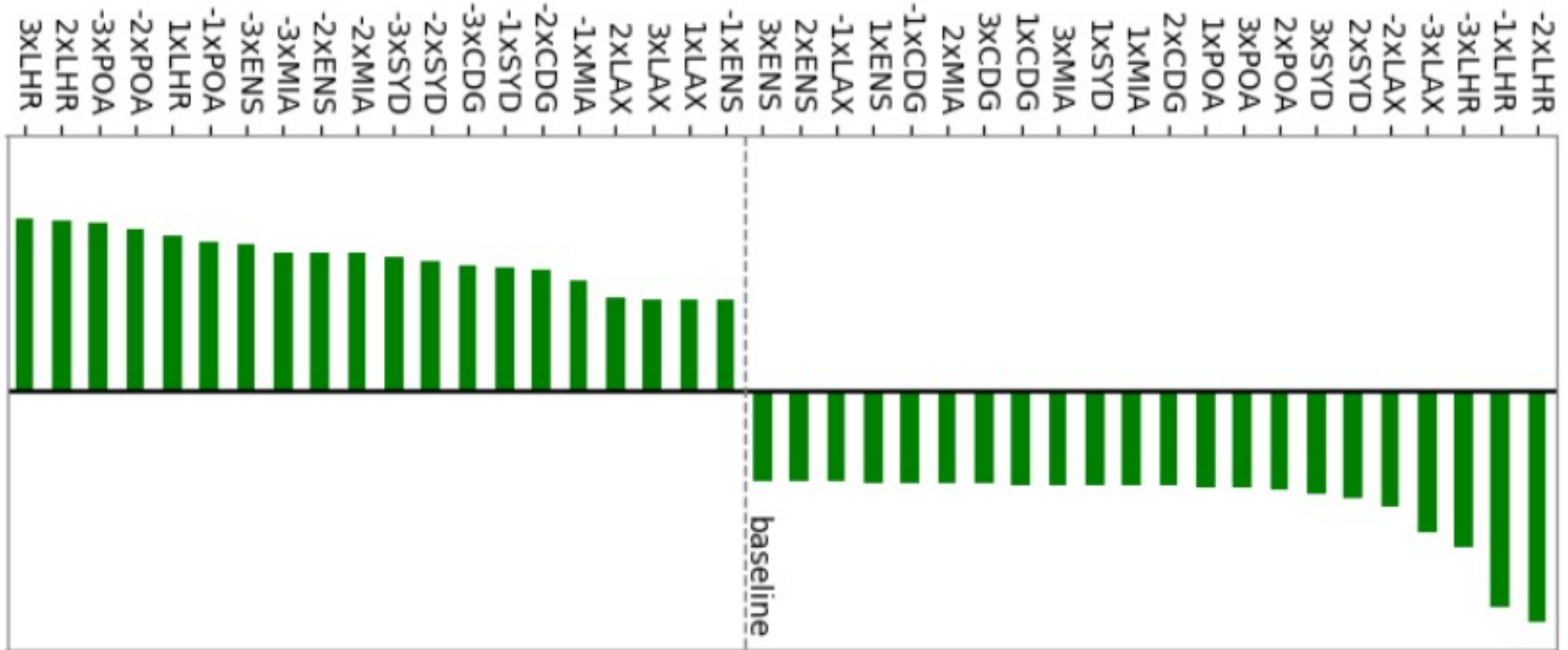
- [The BGP Anycast TUNER](#)



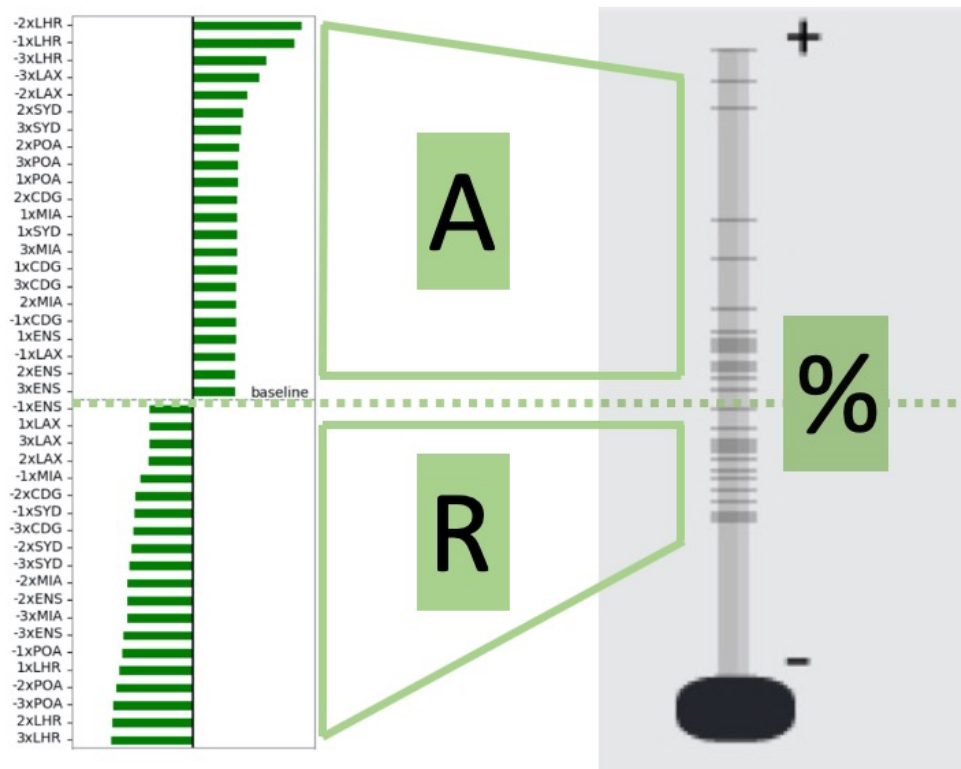
A interface do “BGP Tuner”



A interface do “BGP Tuner”



A interface do “BGP Tuner”

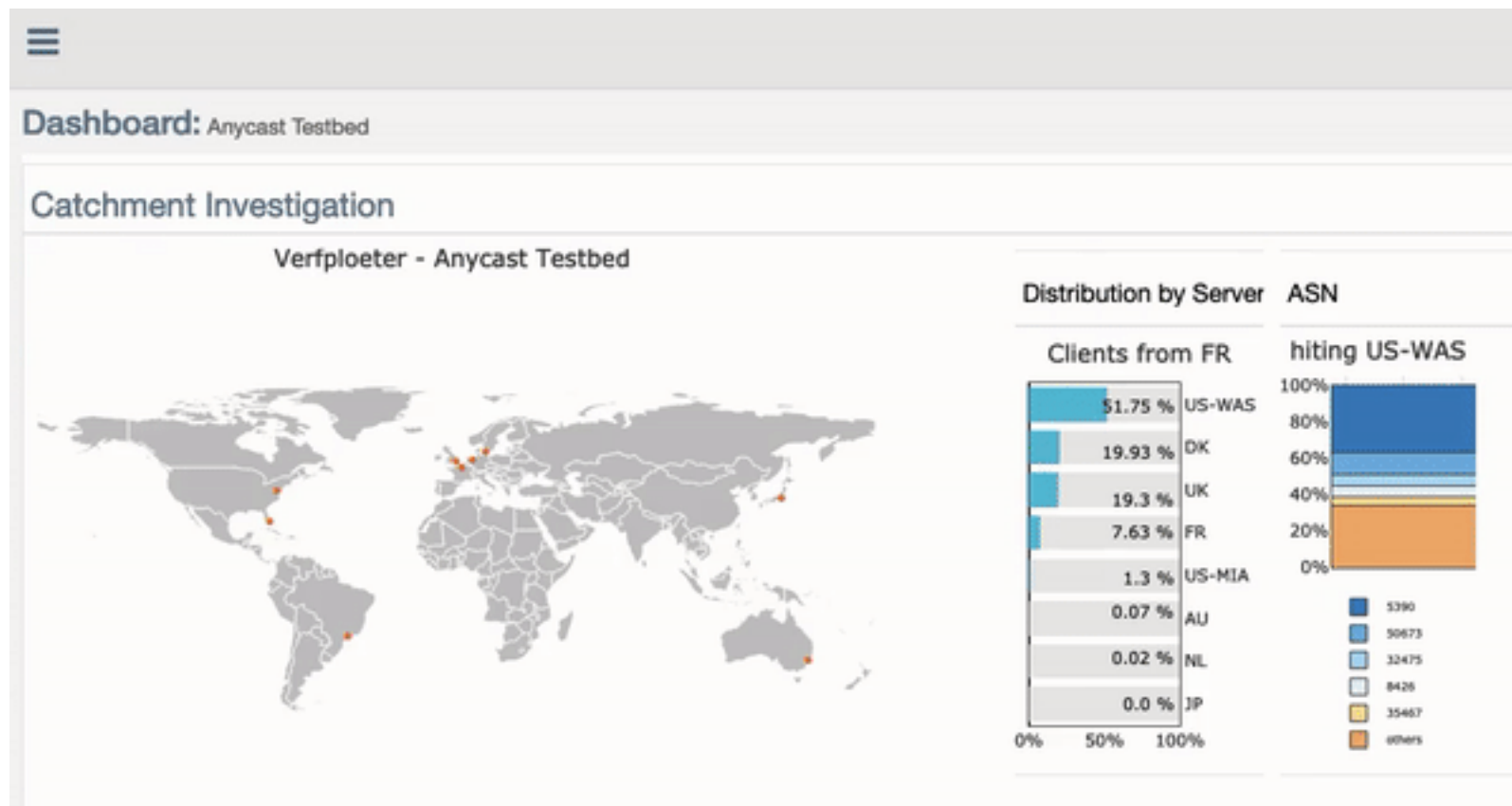


Developed Tool: The BGP Tunner interface for catchment management

SAND Project - The BGP Anycast Tuner



O Dashboard para inspeção de tráfego



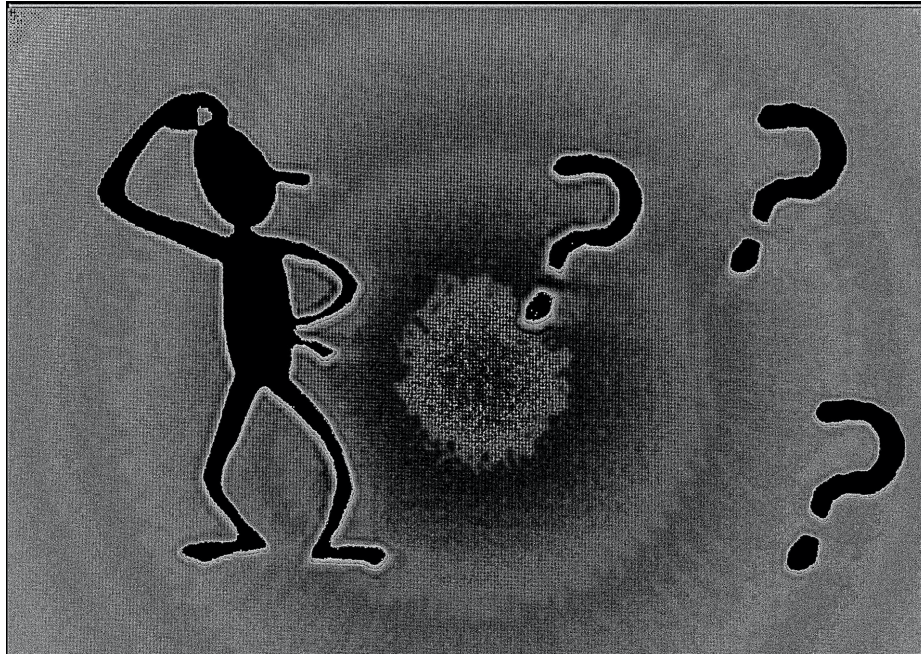
Conclusão

- Medição nas redes anycast Anycast é importante
 - Qualify of experience
 - Otimização de tráfego
- Manipulação de Catchment
 - AS-Prepend funciona!
 - Até 2
- Interface gráfica para auxiliar operadores (BGP Tuner) é importante para ajudar os operadores a gerenciar suas redes anycast.

Mais informações

[<http://dl.ifip.org/db/conf/cnsm/cnsm2020/1570662849.pdf>]

Bertholdo, Leandro M., Joao M. Ceron, Lisandro Z. Granville, Giovane CM Moura, Cristian Hesselman, and Roland van Rijswijk-Deij. "BGP Anycast Tuner: Intuitive Route Management for Anycast Services." (2020).



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BGP Anycast Tuner: Intuitive Route Management for Anycast Services