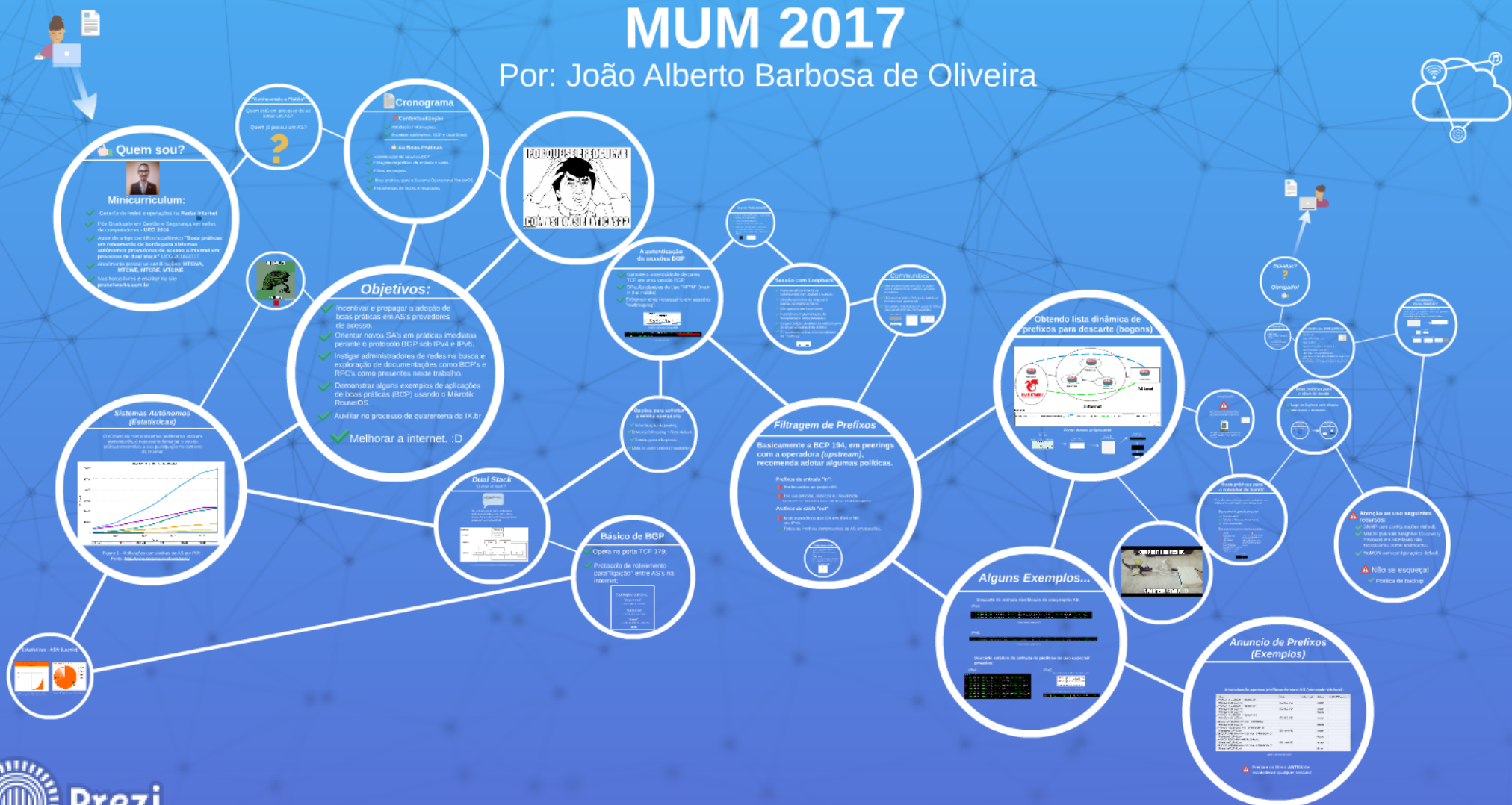


"BOAS PRÁTICAS EM ROTEAMENTO DE BORDA PARA NOVOS SISTEMAS AUTONOMOS PROVEDORES DE ACESSO À INTERNET"

MUM 2017

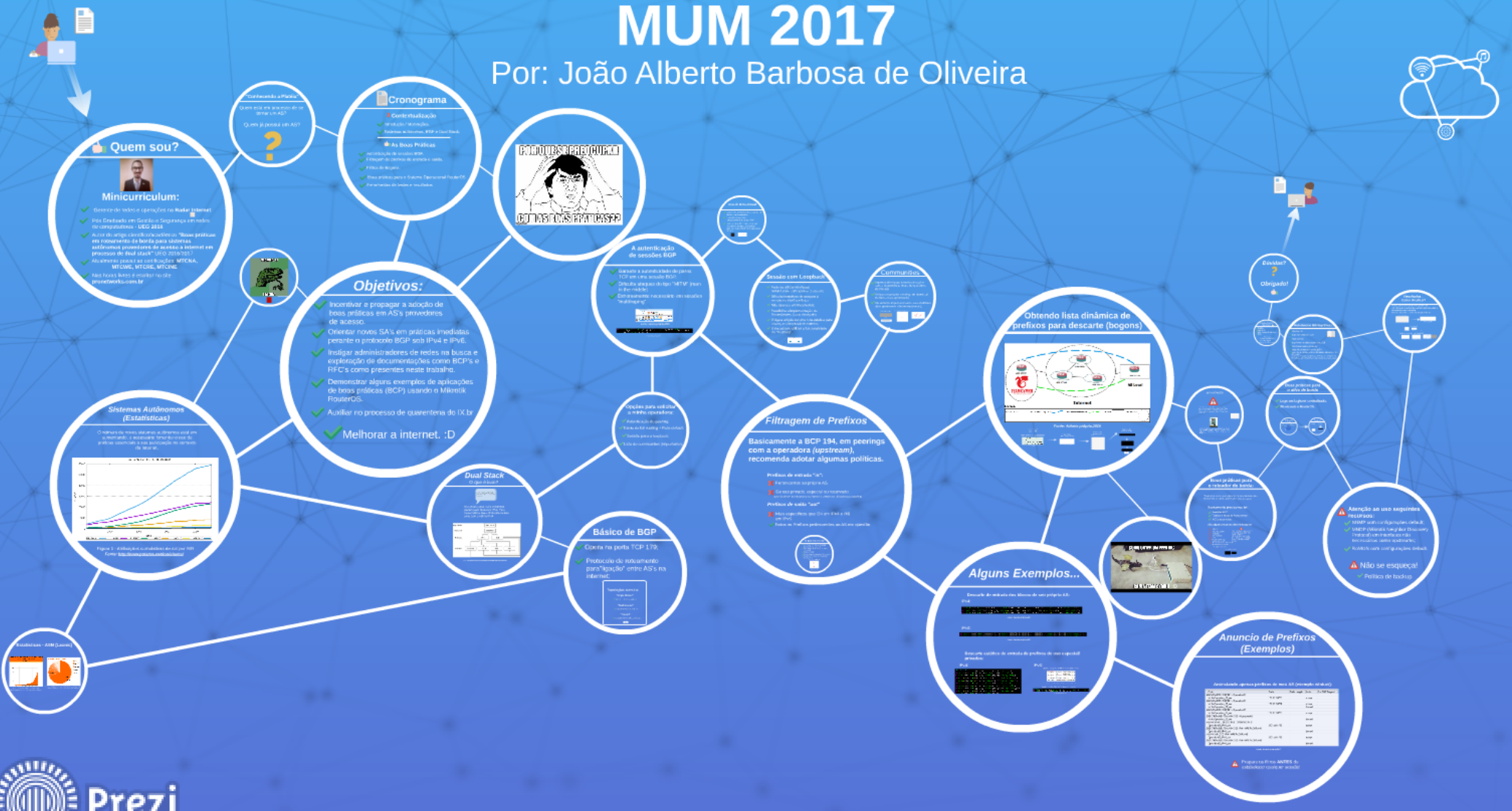
Por: João Alberto Barbosa de Oliveira



"BOAS PRÁTICAS EM ROTEAMENTO DE BORDA PARA NOVOS SISTEMAS AUTÔNOMOS PROVEDORES DE ACESSO À INTERNET"

MUM 2017

Por: João Alberto Barbosa de Oliveira






Quem sou?



Minicurrículo:

- ✓ Gerente de redes e operações na **Radar Internet** 
- ✓ Pós Graduado em Gestão e Segurança em redes de computadores - **UEG 2016**
- ✓ Autor do artigo científico/acadêmico "**Boas práticas em roteamento de borda para sistemas autônomos provedores de acesso a internet em processo de dual stack**" UEG 2016/2017
- ✓ Atualmente possuí as certificações: **MTCNA, MTCWE, MTCRE, MTCINE**
- ✓ Nas horas livres é escritor no site **pronetworks.com.br**

Mapa de Cobertura

— 26 cidades em Goiás —



RadAr
INTERNET BANDA LARGA

"Conhecendo a Platéia"

Quem está em processo de se tornar um AS?

Quem já possui um AS?





Cronograma

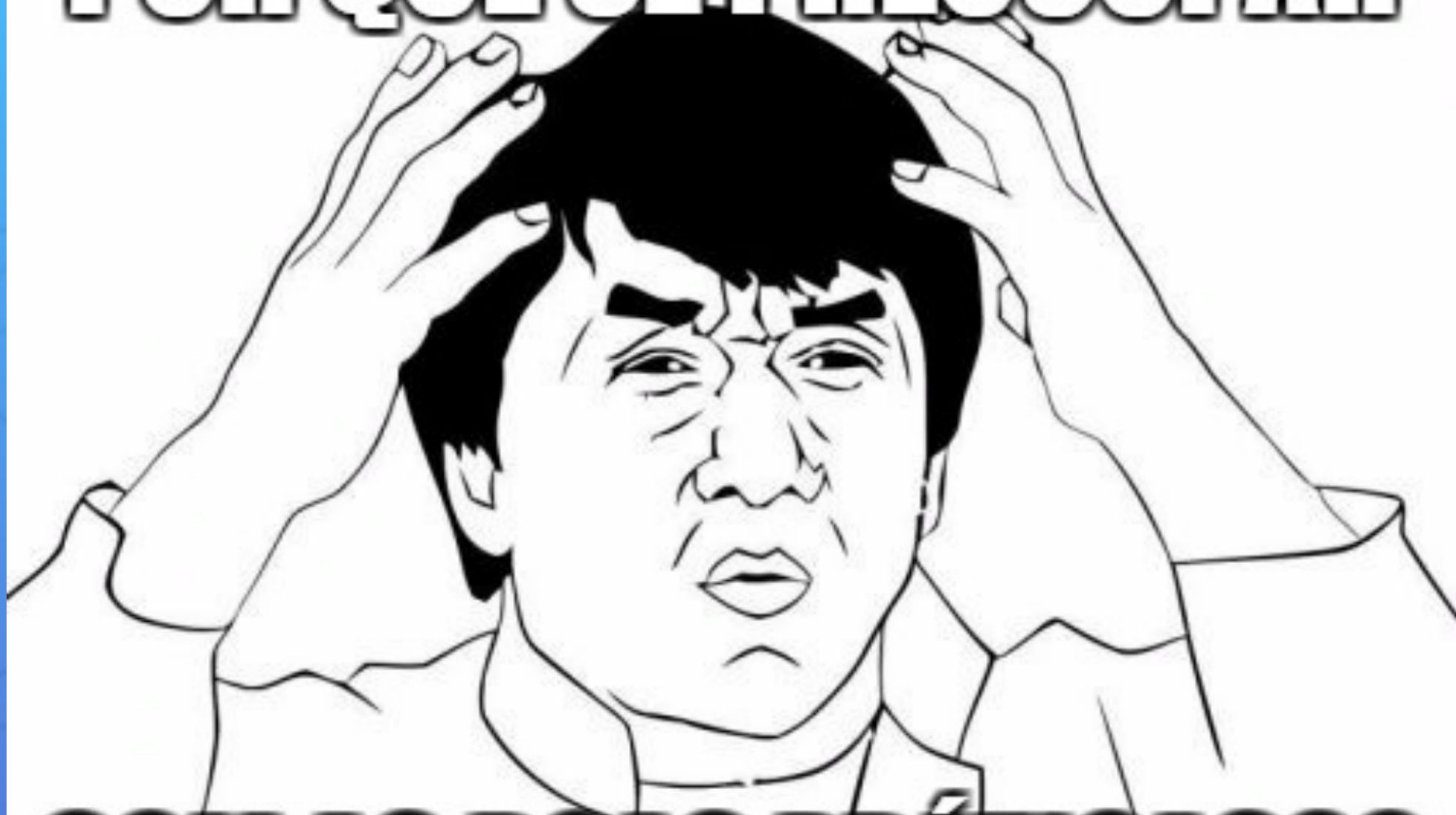
Contextualização

- ✓ Introdução / Motivações.
 - ✓ Sistemas autônomos, BGP e Dual Stack.
-

As Boas Práticas

- ✓ Autenticação de sessões BGP.
- ✓ Filtragem de prefixos de entrada e saída.
- ✓ Filtros de Bogons.
- ✓ Boas práticas para o Sistema Operacional RouterOS.
- ✓ Ferramentas de testes e resultados

POR QUE SE PREOCUPAR



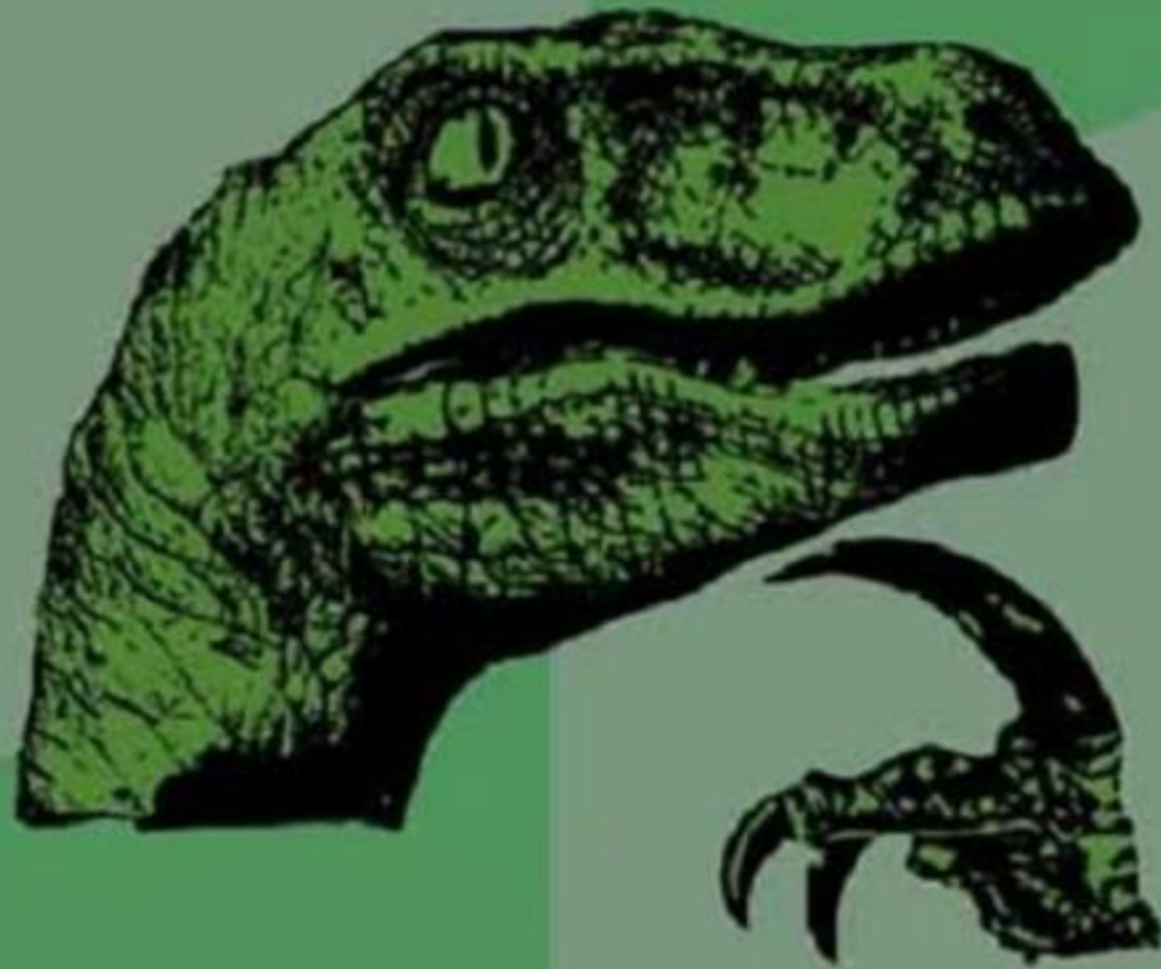
COM AS BOAS PRÁTICAS???



Objetivos:

- ✓ Incentivar e propagar a adoção de boas práticas em AS's provedores de acesso.
- ✓ Orientar novos SA's em práticas imediatas perante o protocolo BGP sob IPv4 e IPv6.
- ✓ Instigar administradores de redes na busca e exploração de documentações como BCP's e RFC's como presentes neste trabalho.
- ✓ Demonstrar alguns exemplos de aplicações de boas práticas (BCP) usando o Mikrotik RouterOS.
- ✓ Auxiliar no processo de quarentena do IX.br
- ✓ Melhorar a internet. :D

TIREI O MEU AS



E AGORA?

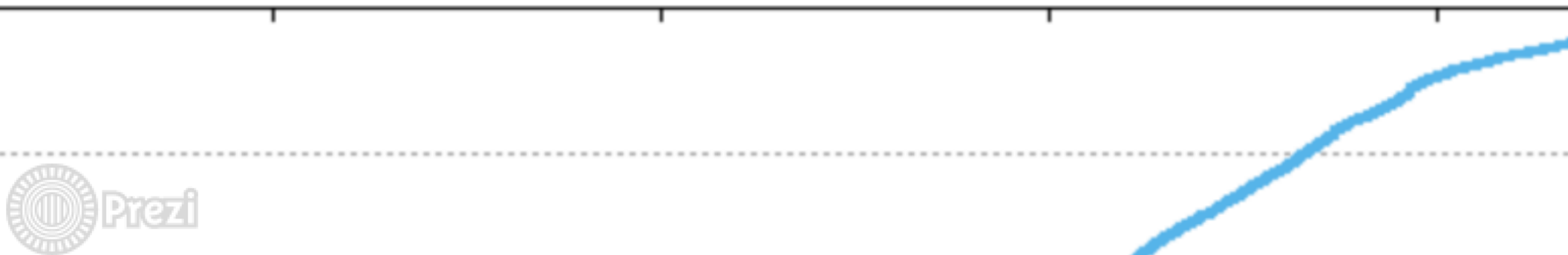


**KEEP
CALM
AND
SIGA AS
BOAS PRÁTICAS**

Sistemas Autônomos (Estatísticas)

O número de novos sistemas autônomos está em aumentando, é necessário fomentar o uso de práticas essenciais à sua participação no contexto da Internet.

Time Series of RIR AS Allocations



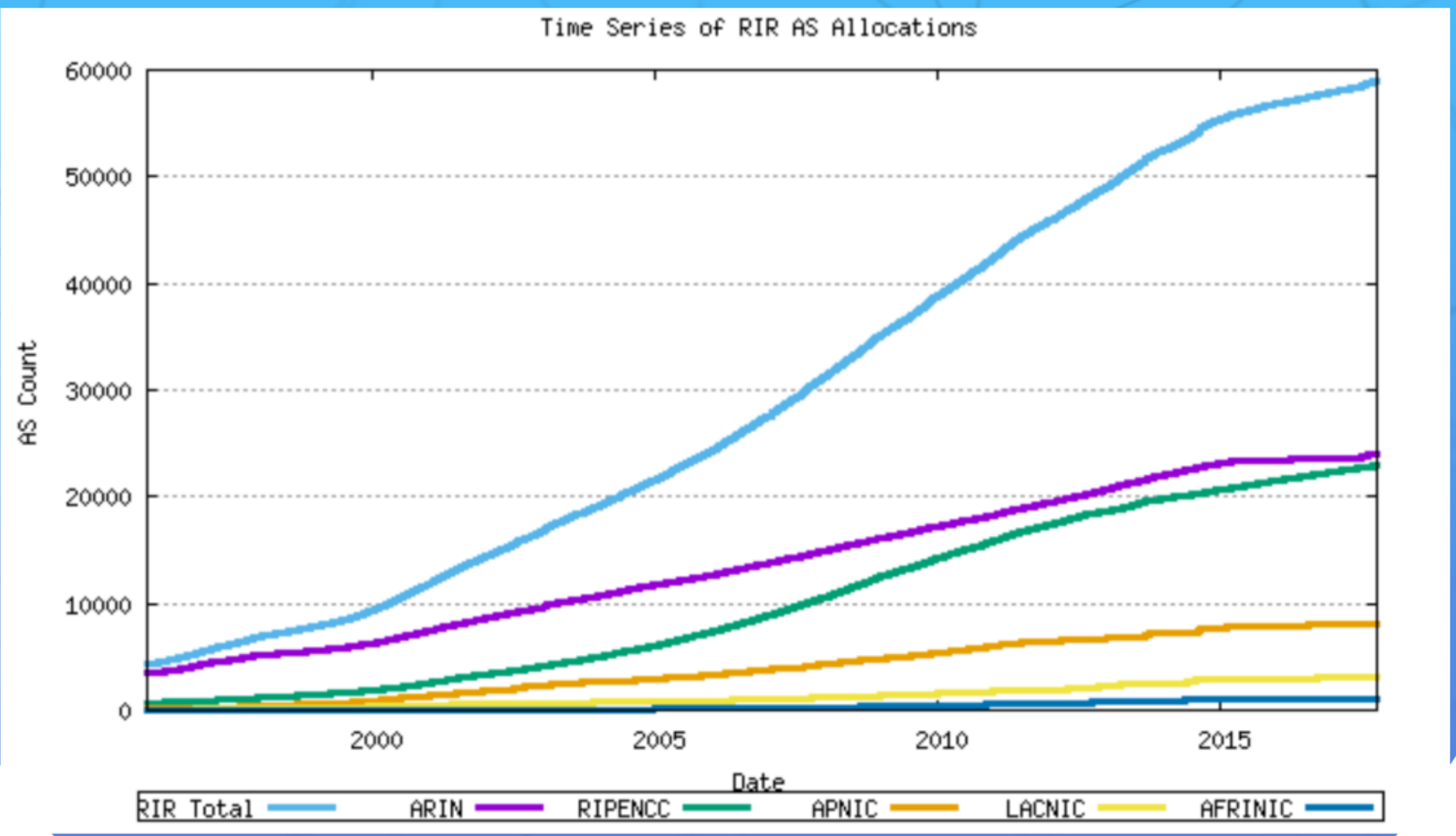


Figura 1 - Atribuições cumulativas de AS por RIR

Fonte: <http://www.potaroo.net/tools/asns/>

Estatísticas - ASN (Lacnic)

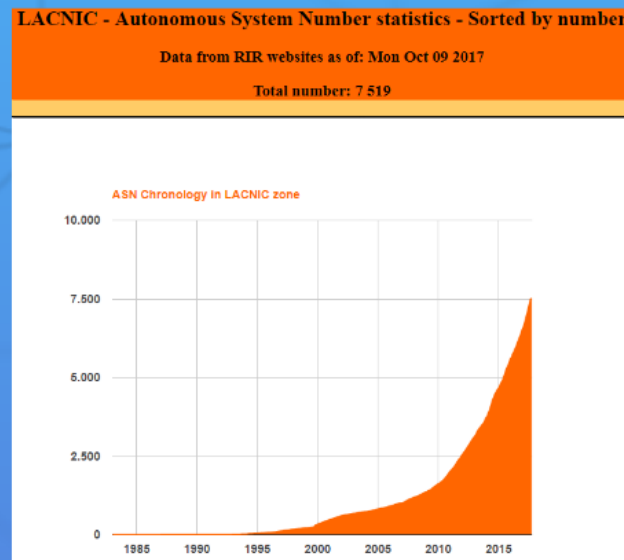


Figura 2 - Histórico de atribuições de ASN's - LACNIC

Fonte: https://www-public.tem-isp.eu/~maigror/RIR_Stats/RIR_Delegations/LACNIC/ASN-ByNb.html

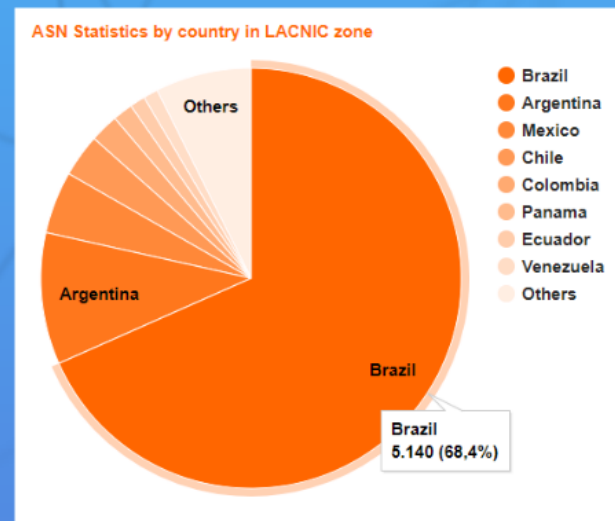


Figura 3 - Ranking de países com ASN's atribuidos (contexto LACNIC)

Fonte: https://www-public.tem-isp.eu/~maigror/RIR_Stats/RIR_Delegations/LACNIC/ASN-ByNb.html

LACNIC - Autonomous System Number statistics - Sorted by number

Data from RIR websites as of: Mon Oct 09 2017

Total number: 7 519

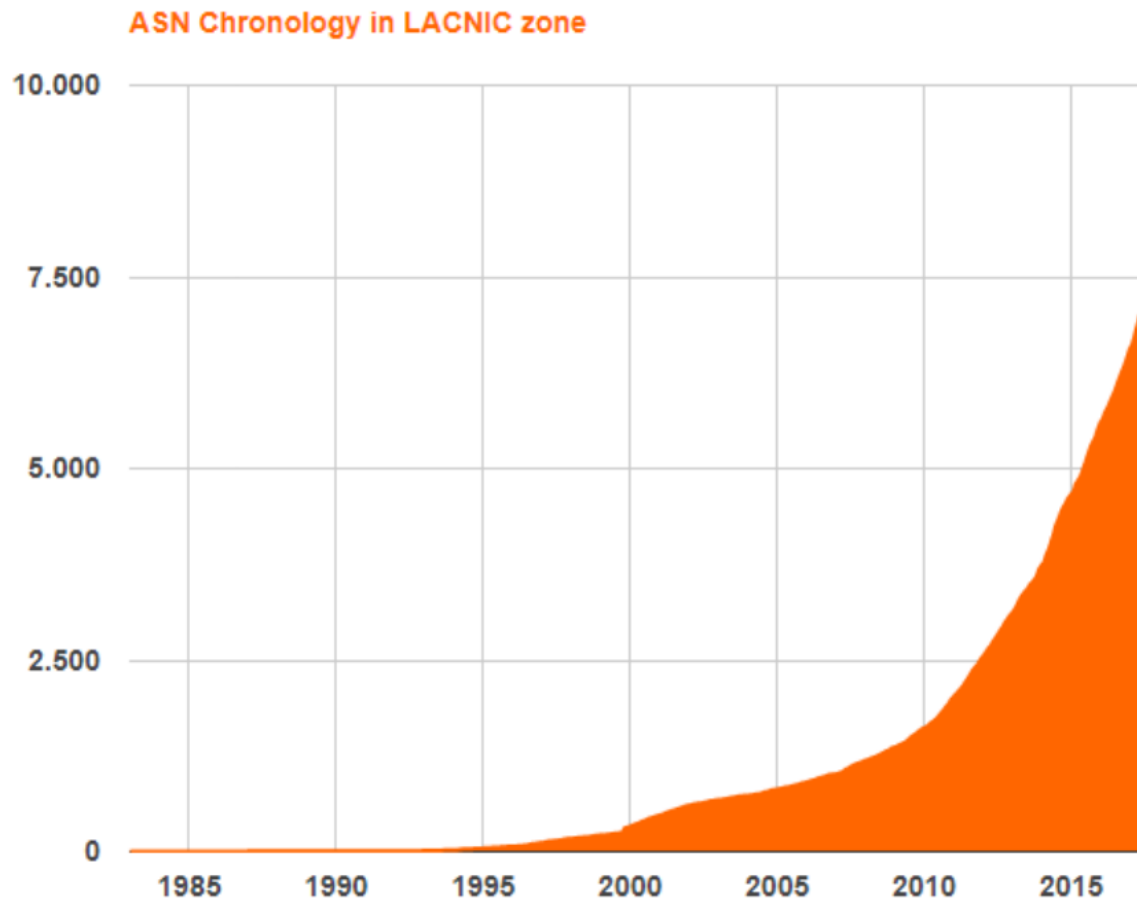


Figura 2 - Histórico de atribuições de ASN's - LACNIC

Fonte: https://www-public.tem-tsp.eu/~maigron/RIR_Stats/RIR_Delegations/LACNIC/ASN-ByNb.html

Figura 3

Fonte

ASN Statistics by country in LACNIC zone

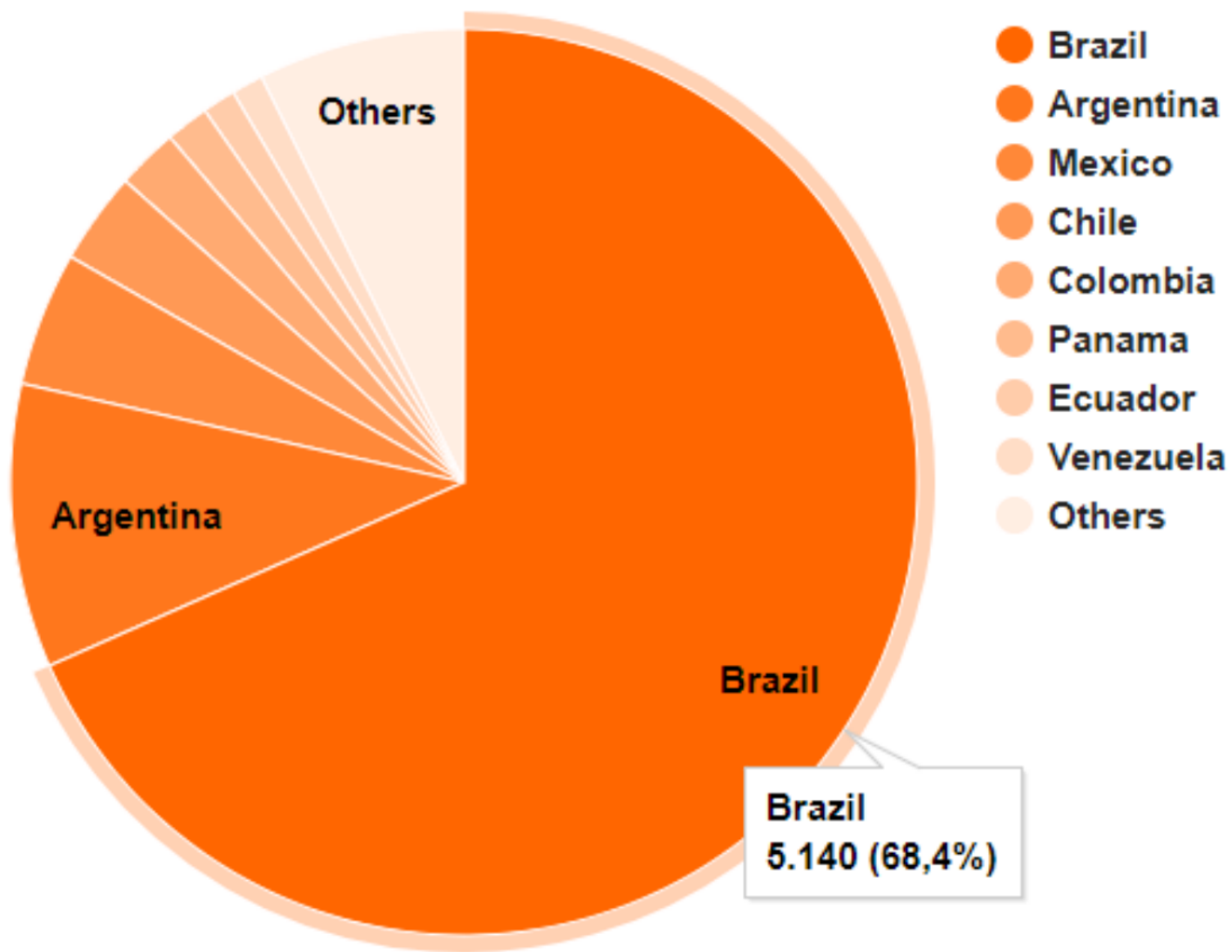


Figura 3 - Ranking de países com ASN's atribuidos (contexto LACNIC)

Fonte: https://www-public.tem-tsp.eu/~maigron/RIR_Stats/RIR_Delegations/LACNIC/ASN-ByNb.html



Básico de BGP

- ✓ Opera na porta TCP 179;
- ✓ Protocolo de roteamento para "ligação" entre AS's na internet;

Topologias comuns:

"Single Homed"

- ✓ Apenas 1 upstream (operadora)

"Multihomed"

- ✓ 2 ou mais upstreams (operadoras)

"Transit"

- ✓ AS que provem trânsito a outros AS's



Full Routing

Topologias comuns:

"Single Homed"

- ✓ Apenas 1 upstream (operadora)

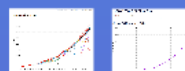
"Multihomed"

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"Transit"

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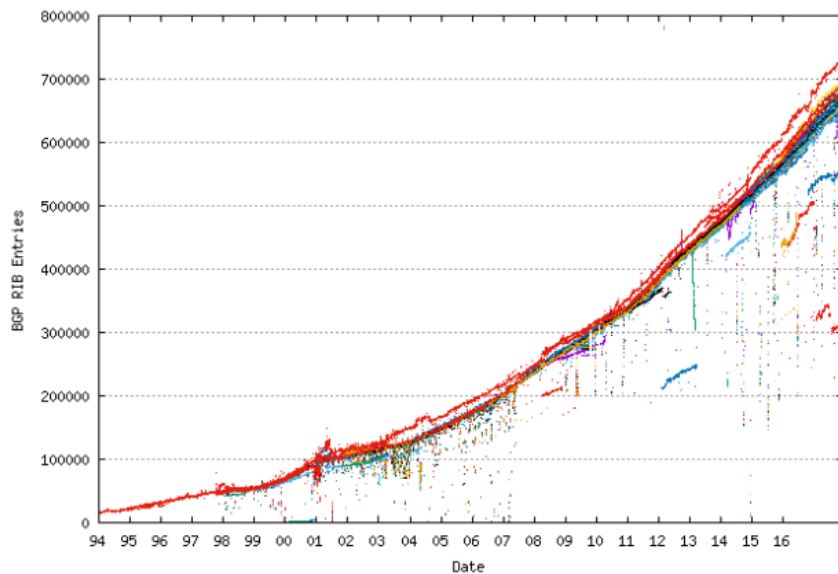
Full Routing



Full Routing

Report Date: 10 Nov 2017 10:43 UTC+1000

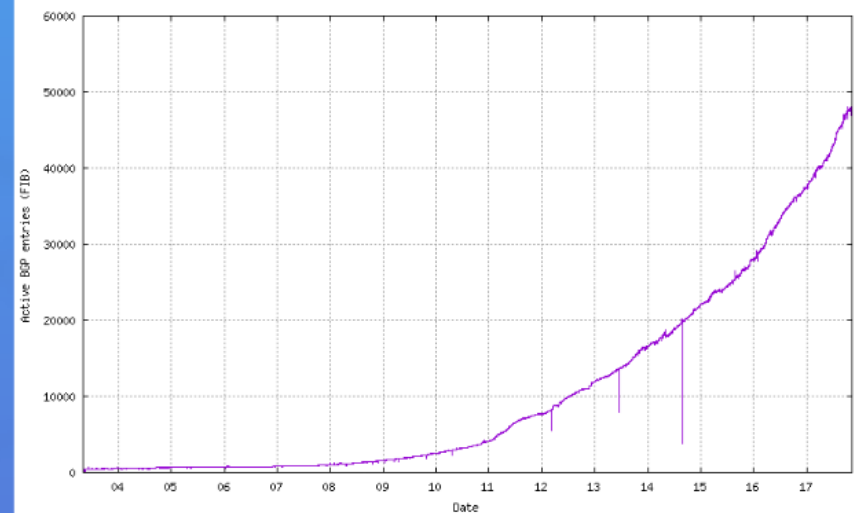
BGP Entries (FIB)



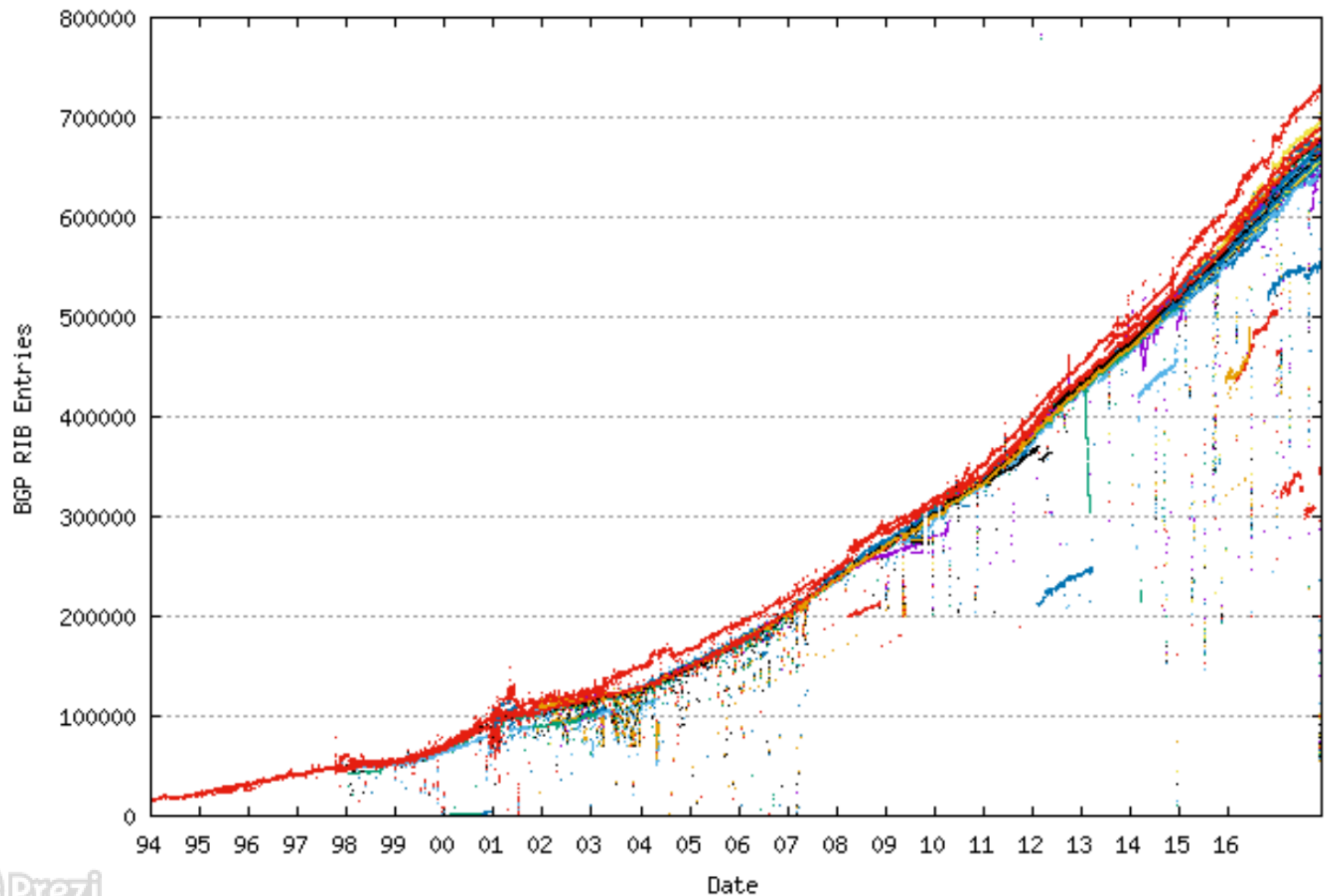
AS6447 IPv6 BGP Table Data

BGP data obtained from AS6447.
Report last updated at Fri Nov 10 06:00:00 2017 (Australian Eastern Time).

Active BGP entries (FIB)



BGP Entries (FIB)

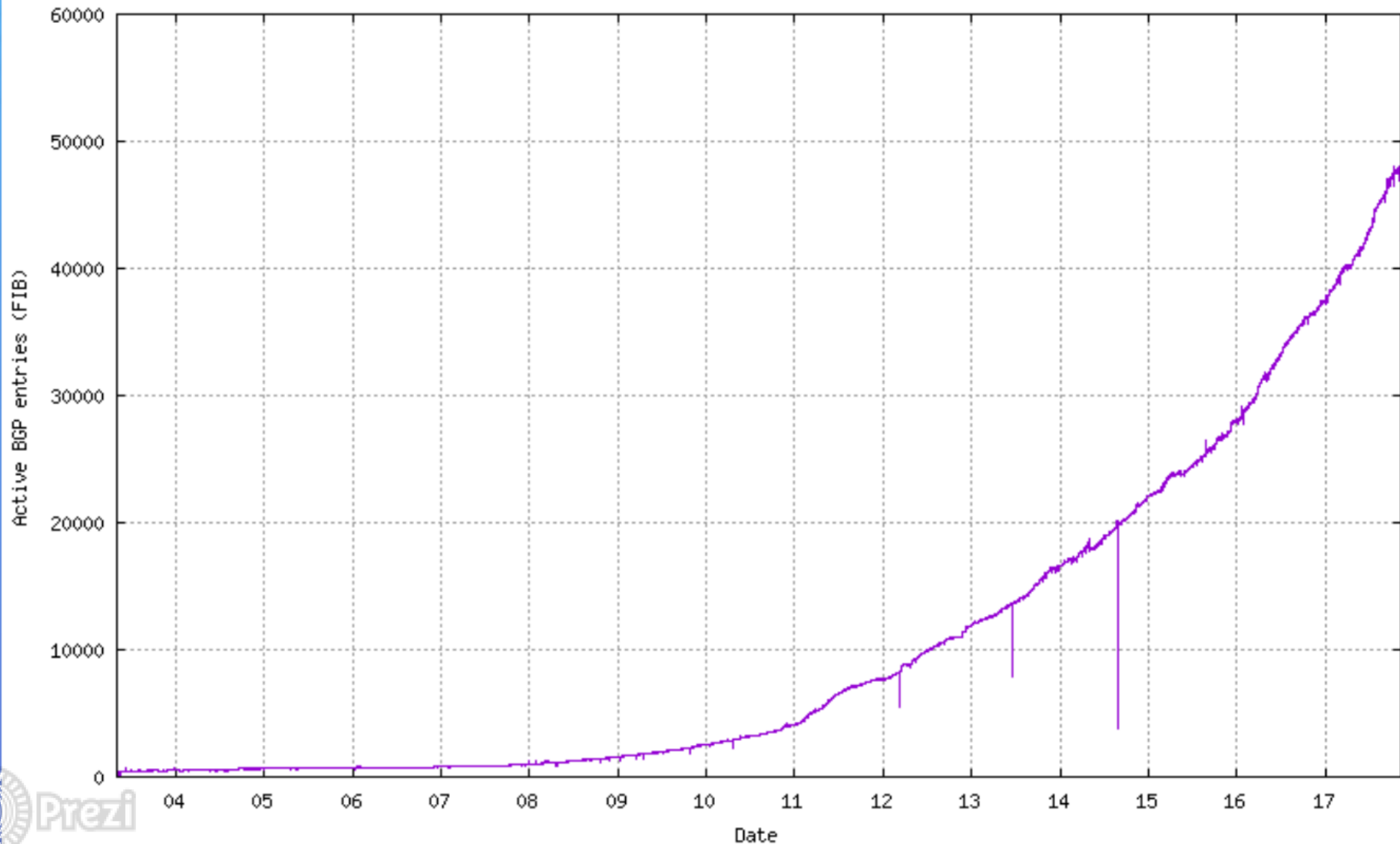


AS6447 IPv6 BGP Table Data

BGP data obtained from AS6447.

Report last updated at Fri Nov 10 06:00:00 2017 (Australian Eastern Time).

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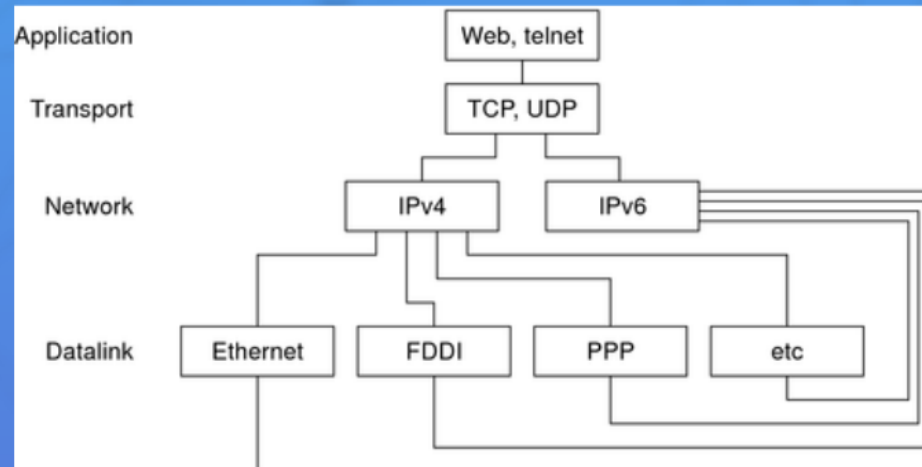


Dual Stack

O que é isso?

Recomenda-se que todos os hosts, antes de migrarem completamente para o protocolo, implementem o protocolo de protocolo. Em outras palavras, uma máquina deve suportar o IPv4 e o IPv6 simultaneamente até que haja a Internet para o IPv6.
Felixson (2008), p. 606.

No cenário atual, SA's existentes podem pedir bloco em IPv6. Para novos SA's o bloco IPv6 está incluso junto com o ASN e IPv4.



Fonte: https://docs.oracle.com/cd/E23823_01/html/816-4554/figures/dual.png

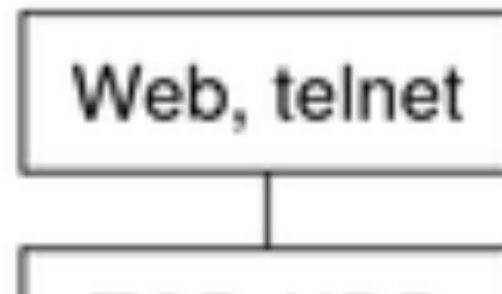
“Recomenda-se que todos os hosts, antes de migrarem completamente para a versão 6, implementem a pilha dupla de protocolos. Em outras palavras, uma estação deve rodar o IPv4 e o IPv6 simultaneamente até que toda a Internet passe a usar o IPv6”.

Furouzan (2008, p.604).

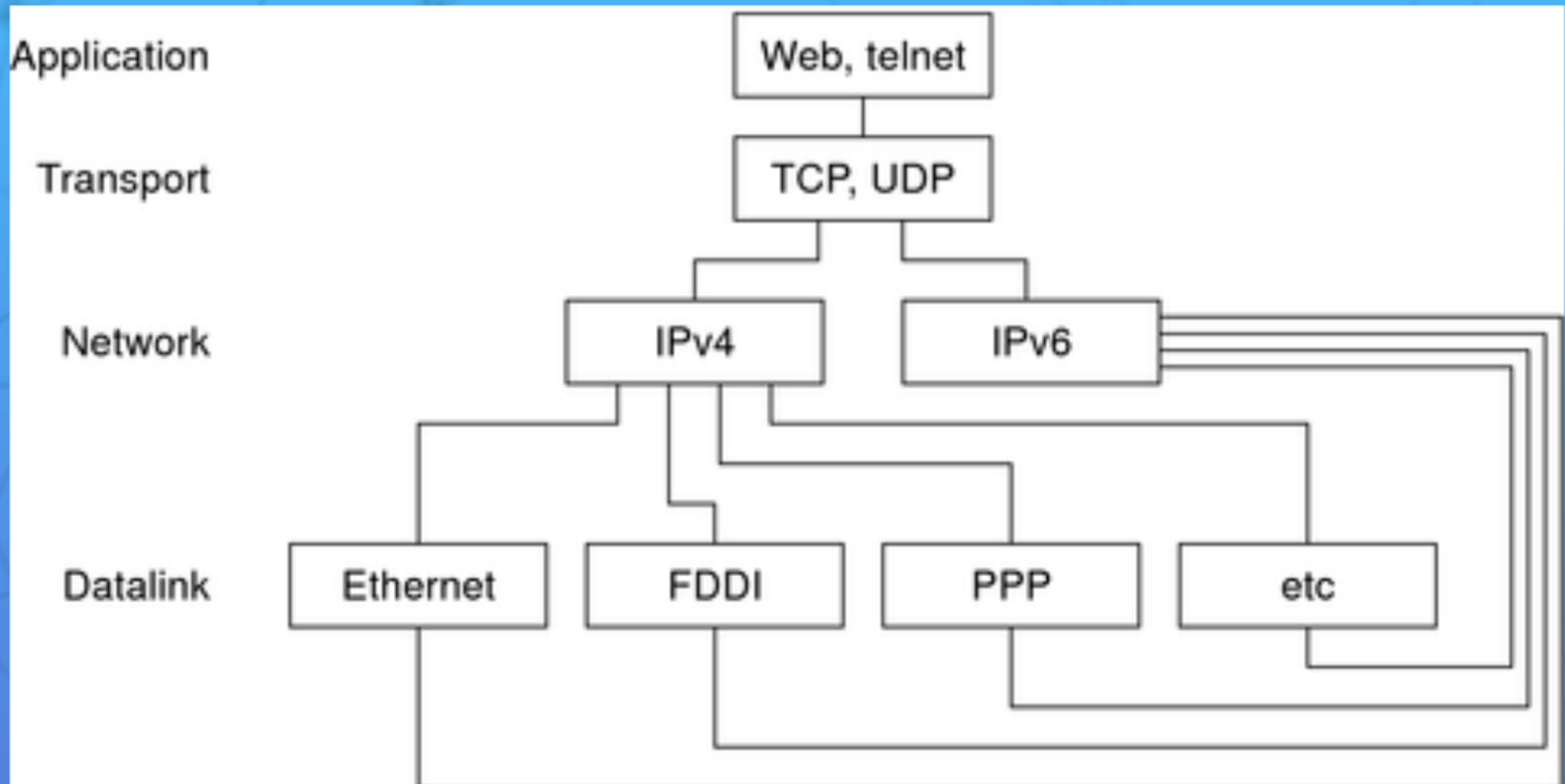
plano, uma solução deve rodar o IPv4 e IPv6 simultaneamente até que toda a Internet passe a usar o IPv6".

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junto com o ASN e IPv4.



Fonte: https://docs.oracle.com/cd/E23823_01/html/816-4554/figures/dual.png

Opções para solicitar a minha operadora:

- ✓ Autenticação do peering;
- ✓ Envio de full routing + Rota default;
- ✓ Sessão para a loopback;
- ✓ Lista de communities (importante);

A autenticação de sessões BGP

- ✓ Garante a autenticidade de pares TCP em uma sessão BGP.
- ✓ Dificulta ataques do tipo "MITM" (man in the middle)
- ✓ Extremamente necessário em sessões "multihopping".

Offset	Hex	ASCII
0000	00 2b 52 b9 4d 00 00 2b 52 c0 30 00 00 00 45 c0	..+R.M..+ R.0...E.
0010	00 3c 55 d4 40 00 40 06 60 d4 c0 a8 01 01 c0 a8	..C.U.@.#.
0020	01 02 00 b3 ab 73 1a f8 f1 fc 07 f3 8c 1e a0 10	...S.
0030	01 c9 3f 04 00 00 01 01 13 32 cd 66 49 b6 e8 0f	..?..... fi...
0040	f2 d9 5c a3 04 8c 11 4d 45 db	..V...M.E.

Fonte: Aatoria própria,2016

```
add address-families=ipv6 in-filter=Operadora01_IPv6 in name=Operadora01_IPv6 out-filter=  
Operadora02_IPv6_out remote-address=2001:db8::f0ca remote-as=20329 tcp-md5-key=Mikrotik-NUM02017 \  
ttl=default update-source=sfp-sfpplus3
```

Fonte: Aatoria própria,2017

oping

```
▼ TCP MD5 signature
  ▼ Type: 19
    0... .... = Copy on fragmentation: No
    .00. .... = Class: Control (0)
    ...1 0011 = Number: Address Extension (19)
-----
0000  00 2b 52 b9 4d 00 00 2b 52 c0 30 00 08 00 45 c0  .+R.M..+ R.0...E.
0010  00 3c 55 d4 40 00 40 06 60 d4 c0 a8 01 01 c0 a8  .<U.@.@. `.....
0020  01 02 00 b3 ab 73 1a f8 f1 fc 97 f3 8c 1e a0 10  .....S..
0030  01 c9 3f 04 00 00 01 01 13 12 cd 66 49 b6 e8 0f  ..?... ..fI...
0040  f2 d9 5c a3 04 8c 11 4d 45 db  ..\....M E.
```

Fonte: Autoria própria, 2016

multiplying .

▼ TCP MD5 signature

▼ Type: 19

- 0... = Copy on fragmentation: No
- .00. = Class: Control (0)
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0000	00 2b 52 b9 4d 00 00 2b	52 c0 30 00 08 00 45 c0	.+R.M..+ R.0...E.
0010	00 3c 55 d4 40 00 40 06	60 d4 c0 a8 01 01 c0 a8	.<U.@.@. `.....
0020	01 02 00 b3 ab 73 1a f8	f1 fc 97 f3 8c 1e a0 10S..
0030	01 c9 3f 04 00 00 01 01	13 12 cd 66 49 b6 e8 0f	..?..... ..fI...
0040	f2 d9 5c a3 04 8c 11 4d	45 db	..\.M E.

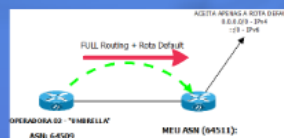
Fonte: Aatoria própria,2016

```
add address-families=ipv6 in-filter=Operadora01_IPv6_in name=Operadora01_IPv6 out-filter=\
Operadora02_IPv6_out remote-address=2001:db8::f0ca remote-as=28329 tcp-md5-key=MikrOtik-MUM@2017 \
ttl=default update-source=sfp-sfpplus3
```

Fonte: Aatoria própria,2017

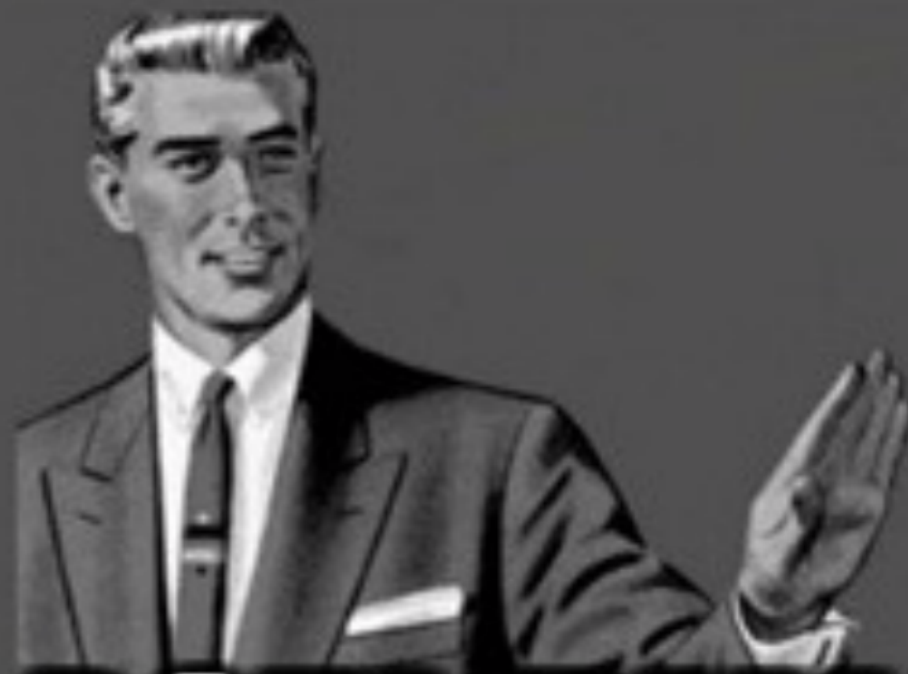
Uso de Rota default

- ✓ A BCP 194 também indica o uso da rota default, **se necessário**;
- ✓ Vantajoso para poupar processamento da tabela "full";
- ✓ Pode-se descartar tudo e criar uma rota default estatica, ou receber apenas a rota default (se a operadora enviar).



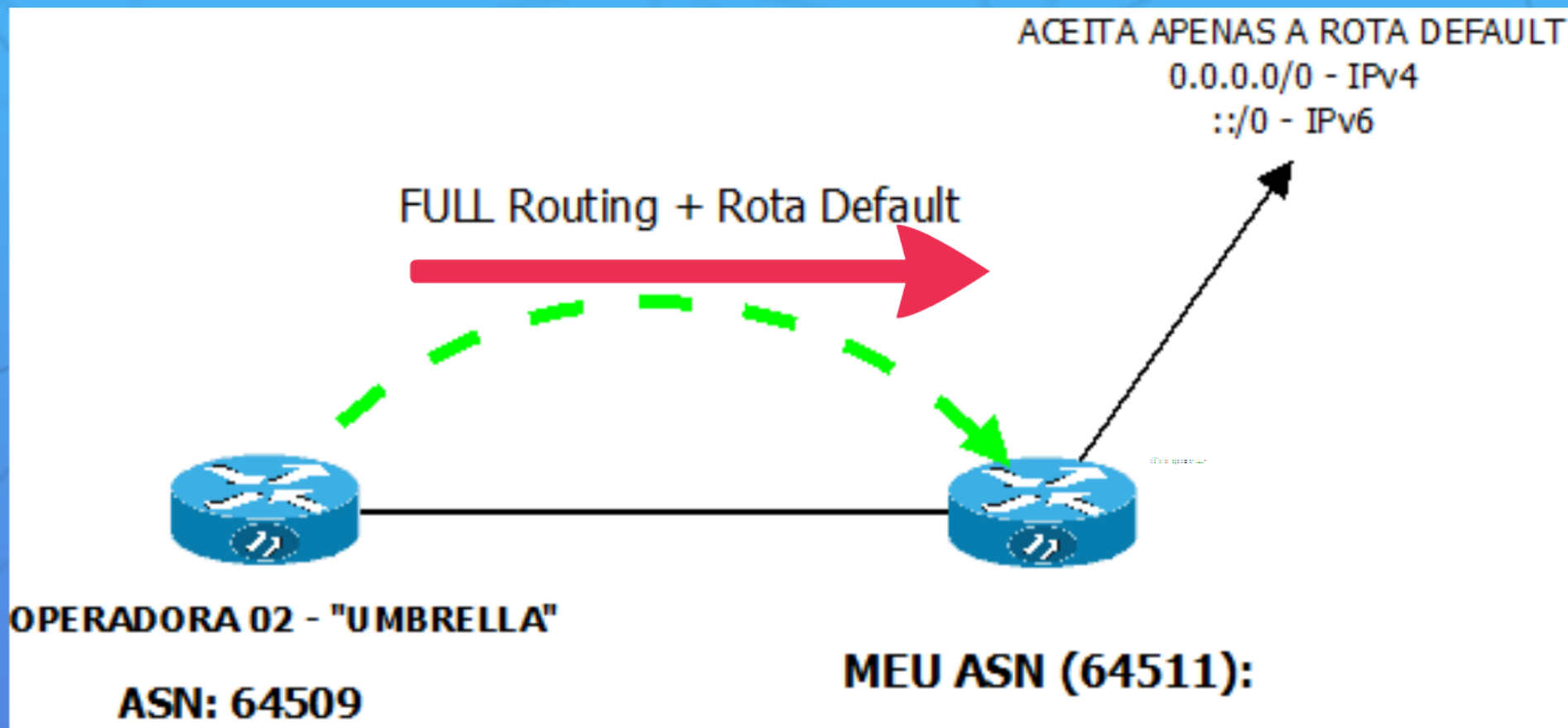
Fonte: Autoria propria, 2017

APENAS



A ROTA DEFAULT

imgflip.com



Fonte: Autoria propria, 2017

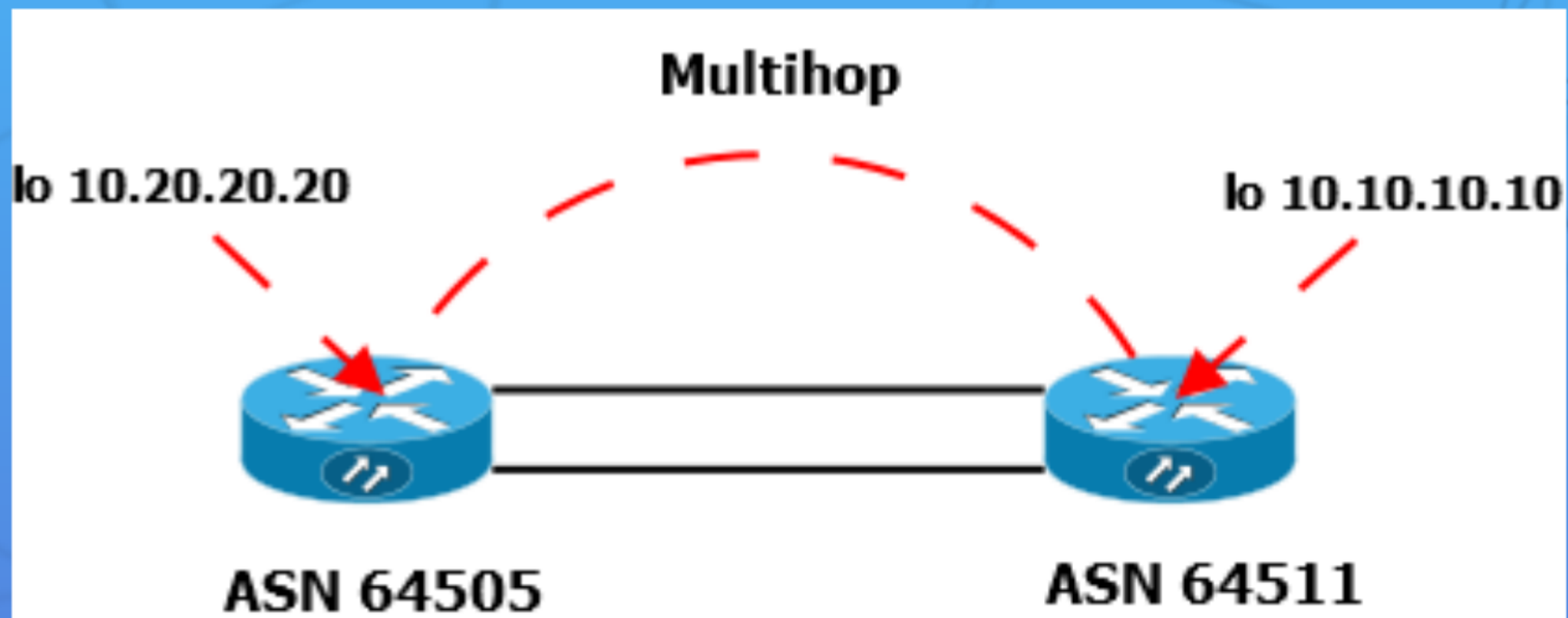
```
-  
/routing filter  
add action=discard chain=Operadoral_in prefix=!0.0.0.0/0  
add action=discard chain=Operadoral_IPv6_in prefix=!::/0  
- - - - -
```


Sessão com Loopback

- ✓ Pode-se utilizar interfaces redundantes com apenas 1 sessão;
- ✓ Dificulta tentativas de ataques à sessão na interface física ;
- ✓ Não aparece em traceroutes;
- ✓ Possibilita a implementação de RouteServers (caso desejado).
- ✓ Exige a adição de uma rota estática para alcançar a loopback do vizinho;
- ✓ É necessário utilizar a funcionalidade de "multihop".



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Fonte: Aatoria própria, 2017

Communities

- ✓ Imprescindível para tomadas de ações sem a dependência direta da operadora de trânsito;
- ✓ Util para manipular o tráfego de download de forma mais aprimorada;
- ✓ De extrema importancia em casos de DDoS (que geralmente são internacionais);

lista (alguns exemplos)

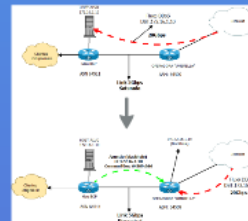
AS	Nome	País
AS161	Dynamic Internet	US
AS174	AS174	US
AS201	AS201	US
AS202	AS202	US
AS203	AS203	US
AS204	AS204	US
AS205	AS205	US
AS206	AS206	US
AS207	AS207	US
AS208	AS208	US
AS209	AS209	US
AS210	AS210	US
AS211	AS211	US
AS212	AS212	US
AS213	AS213	US
AS214	AS214	US
AS215	AS215	US
AS216	AS216	US
AS217	AS217	US
AS218	AS218	US
AS219	AS219	US
AS220	AS220	US
AS221	AS221	US
AS222	AS222	US
AS223	AS223	US
AS224	AS224	US
AS225	AS225	US
AS226	AS226	US
AS227	AS227	US
AS228	AS228	US
AS229	AS229	US
AS230	AS230	US
AS231	AS231	US
AS232	AS232	US
AS233	AS233	US
AS234	AS234	US
AS235	AS235	US
AS236	AS236	US
AS237	AS237	US
AS238	AS238	US
AS239	AS239	US
AS240	AS240	US
AS241	AS241	US
AS242	AS242	US
AS243	AS243	US
AS244	AS244	US
AS245	AS245	US
AS246	AS246	US
AS247	AS247	US
AS248	AS248	US
AS249	AS249	US
AS250	AS250	US
AS251	AS251	US
AS252	AS252	US
AS253	AS253	US
AS254	AS254	US
AS255	AS255	US

Level3

28329/666	BLACKHOLE
-----------	-----------

G8

Exemplo básico de uso em ataque DDoS



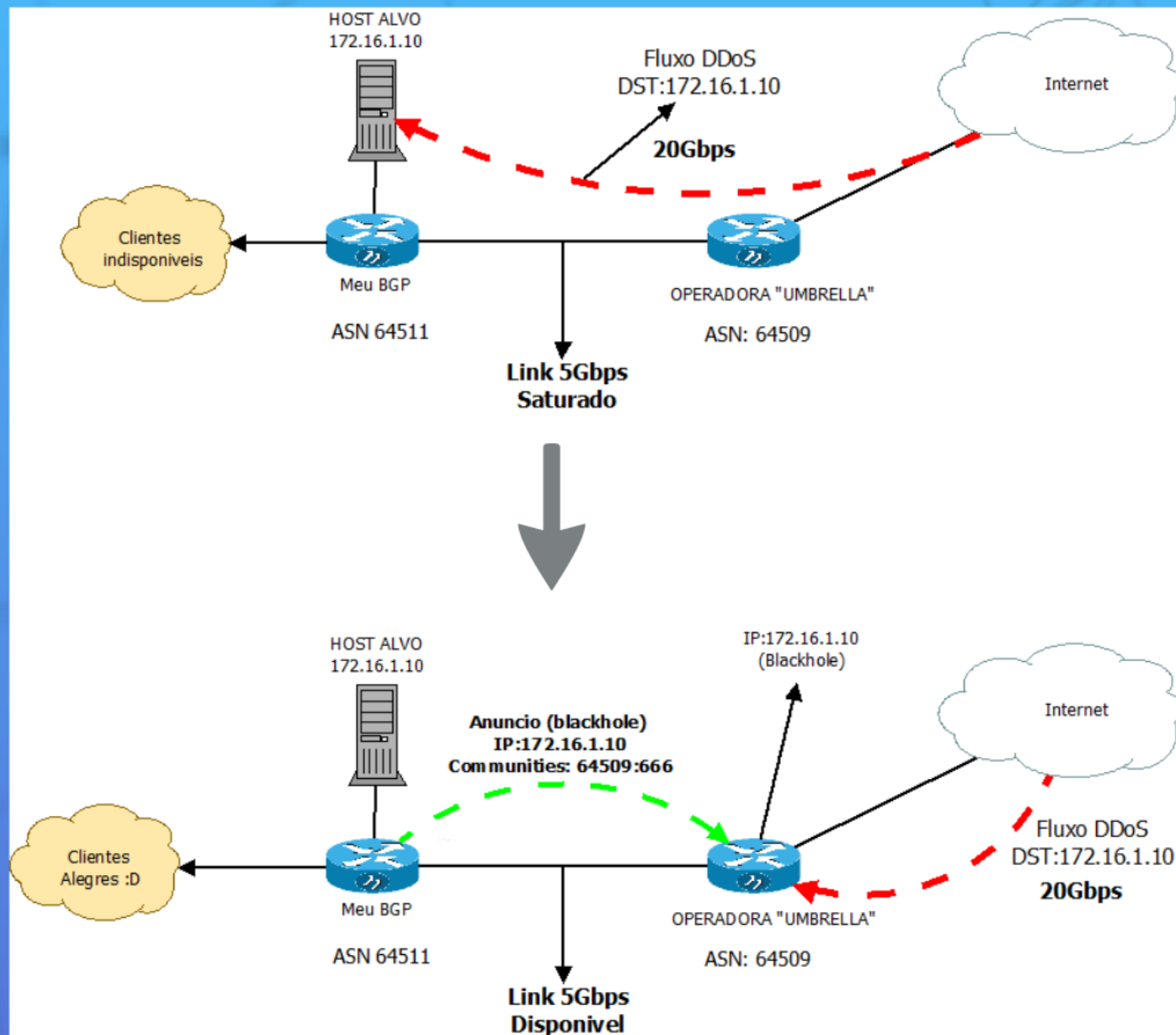
lista (alguns exemplos)

Controlling Route Propagation		
Community	Action	Region Enabled
3549:600	Deny inter-continental export of tagged prefix [iBGP].	EU/SA
3549:601	Deny inter-cluster export of tagged prefix [iBGP].	SA
3549:602	Deny inter-country export of tagged prefix [iBGP].	SA
3549:603	Deny inter-metro export of tagged prefix [iBGP].	TBD
3549:604	Deny inter-Hub export of tagged prefix [iBGP].	TBD
3549:605	Deny inter-router export of tagged prefix [iBGP].	TBD
3549:666	Deny inter-as export of tagged prefix (deny to peers, send to customers) [eBGP].	NA/SA/EU/AS
3549:695	Deny in country peers but export globally	SA

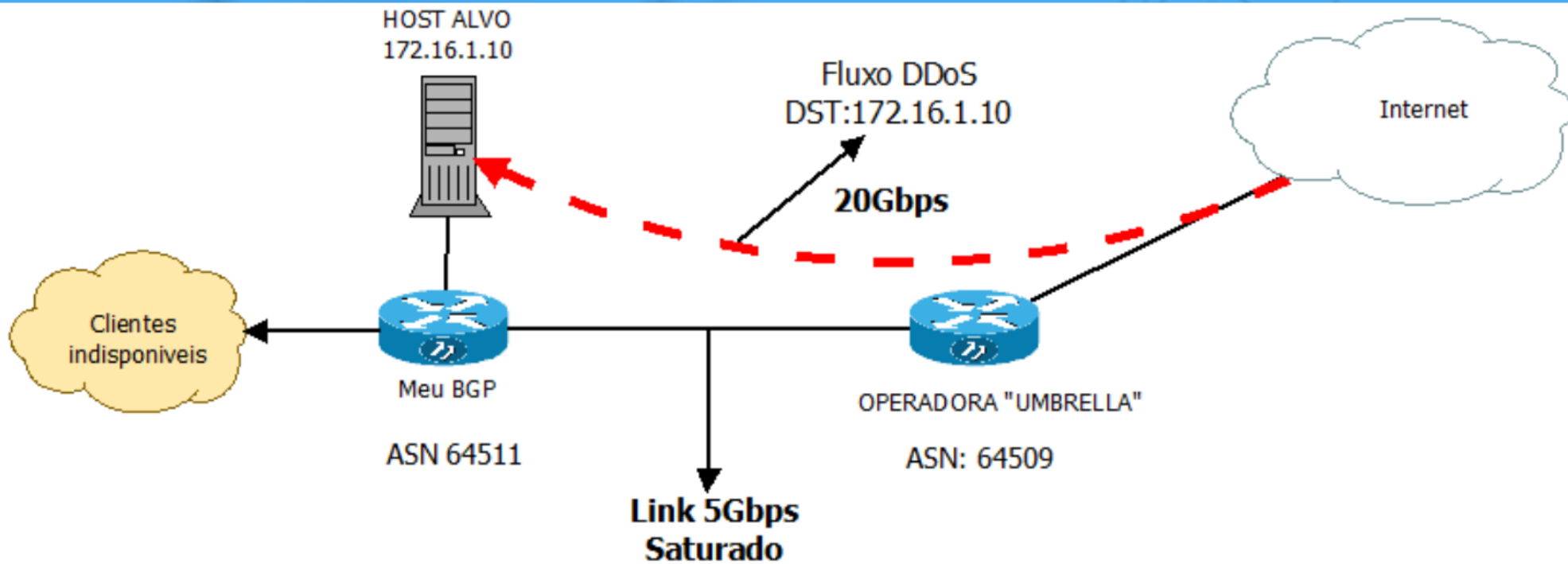
Level3

28329:666 BLACKHOLE

Exemplo básico de uso em ataque DDoS



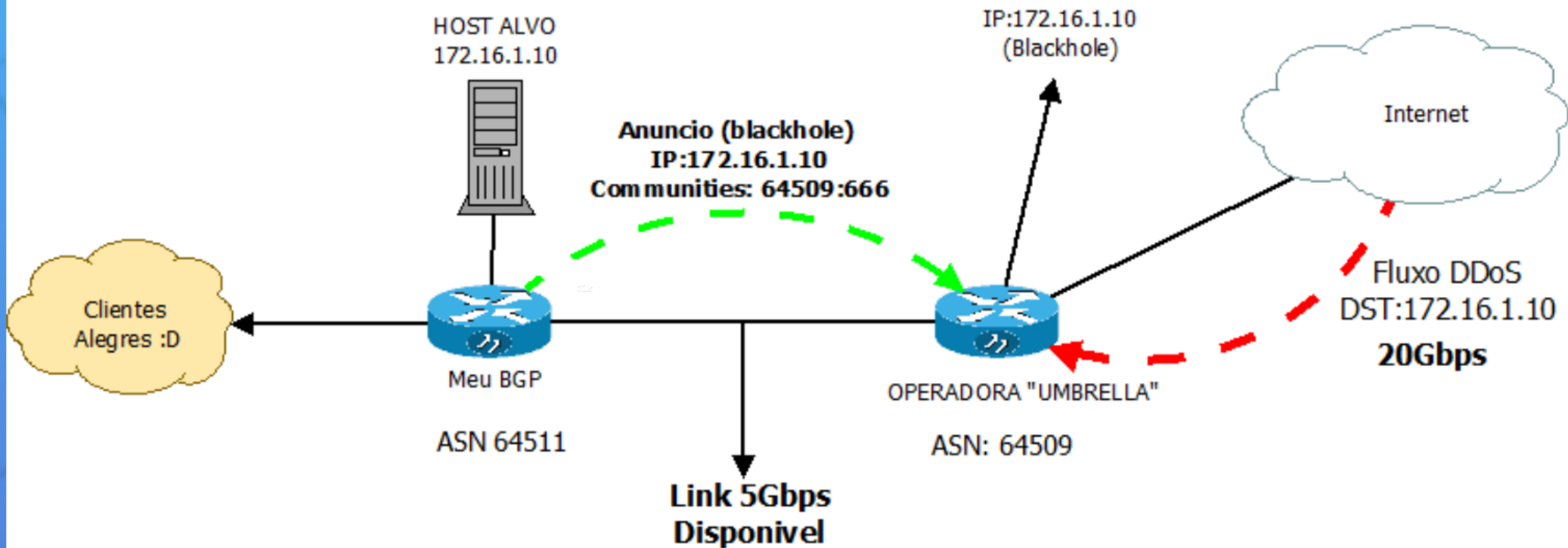
Modelo básico de uso em ataque DDoS



HOST ALVO
172.16.1.10

IP:172.16.1.10
(Blackhole)

Link 5Gbps
Saturado

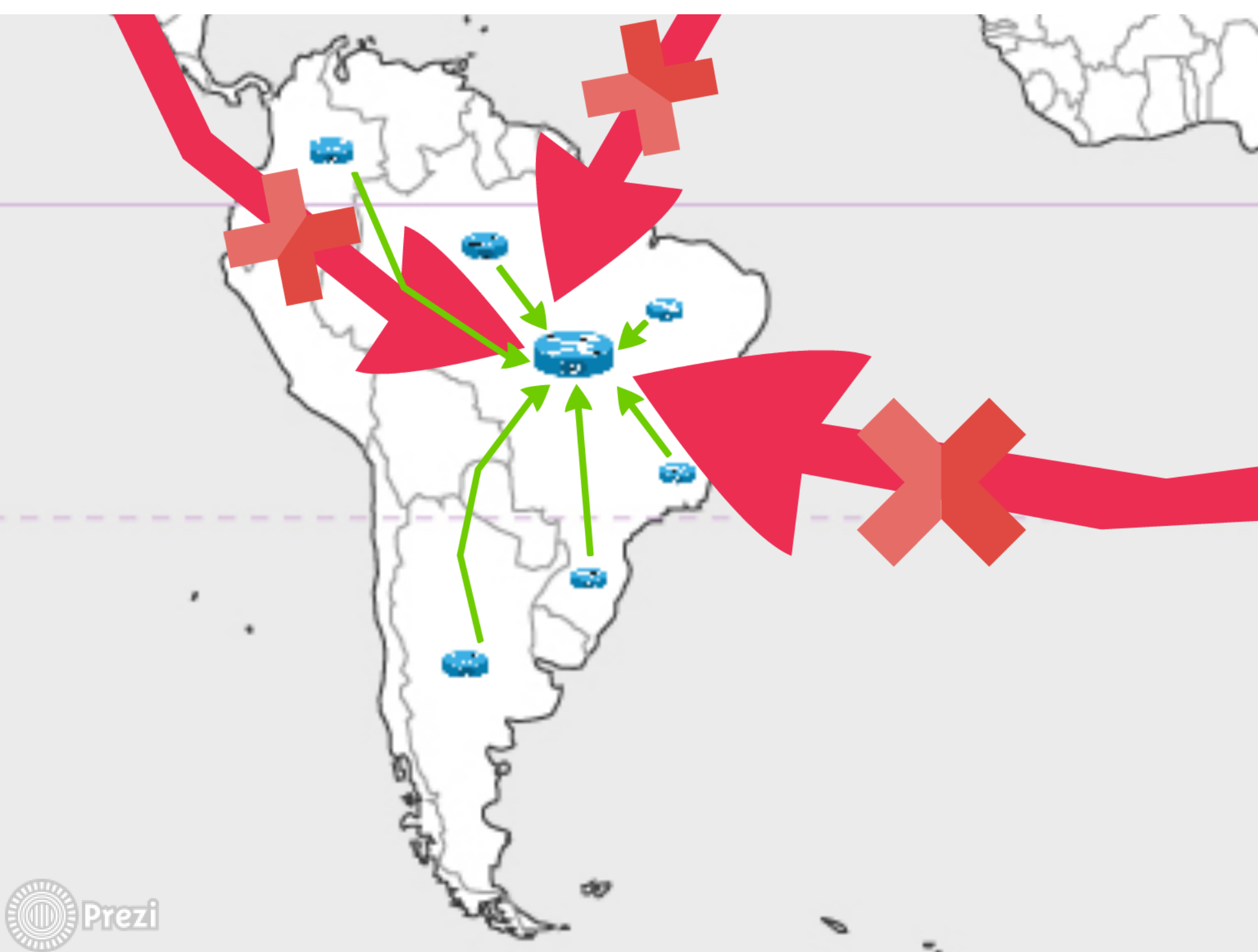



```
/routing bgp network  
add network=172.16.1.10/32 synchronize=no
```



```
/routing filter  
add action=accept chain=Operadoral_out comment="ANUNCIO PARA BLACKHOLE" prefix=\  
172.16.1.10 set-bgp-communities=64509:666
```





Filtragem de Prefixos

Basicamente a BCP 194, em peerings com a operadora (*upstream*), recomenda adotar algumas políticas.

Prefixos de entrada "in":

- ✘ Pertencentes ao próprio AS.
- ✘ De uso privado, especial ou reservado.
(que não devem ter roteamento na internet, e também ser utilizados para spoofing)

Prefixos de saída "out"

- ✘ Mais específicos que /24 em IPv4 e /48 em IPv6.
- ✓ Todos os Prefixos pertencentes ao AS em questão.

O que isso evita?

- ✓ Qualquer possibilidade de receber prefixos de meu próprio AS;
- ✓ Virar trânsito para terceiros, de forma indesejada;
- ✓ "Route Leaking";
- ✓ Encaminhamento de pacotes "Marcianos";
- ✓ "Flood" descontrolado da tabela global de roteamento;

Exemplo: Bando Indesejados:



Fonte: www.ietf.org, 2017

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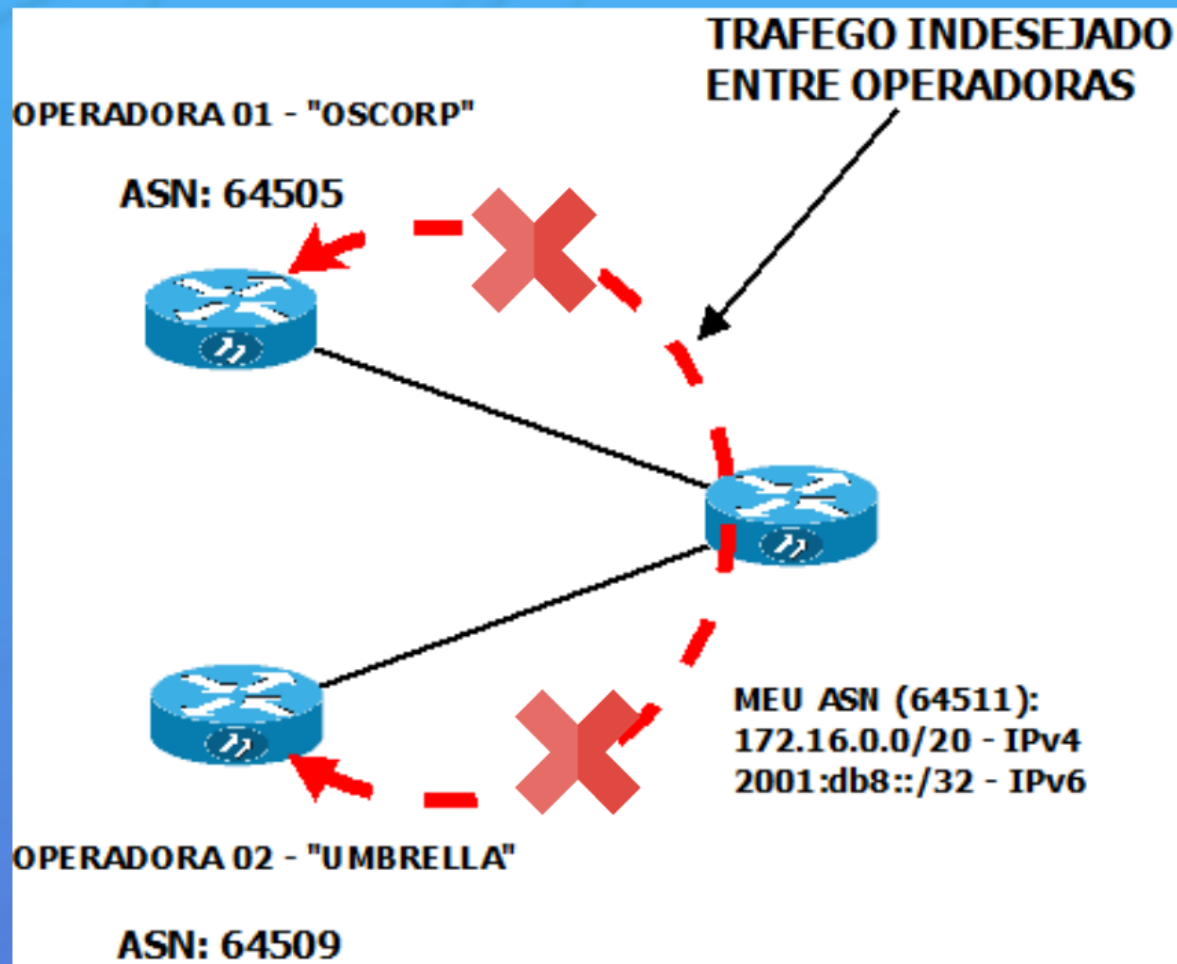
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- ✓ "Route Leaking";
- ✓ Encaminhamento de pacotes "Marcianos";
- ✓ "Flood" descontrolado da tabela global de roteamento;

Exemplo (transito indesejavel):



Fonte: Autoria própria, 2017

Alguns Exemplos...

Descarte de entrada dos blocos de seu próprio AS:

IPv4:

```
add action=discard chain=MinhaOperadora_01 in comment="DESCARTA ENTRADA MEU BLOCO 1 - Operadora01" prefix=172.16.0.0/20 prefix-length=20-32
add action=discard chain=MinhaOperadora_01 in comment="DESCARTA ENTRADA MEU BLOCO 2 - Operadora01" prefix=172.16.16.0/21 prefix-length=21-32
add action=discard chain=MinhaOperadora_02 in comment="DESCARTA ENTRADA MEU BLOCO 1 - Operadora02" prefix=172.16.0.0/20 prefix-length=20-32
add action=discard chain=MinhaOperadora_02 in comment="DESCARTA ENTRADA MEU BLOCO 2 - Operadora02" prefix=172.16.16.0/21 prefix-length=21-32
```

Fonte: Autoria própria,2017

IPv6:

```
add action=discard chain=Operadora01 IPv6 in comment="DESCARTA MEU BLOCO IPv6 - OPERADORA 01" prefix=2001:db8::1/32 prefix-length=32-128
add action=discard chain=Operadora02 IPv6 in comment="DESCARTA MEU BLOCO IPv6 - OPERADORA 02" prefix=2001:db8::1/32 prefix-length=32-128
```

Fonte: Autoria própria,2017

Descarte estático de entrada de prefixos de uso especial/ privados:

IPv4:

```
/root@mg #cat
add action=discard chain=80P-IN-IPv4 prefix=0.0.0.0/8 prefix-length=8-32
add action=discard chain=80P-IN-IPv4 prefix=10.0.0.0/8 prefix-length=8-32
add action=discard chain=80P-IN-IPv4 prefix=100.64.0.0/10 prefix-length=10-32
add action=discard chain=80P-IN-IPv4 prefix=127.0.0.0/8 prefix-length=8-32
add action=discard chain=80P-IN-IPv4 prefix=169.254.0.0/16 prefix-length=16-32
add action=discard chain=80P-IN-IPv4 prefix=172.16.0.0/12 prefix-length=12-32
add action=discard chain=80P-IN-IPv4 prefix=192.0.0.0/24 prefix-length=24-32
add action=discard chain=80P-IN-IPv4 prefix=192.0.2.0/24 prefix-length=24-32
add action=discard chain=80P-IN-IPv4 prefix=192.168.0.0/16 prefix-length=16-32
add action=discard chain=80P-IN-IPv4 prefix=198.18.0.0/15 prefix-length=15-32
add action=discard chain=80P-IN-IPv4 prefix=198.51.100.0/24 prefix-length=24-32
add action=discard chain=80P-IN-IPv4 prefix=203.0.113.0/24 prefix-length=24-32
add action=discard chain=80P-IN-IPv4 prefix=224.0.0.0/4 prefix-length=4-32
add action=discard chain=80P-IN-IPv4 prefix=0.0.0.0/0
```

IPv6:

Aceitar alocações de RIR's e descartar o resto

Prefixo	Operadora	Operadora	Operadora
2001:db8::1/32	Operadora 01	Operadora 02	Operadora 03
2001:db8::2/32	Operadora 01	Operadora 02	Operadora 03
2001:db8::3/32	Operadora 01	Operadora 02	Operadora 03
2001:db8::4/32	Operadora 01	Operadora 02	Operadora 03
2001:db8::5/32	Operadora 01	Operadora 02	Operadora 03
2001:db8::6/32	Operadora 01	Operadora 02	Operadora 03
2001:db8::7/32	Operadora 01	Operadora 02	Operadora 03
2001:db8::8/32	Operadora 01	Operadora 02	Operadora 03
2001:db8::9/32	Operadora 01	Operadora 02	Operadora 03
2001:db8::10/32	Operadora 01	Operadora 02	Operadora 03

Aceitar "Global Unicast" e descartar o resto

```
add action=discard chain=80P-IN-IPv6 in comment="DESCARTA RESTO IPv6 - GLOBAL UNICAST" prefix=2001:db8::1/32 prefix-length=32-128
add action=discard chain=80P-IN-IPv6 in comment="DESCARTA RESTO IPv6 - GLOBAL UNICAST" prefix=2001:db8::1/32 prefix-length=32-128
```

Fonte: Autoria própria, 2017



Alguns Exemplos...

Descarte de entrada dos blocos de seu próprio AS:

IPv4:

```
add action=discard chain=MinhaOperadora_01_in comment="DESCARTA ENTRADA MEU BLOCO 1 - Operadora01" prefix=172.16.0.0/20 prefix-length=20-32
add action=discard chain=MinhaOperadora_01_in comment="DESCARTA ENTRADA MEU BLOCO 2 - Operadora01" prefix=172.16.16.0/21 prefix-length=21-32
add action=discard chain=MinhaOperadora_02_in comment="DESCARTA ENTRADA MEU BLOCO 1 - Operadora02" prefix=172.16.0.0/20 prefix-length=20-32
add action=discard chain=MinhaOperadora_02_in comment="DESCARTA ENTRADA MEU BLOCO 2 - Operadora02" prefix=172.16.16.0/21 prefix-length=21-32
```

Fonte: Autoria própria,2017

IPv6:

```
add action=discard chain=Operadora01_IPv6_in comment="DESCARTA MEU BLOCO IPv6 - OPERADORA 01" prefix=2001:db8::/32 prefix-length=32-128
add action=discard chain=Operadora02_IPv6_in comment="DESCARTA MEU BLOCO IPv6 - OPERADORA 02" prefix=2001:db8::/32 prefix-length=32-128
```

Fonte: Autoria própria,2017



Descarte estático de entrada de prefixos de uso especial/
privados:

Descarte de entrada dos blocos de seu próprio AS:

IPv4:

```
add action=discard chain=MinhaOperadora_01_in comment="DESCARTA ENTRADA MEU BLOCO 1 - Operadora01" prefix=172.16.0.0/20 prefix-length=20-32
add action=discard chain=MinhaOperadora_01_in comment="DESCARTA ENTRADA MEU BLOCO 2 - Operadora01" prefix=172.16.16.0/21 prefix-length=21-32
add action=discard chain=MinhaOperadora_02_in comment="DESCARTA ENTRADA MEU BLOCO 1 - Operadora02" prefix=172.16.0.0/20 prefix-length=20-32
add action=discard chain=MinhaOperadora_02_in comment="DESCARTA ENTRADA MEU BLOCO 2 - Operadora02" prefix=172.16.16.0/21 prefix-length=21-32
```

Fonte: Aatoria própria,2017

IPv6:

```
add action=discard chain=Operadora01_IPv6_in comment="DESCARTA MEU BLOCO IPv6 - OPERADORA 01" prefix=2001:db8::/32 prefix-length=32-128
add action=discard chain=Operadora02_IPv6_in comment="DESCARTA MEU BLOCO IPv6 - OPERADORA 02" prefix=2001:db8::/32 prefix-length=32-128
```

Fonte: Aatoria própria,2017

Descarte estático de entrada de prefixos de uso especial/ privados:

IPv4:

```
outing filter
action=discard chain=BGP-IN-IPV4 prefix=0.0.0.0/8 prefix-length=8-32
action=discard chain=BGP-IN-IPV4 prefix=10.0.0.0/8 prefix-length=8-32
action=discard chain=BGP-IN-IPV4 prefix=100.64.0.0/10 prefix-length=10-32
action=discard chain=BGP-IN-IPV4 prefix=127.0.0.0/8 prefix-length=8-32
action=discard chain=BGP-IN-IPV4 prefix=169.254.0.0/16 prefix-length=16-32
action=discard chain=BGP-IN-IPV4 prefix=172.16.0.0/12 prefix-length=12-32
action=discard chain=BGP-IN-IPV4 prefix=192.0.0.0/24 prefix-length=24-32
action=discard chain=BGP-IN-IPV4 prefix=192.0.2.0/24 prefix-length=24-32
```

IPv6:

Aceitar alocações de RIR's e descartar o resto

2500 0000 /12	ARIN	2006-10-03	whols arin net	https://rdap.arin.net/registry	ALLOCATED
2510 0000 /23	ARIN	2005-11-17	whols arin net	https://rdap.arin.net/registry	ALLOCATED
2520 0000 /23	ARIN	2006-09-12	whols arin net	https://rdap.arin.net/registry	ALLOCATED
2800 0000 /12	LACNIC	2005-10-03	whols lacnic net	https://rdap.lacnic.net/rdap/	ALLOCATED
2a00 0000 /12	RIPE NCC	2006-10-03	whols ripe net	https://rdap.db.ripe.net/	ALLOCATED
2c00 0000 /12	AFRINIC	2006-10-03	whols afrinic net	https://rdap.afrinic.net/rdap/	ALLOCATED

IPv6:

```
add action=discard chain=Operadora01_IPv6_in comment="DESCARTA MEU BLOCO IPv6 - OPERADORA 01" prefix=2001:db8::/32 prefix-length=32-128
add action=discard chain=Operadora02_IPv6_in comment="DESCARTA MEU BLOCO IPv6 - OPERADORA 02" prefix=2001:db8::/32 prefix-length=32-128
```

Fonte: Autoria própria, 2017

Descarte estático de entrada de prefixos de uso especial/ privados:

IPv4:

```
/routing filter
add action=discard chain=BGP-IN-IPv4 prefix=0.0.0.0/8 prefix-length=8-32
add action=discard chain=BGP-IN-IPv4 prefix=10.0.0.0/8 prefix-length=8-32
add action=discard chain=BGP-IN-IPv4 prefix=100.64.0.0/10 prefix-length=10-32
add action=discard chain=BGP-IN-IPv4 prefix=127.0.0.0/8 prefix-length=8-32
add action=discard chain=BGP-IN-IPv4 prefix=169.254.0.0/16 prefix-length=16-32
add action=discard chain=BGP-IN-IPv4 prefix=172.16.0.0/12 prefix-length=12-32
add action=discard chain=BGP-IN-IPv4 prefix=192.0.0.0/24 prefix-length=24-32
add action=discard chain=BGP-IN-IPv4 prefix=192.0.2.0/24 prefix-length=24-32
add action=discard chain=BGP-IN-IPv4 prefix=192.168.0.0/16 prefix-length=16-32
add action=discard chain=BGP-IN-IPv4 prefix=198.18.0.0/15 prefix-length=15-32
add action=discard chain=BGP-IN-IPv4 prefix=198.51.100.0/24 prefix-length=24-32
add action=discard chain=BGP-IN-IPv4 prefix=203.0.113.0/24 prefix-length=24-32
add action=discard chain=BGP-IN-IPv4 prefix=224.0.0.0/4 prefix-length=4-32
add action=discard chain=BGP-IN-IPv4 prefix=0.0.0.0/0
```

IPv6:

Aceitar alocações de RIR's e descartar o resto

2000 0000 /12	ARIN	2006-10-03	whois arin net	https://rdap.arin.net/registry	ALLOCATED
2010 0000 /23	ARIN	2005-11-17	whois arin net	https://rdap.arin.net/registry	ALLOCATED
2020 0000 /23	ARIN	2006-09-12	whois arin net	https://rdap.arin.net/registry	ALLOCATED
2000 0000 /12	LACNIC	2006-10-03	whois lacnic net	https://rdap.lacnic.net/rdap/	ALLOCATED
2a00 0000 /12	RIPE NCC	2006-10-03	whois ripe net	https://rdap.ripenet.net/	ALLOCATED
2c00 0000 /12	AFRINIC	2006-10-03	whois afrinic net	https://rdap.afrinic.net/rdap/	ALLOCATED

Nota completa em: <https://www.zenix.org/usage/nextstep/unicast-address-usage/nextstep/unicast-address-usage/nextstep/>

Aceitar "Global Unicast" e descartar o resto

```
/routing filter
add action=accept chain=BGP-IN-IPv6 comment="ACEITA - GLOBAL - IPv6" prefix=2000::/3 prefix-length=3-48
add action=discard chain=BGP-IN-IPv6 comment="DESCARTA - RESTO - IPv6"
```

Fonte: Autoria própria, 2017

privados:

IPv4:

```
/routing filter
add action=discard chain=BGP-IN-IPV4 prefix=0.0.0.0/8 prefix-length=8-32
add action=discard chain=BGP-IN-IPV4 prefix=10.0.0.0/8 prefix-length=8-32
add action=discard chain=BGP-IN-IPV4 prefix=100.64.0.0/10 prefix-length=10-32
add action=discard chain=BGP-IN-IPV4 prefix=127.0.0.0/8 prefix-length=8-32
add action=discard chain=BGP-IN-IPV4 prefix=169.254.0.0/16 prefix-length=16-32
add action=discard chain=BGP-IN-IPV4 prefix=172.16.0.0/12 prefix-length=12-32
add action=discard chain=BGP-IN-IPV4 prefix=192.0.0.0/24 prefix-length=24-32
add action=discard chain=BGP-IN-IPV4 prefix=192.0.2.0/24 prefix-length=24-32
add action=discard chain=BGP-IN-IPV4 prefix=192.168.0.0/16 prefix-length=16-32
add action=discard chain=BGP-IN-IPV4 prefix=198.18.0.0/15 prefix-length=15-32
add action=discard chain=BGP-IN-IPV4 prefix=198.51.100.0/24 prefix-length=24-32
add action=discard chain=BGP-IN-IPV4 prefix=203.0.113.0/24 prefix-length=24-32
add action=discard chain=BGP-IN-IPV4 prefix=224.0.0.0/4 prefix-length=4-32
add action=discard chain=BGP-IN-IPV4 prefix=0.0.0.0/0
```

IPv6:

Aceitar alocações de RIR's e descartar o resto

2600:0000::/12	ARIN	2006-10-03	whois.arin.net	https://rdap.arin.net/registry http://rdap.arin.net/registry	ALLOCATED
2610:0000::/23	ARIN	2005-11-17	whois.arin.net	https://rdap.arin.net/registry http://rdap.arin.net/registry	ALLOCATED
2620:0000::/23	ARIN	2006-09-12	whois.arin.net	https://rdap.arin.net/registry http://rdap.arin.net/registry	ALLOCATED
2800:0000::/12	LACNIC	2006-10-03	whois.lacnic.net	https://rdap.lacnic.net/rdap/	ALLOCATED
2a00:0000::/12	RIPE NCC	2006-10-03	whois.ripe.net	https://rdap.db.ripe.net/	ALLOCATED
2c00:0000::/12	AFRINIC	2006-10-03	whois.afrinic.net	https://rdap.afrinic.net/rdap/ http://rdap.afrinic.net/rdap/	ALLOCATED

lista completa em: <https://www.iana.org/assignments/ipv6-unicast-address-assignments/ipv6-unicast-address-assignments.xhtml>

Aceitar "Global Unicast" e descartar o resto

```
/routing filter
add action=accept chain=BGP-IN-IPV6 comment="ACEITA - GLOBAL - IPv6" prefix=2000::/3 prefix-length=3-48
add action=discard chain=BGP-IN-IPV6 comment="DESCARTA - RESTO - IPv6"
```

Fonte: Autoria propria, 2017

Aceitar alocações de RIR's e descartar o resto

2600:0000::/12	ARIN	2006-10-03	whois.arin.net	https://rdap.arin.net/registry http://rdap.arin.net/registry	ALLOCATED
2610:0000::/23	ARIN	2005-11-17	whois.arin.net	https://rdap.arin.net/registry http://rdap.arin.net/registry	ALLOCATED
2620:0000::/23	ARIN	2006-09-12	whois.arin.net	https://rdap.arin.net/registry http://rdap.arin.net/registry	ALLOCATED
2800:0000::/12	LACNIC	2006-10-03	whois.lacnic.net	https://rdap.lacnic.net/rdap/	ALLOCATED
2a00:0000::/12	RIPE NCC	2006-10-03	whois.ripe.net	https://rdap.db.ripe.net/	ALLOCATED
2c00:0000::/12	AFRINIC	2006-10-03	whois.afrinic.net	https://rdap.afrinic.net/rdap/ http://rdap.afrinic.net/rdap/	ALLOCATED

lista completa em: <https://www.iana.org/assignments/ipv6-unicast-address-assignments/ipv6-unicast-address-assignments.xhtml>

aceitar "Global Unicast" e descartar o resto

2600:0000::/12	ARIN	2006-10-03	whois.arin.net	https://rdap.arin.net/registry http://rdap.arin.net/registry	ALLOCATED
2610:0000::/23	ARIN	2005-11-17	whois.arin.net	https://rdap.arin.net/registry http://rdap.arin.net/registry	ALLOCATED
2620:0000::/23	ARIN	2006-09-12	whois.arin.net	https://rdap.arin.net/registry http://rdap.arin.net/registry	ALLOCATED
2800:0000::/12	LACNIC	2006-10-03	whois.lacnic.net	https://rdap.lacnic.net/rdap/	ALLOCATED
2a00:0000::/12	RIPE NCC	2006-10-03	whois.ripe.net	https://rdap.db.ripe.net/	ALLOCATED
2c00:0000::/12	AFRINIC	2006-10-03	whois.afrinic.net	https://rdap.afrinic.net/rdap/ http://rdap.afrinic.net/rdap/	ALLOCATED

lista completa em: <https://www.iana.org/assignments/pv6-unicast-address-assignments/pv6-unicast-address-assignments.xhtml>

Aceitar "Global Unicast" e descartar o resto

```
/routing filter
add action=accept chain=BGP-IN-IPV6 comment="ACEITA - GLOBAL - IPv6" prefix=2000::/3 prefix-length=3-48
add action=discard chain=BGP-IN-IPV6 comment="DESCARTA - RESTO - IPv6"
```

Fonte: Autoria propria, 2017

Anuncio de Prefixos (Exemplos)

Anunciando apenas prefixos de meu AS (exemplo winbox):

Chain	Prefix	Prefix Length	Action	Set BGP Prepend
: ANUNCIA MEU BLOCO 1 - Operadora01				
MinhaOperadora_01_out	172.16.0.0/20		accept	
: ANUNCIA MEU BLOCO 1 - Operadora01				
MinhaOperadora_01_out	172.16.0.0/24		accept	
MinhaOperadora_01_out			discard	
: ANUNCIA MEU BLOCO 1 - Operadora02				
MinhaOperadora_02_out	172.16.0.0/20		accept	
: DESCARTA RESTO ANUNCIOS - Operadora02				
MinhaOperadora_02_out			discard	
: ANUNCIO MEU BLOCO IPv6 - OPERADORA 01				
Operadora01_IPv6_out	2001:db8::/32		accept	
: DESCARTA RESTO ANUNCIOS IPv6 - OPERADORA 01				
Operadora01_IPv6_out			discard	
: ANUNCIA BLOCO IPv6 - OPERADORA 02				
Operadora02_IPv6_out	2001:db8::/32		accept	
: DESCARTA RESTO ANUNCIOS IPv6 - OPERADORA 02				
Operadora02_IPv6_out			discard	

Fonte: Autoria própria,2017



Prepare os filtros **ANTES** de estabelecer qualquer sessão!

Anunciando apenas prefixos de meu AS (exemplo winbox):

Chain	Prefix	Prefix Length	Action	Set BGP Prepend
: ANUNCIA MEU BLOCO 1 - Operadora01				
MinhaOperadora_01_out	172.16.0.0/20		accept	
: ANUNCIA MEU BLOCO 1 - Operadora01				
MinhaOperadora_01_out	172.16.0.0/24		accept	
MinhaOperadora_01_out			discard	
: ANUNCIA MEU BLOCO 1 - Operadora02				
MinhaOperadora_02_out	172.16.0.0/20		accept	
: DESCARTA RESTO ANUNCIOS - Operadora02				
MinhaOperadora_02_out			discard	
: ANUNCIO MEU BLOCO IPv6 - OPERADORA 01				
Operadora01_IPv6_out	2001:db8::/32		accept	
: DESCARTA RESTO ANUNCIOS IPv6 - OPERADORA 01				
Operadora01_IPv6_out			discard	
: ANUNCIA BLOCO IPv6 - OPERADORA 02				
Operadora02_IPv6_out	2001:db8::/32		accept	
: DESCARTA RESTO ANUNCIOS IPv6 - OPERADORA 02				
Operadora02_IPv6_out			discard	

Fonte: Aatoria própria,2017



out

2001:db8::/32

ANUNCIOS IPv6 - OPERADORA 02

out

Fonte: Autoria própria,2017

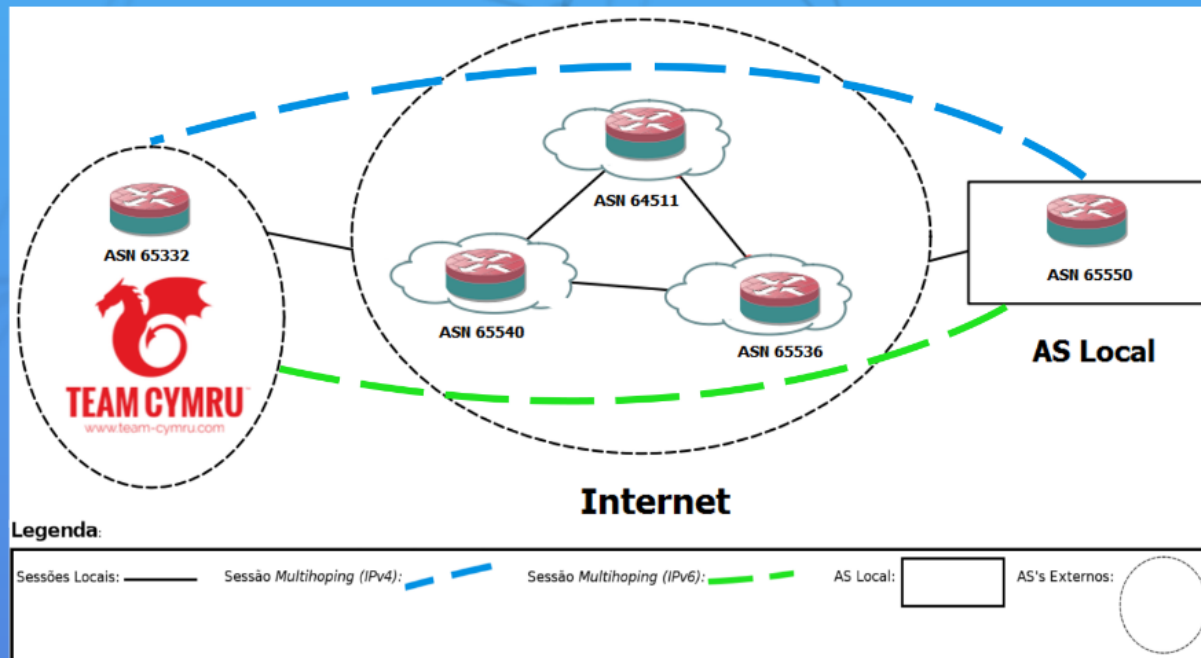


Prepare os filtros **ANTES** de estabelecer qualquer sessão!

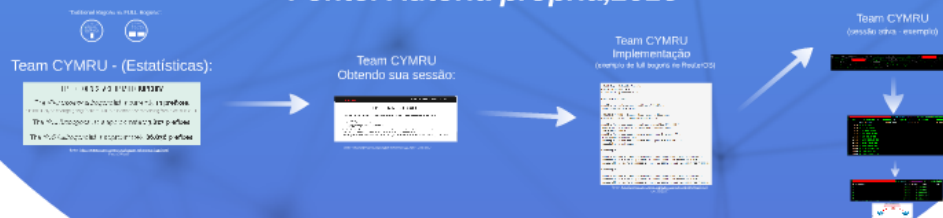
COMO OBTER UM PEERING

COM A TEAM CYMRU :D

Obtendo lista dinâmica de prefixos para descarte (bogons)



Fonte: Autoria própria, 2016



SEMPRE em seu AS sempre caso contrário "Route Leak" da Internet.

O anúncio em quais princípios "Hijacking"

"Traditional Bogons vs FULL Bogons":

"Traditional Bogons"

- ✓ Lista atual de 13 prefixos
- ✓ De uso reservado para uso especial ou privado pela IANA.
- ✓ Pode ser utilizado para compor ACL's que analisam a origem de pacotes como o antispoofing.

```
00000000
00000001
00000002
00000003
00000004
00000005
00000006
00000007
00000008
00000009
0000000A
0000000B
0000000C
0000000D
0000000E
0000000F
00000010
00000011
00000012
00000013
00000014
00000015
00000016
00000017
00000018
00000019
0000001A
0000001B
0000001C
0000001D
0000001E
0000001F
00000020
00000021
00000022
00000023
00000024
00000025
00000026
00000027
00000028
00000029
0000002A
0000002B
0000002C
0000002D
0000002E
0000002F
00000030
00000031
00000032
00000033
00000034
00000035
00000036
00000037
00000038
00000039
0000003A
0000003B
0000003C
0000003D
0000003E
0000003F
00000040
00000041
00000042
00000043
00000044
00000045
00000046
00000047
00000048
00000049
0000004A
0000004B
0000004C
0000004D
0000004E
0000004F
00000050
00000051
00000052
00000053
00000054
00000055
00000056
00000057
00000058
00000059
0000005A
0000005B
0000005C
0000005D
0000005E
0000005F
00000060
00000061
00000062
00000063
00000064
00000065
00000066
00000067
00000068
00000069
0000006A
0000006B
0000006C
0000006D
0000006E
0000006F
00000070
00000071
00000072
00000073
00000074
00000075
00000076
00000077
00000078
00000079
0000007A
0000007B
0000007C
0000007D
0000007E
0000007F
00000080
00000081
00000082
00000083
00000084
00000085
00000086
00000087
00000088
00000089
0000008A
0000008B
0000008C
0000008D
0000008E
0000008F
00000090
00000091
00000092
00000093
00000094
00000095
00000096
00000097
00000098
00000099
0000009A
0000009B
0000009C
0000009D
0000009E
0000009F
000000A0
000000A1
000000A2
000000A3
000000A4
000000A5
000000A6
000000A7
000000A8
000000A9
000000AA
000000AB
000000AC
000000AD
000000AE
000000AF
000000B0
000000B1
000000B2
000000B3
000000B4
000000B5
000000B6
000000B7
000000B8
000000B9
000000BA
000000BB
000000BC
000000BD
000000BE
000000BF
000000C0
000000C1
000000C2
000000C3
000000C4
000000C5
000000C6
000000C7
000000C8
000000C9
000000CA
000000CB
000000CC
000000CD
000000CE
000000CF
000000D0
000000D1
000000D2
000000D3
000000D4
000000D5
000000D6
000000D7
000000D8
000000D9
000000DA
000000DB
000000DC
000000DD
000000DE
000000DF
000000E0
000000E1
000000E2
000000E3
000000E4
000000E5
000000E6
000000E7
000000E8
000000E9
000000EA
000000EB
000000EC
000000ED
000000EE
000000EF
000000F0
000000F1
000000F2
000000F3
000000F4
000000F5
000000F6
000000F7
000000F8
000000F9
000000FA
000000FB
000000FC
000000FD
000000FE
000000FF
```

ver em <http://www.com.com.org/Services/Bogon/bogons.html>

"FULL Bogons"

- ✓ Inclui todos os prefixos do modo "tradicional" com acréscimo de prefixos não alocados pelos RIR's.
- ✓ Lista constantemente atualizada

```
00000000
00000001
00000002
00000003
00000004
00000005
00000006
00000007
00000008
00000009
0000000A
0000000B
0000000C
0000000D
0000000E
0000000F
00000010
00000011
00000012
00000013
00000014
00000015
00000016
00000017
00000018
00000019
0000001A
0000001B
0000001C
0000001D
0000001E
0000001F
00000020
00000021
00000022
00000023
00000024
00000025
00000026
00000027
00000028
00000029
0000002A
0000002B
0000002C
0000002D
0000002E
0000002F
00000030
00000031
00000032
00000033
00000034
00000035
00000036
00000037
00000038
00000039
0000003A
0000003B
0000003C
0000003D
0000003E
0000003F
00000040
00000041
00000042
00000043
00000044
00000045
00000046
00000047
00000048
00000049
0000004A
0000004B
0000004C
0000004D
0000004E
0000004F
00000050
00000051
00000052
00000053
00000054
00000055
00000056
00000057
00000058
00000059
0000005A
0000005B
0000005C
0000005D
0000005E
0000005F
00000060
00000061
00000062
00000063
00000064
00000065
00000066
00000067
00000068
00000069
0000006A
0000006B
0000006C
0000006D
0000006E
0000006F
00000070
00000071
00000072
00000073
00000074
00000075
00000076
00000077
00000078
00000079
0000007A
0000007B
0000007C
0000007D
0000007E
0000007F
00000080
00000081
00000082
00000083
00000084
00000085
00000086
00000087
00000088
00000089
0000008A
0000008B
0000008C
0000008D
0000008E
0000008F
00000090
00000091
00000092
00000093
00000094
00000095
00000096
00000097
00000098
00000099
0000009A
0000009B
0000009C
0000009D
0000009E
0000009F
000000A0
000000A1
000000A2
000000A3
000000A4
000000A5
000000A6
000000A7
000000A8
000000A9
000000AA
000000AB
000000AC
000000AD
000000AE
000000AF
000000B0
000000B1
000000B2
000000B3
000000B4
000000B5
000000B6
000000B7
000000B8
000000B9
000000BA
000000BB
000000BC
000000BD
000000BE
000000BF
000000C0
000000C1
000000C2
000000C3
000000C4
000000C5
000000C6
000000C7
000000C8
000000C9
000000CA
000000CB
000000CC
000000CD
000000CE
000000CF
000000D0
000000D1
000000D2
000000D3
000000D4
000000D5
000000D6
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000000D8
000000D9
000000DA
000000DB
000000DC
000000DD
000000DE
000000DF
000000E0
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000000E7
000000E8
000000E9
000000EA
000000EB
000000EC
000000ED
000000EE
000000EF
000000F0
000000F1
000000F2
000000F3
000000F4
000000F5
000000F6
000000F7
000000F8
000000F9
000000FA
000000FB
000000FC
000000FD
000000FE
000000FF
```

"Traditional Bogons"

- ✓ Lista atual de 13 prefixos
- ✓ De uso reservado para uso especial ou privado pela IANA.
- ✓ Pode ser utilizado para compor ACL's que analisam a origem de pacotes como o antispoofing.

```
0.0.0.0/8
10.0.0.0/8
100.64.0.0/10
127.0.0.0/8
169.254.0.0/16
172.16.0.0/12
192.0.0.0/24
192.0.2.0/24
192.168.0.0/16
198.18.0.0/15
198.51.100.0/24
203.0.113.0/24
224.0.0.0/3
```

Disponível em: <http://www.team-cymru.org/Services/Bogons/bogon-bases.txt>

0.0.0.0/8
10.0.0.0/8
100.64.0.0/10
127.0.0.0/8
169.254.0.0/16
172.16.0.0/12
192.0.0.0/24
192.0.2.0/24
192.168.0.0/16
198.18.0.0/15
198.51.100.0/24
203.0.113.0/24
224.0.0.0/3

"FULL Bogons"

- ✓ Inclui todos os prefixos do modo "traditional" com acréscimo de prefixos não alocados pelos RIR's.
- ✓ Lista constantemente atualizada

```
# last updated 1509655801 (Thu Nov 2 20:50:01 2017 GMT)
0.0.0.0/8
2.56.0.0/14
5.8.248.0/21
5.39.200.0/21
5.45.32.0/20
5.100.240.0/21
5.104.72.0/21
5.133.64.0/18
5.172.176.0/21
5.180.0.0/14
5.199.184.0/21
5.252.0.0/15
10.0.0.0/8
31.12.72.0/21
31.13.104.0/21
31.22.8.0/21
31.40.192.0/18
31.132.8.0/21
31.132.32.0/19
31.133.96.0/21
31.169.120.0/21
```

lista completa em: <http://www.team-cymru.org/Services/Bogons/fullbogons-ipv4.txt>

```
# last updated 1509655801 (Thu Nov 2 20:50:01 2017 GMT)
::/8
100::/8
200::/7
400::/6
800::/5
1000::/4
2000::/16
2001:201::/32
2001:202::/31
2001:204::/30
2001:209::/32
2001:20a::/31
2001:20c::/30
2001:210:2000::/35
2001:210:4000::/34
2001:210:8000::/33
```

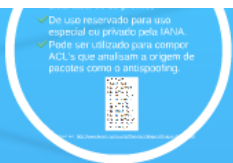
lista completa em: <http://www.team-cymru.org/Services/Bogons/fullbogons-ipv6.txt>

```
# last updated 1509655801 (Thu Nov  2 20:50:01 2017 GMT)
0.0.0.0/8
2.56.0.0/14
5.8.248.0/21
5.39.200.0/21
5.45.32.0/20
5.100.240.0/21
5.104.72.0/21
5.133.64.0/18
5.172.176.0/21
5.180.0.0/14
5.199.184.0/21
5.252.0.0/15
10.0.0.0/8
31.12.72.0/21
31.13.184.0/21
31.22.8.0/21
31.40.192.0/18
31.132.8.0/21
31.132.32.0/19
31.133.96.0/21
31.169.120.0/21
```

lista completa em: <http://www.team-cymru.org/Services/Bogons/fullbogons-ipv4.txt>

```
# last updated 1509655801 (Thu Nov  2 20:50:01 2017 GMT)
::/8
100::/8
200::/7
400::/6
800::/5
1000::/4
2000::/16
2001:201::/32
2001:202::/31
2001:204::/30
2001:209::/32
2001:20a::/31
2001:20c::/30
2001:210:2000::/35
2001:210:4000::/34
2001:210:8000::/33
```

lista completa em: <http://www.team-cymru.org/Services/Bogons/fullbogons-ipv6.txt>



Team CYMRU - (Estatísticas):

PREFIX COUNTS LAST UPDATED: **JULY 2017**

The *IPv4 traditional bogons* list is currently **13 prefixes**.
It is not likely to change going forward (IANA allocated the remaining free blocks in 2011.)

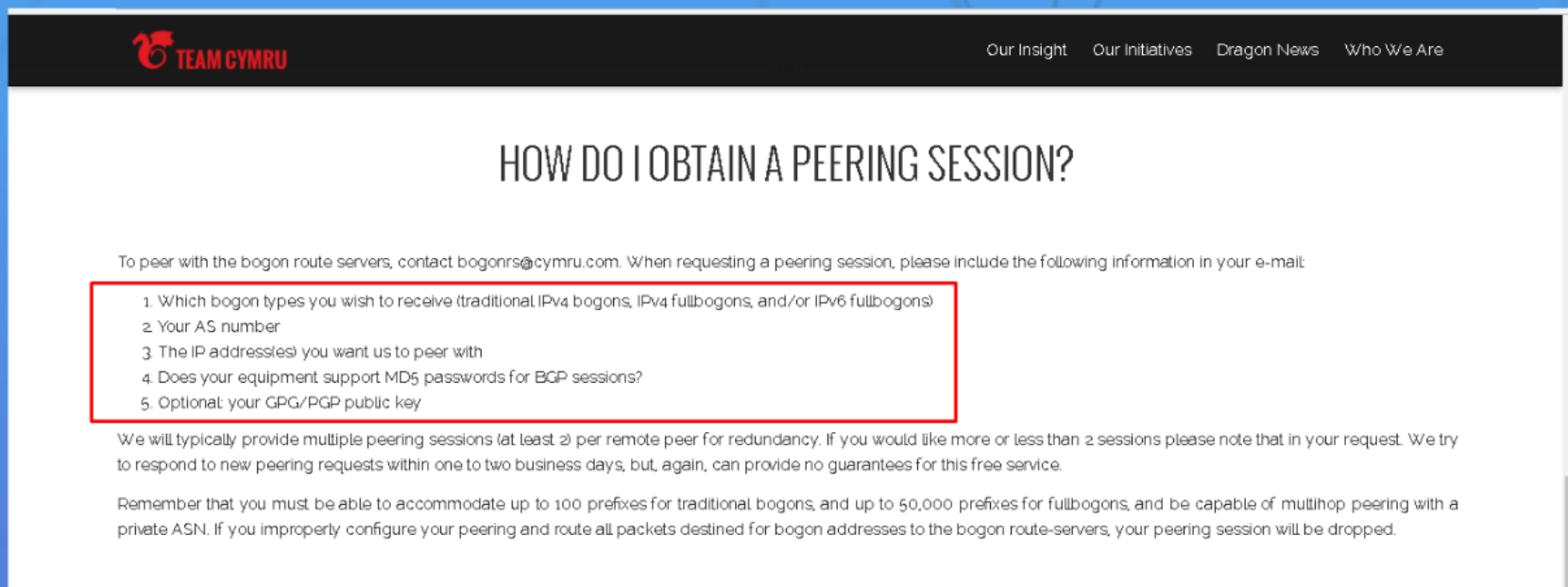
The *IPv4 fullbogons* list is approximately **3,827 prefixes**.

The *IPv6 fullbogons* list is approximately **86,836 prefixes**.

fonte: <http://www.team-cymru.org/bogon-reference-bgp.html>
Em: 07/2017

Team CYMRU

Obtendo sua sessão:



The screenshot shows a website header with the Team CYMRU logo on the left and navigation links 'Our Insight', 'Our Initiatives', 'Dragon News', and 'Who We Are' on the right. The main heading is 'HOW DO I OBTAIN A PEERING SESSION?'. Below this, a paragraph states: 'To peer with the bogon route servers, contact bogonrs@cymru.com. When requesting a peering session, please include the following information in your e-mail:'. A red box highlights a list of five items: 1. Which bogon types you wish to receive (traditional IPv4 bogons, IPv4 fullbogons, and/or IPv6 fullbogons), 2. Your AS number, 3. The IP address(es) you want us to peer with, 4. Does your equipment support MD5 passwords for BGP sessions?, and 5. Optional: your GPG/PGP public key. Below the list, a paragraph explains: 'We will typically provide multiple peering sessions (at least 2) per remote peer for redundancy. If you would like more or less than 2 sessions please note that in your request. We try to respond to new peering requests within one to two business days, but, again, can provide no guarantees for this free service.' A final paragraph notes: 'Remember that you must be able to accommodate up to 100 prefixes for traditional bogons, and up to 50,000 prefixes for fullbogons, and be capable of multihop peering with a private ASN. If you improperly configure your peering and route all packets destined for bogon addresses to the bogon route-servers, your peering session will be dropped.'

fonte: www.team-cymru.org/bogon-reference-bgp.html - julho 2017

HOW DO I OBTAIN A PEERING SESSION?

To peer with the bogon route servers, contact bogons@cymru.com. When requesting a peering session, please include the following information in your e-mail:

1. Which bogon types you wish to receive (traditional IPv4 bogons, IPv4 fullbogons, and/or IPv6 fullbogons)
2. Your AS number
3. The IP address(es) you want us to peer with
4. Does your equipment support MD5 passwords for BGP sessions?
5. Optional: your GPG/PGP public key

We will typically provide multiple peering sessions (at least 2) per remote peer for redundancy. If you would like more or less than 2 sessions please note that in your request. We try to respond to new peering requests within one to two business days, but, again, can provide no guarantees for this free service.

Remember that you must be able to accommodate up to 100 prefixes for traditional bogons, and up to 50,000 prefixes for fullbogons, and be capable of multihop peering with a private ASN. If you improperly configure your peering and route all packets destined for bogon addresses to the bogon route-servers, your peering session will be dropped.

fonte: www.team-cymru.org/bogon-reference-bgp.html - julho 2017

Team CYMRU

Implementação

(exemplo de full bogons no RouterOS)



```
# Full Bogons Mikrotik Template
# Work on RouterOS 4.X
# 2010-11-01 by Ricardo Ozelo

# BGP instance setup

/routing bgp instance set default as=<YOUR_ASN> \
router-id=<WAN_IP_ADDRESS>

# ROUTING FILTERS - Install these routes as blackholes,
# does NOT receive or announce anything else

/routing filter add action=accept bgp-communities=65332:888 \
chain=cymru-in comment="" disabled=no invert-match=no \
set-type=blackhole
/routing filter add action=discard chain=cymru-in comment="" \
disabled=no invert-match=no
/routing filter add action=discard chain=cymru-out comment="" \
disabled=no invert-match=no

# Peering #1

/routing bgp peer add address-families=ip,ipv6 disabled=no in-filter=cymru-in \
instance=default multihop=yes name=FULLBOGONS-CYMRU-1 out-filter=cymru-out \
remote-address=<CYMRU_IP_ADDRESS_1> remote-as=65332 tcp-md5-key=<CYMRU_MD5_PASSWORD>

# Peering #2

/routing bgp peer add address-families=ip,ipv6 disabled=no in-filter=cymru-in \
instance=default multihop=yes name=FULLBOGONS-CYMRU-2 out-filter=cymru-out \
remote-address=<CYMRU_IP_ADDRESS_2> remote-as=65332 tcp-md5-key=<CYMRU_MD5_PASSWORD>
```

fonte: <http://www.team-cymru.org/bgp-examples.html#mikrotik-full>
em 10/2017

```
# Full Bogons Mikrotik Template
# Work on RouterOS 4.X
# 2010-11-01 by Ricardo Ozelo

# BGP instance setup

/routing bgp instance set default as=<YOUR_ASN> \
router-id=<WAN_IP_ADDRESS>

# ROUTING FILTERS - Install these routes as blackholes,
# does NOT receive or announce anything else

/routing filter add action=accept bgp-communities=65332:888 \
chain=cymru-in comment="" disabled=no invert-match=no \
set-type=blackhole
/routing filter add action=discard chain=cymru-in comment="" \
disabled=no invert-match=no
/routing filter add action=discard chain=cymru-out comment="" \
disabled=no invert-match=no

# Peering #1

/routing bgp peer add address-families=ip,ipv6 disabled=no in-filter=cymru-in \
instance=default multihop=yes name=FULLBOGONS-CYMRU-1 out-filter=cymru-out \
remote-address=<CYMRU_IP_ADDRESS_1> remote-as=65332 tcp-md5-key=<CYMRU_MD5_PASSWORD>

# Peering #2

/routing bgp peer add address-families=ip,ipv6 disabled=no in-filter=cymru-in \
instance=default multihop=yes name=FULLBOGONS-CYMRU-2 out-filter=cymru-out \
remote-address=<CYMRU_IP_ADDRESS_2> remote-as=65332 tcp-md5-key=<CYMRU_MD5_PASSWORD>
```

fonte: <http://www.team-cymru.org/bgp-examples.html#mikrotik-full>
em 10/2017

Team CYMRU

(sessão ativa - exemplo)

```
E name="TeamCYMRU_Bogons_IPv4" instance=default remote-address=193. [REDACTED] remote-as=65332
tcp-md5-key="[REDACTED]" nexthop-choice=default multihop=yes route-reflect=no hold-time=3m
ttl=default max-prefix-limit=10000 max-prefix-restart-time=30m in-filter=Cymru_in
out-filter=Cymru_out address-families=ip default-originate=never remove-private-as=no
as-override=no passive=no use-bfd=no
```

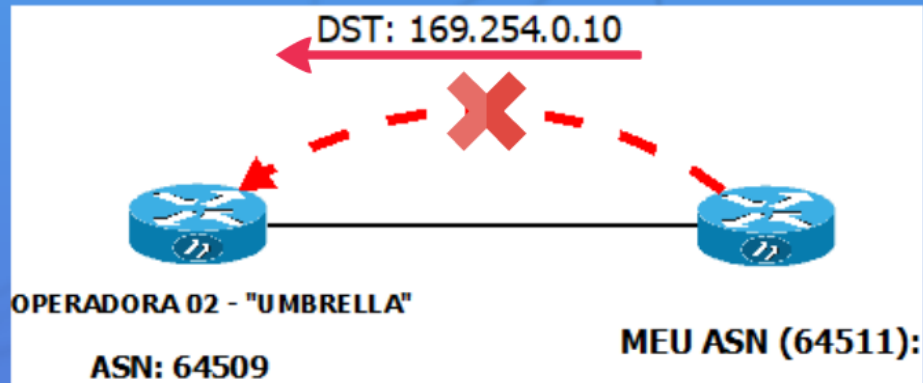
```
[redacted] > ip route print where type=blackhole
Flags: X - disabled, A - active, D - dynamic, C - connect, S - static, r
#      DST-ADDRESS      PREF-SRC      GATEWAY      DISTANCE
0 ADbB 0.0.0.0/8          20
1 ADbB 2.56.0.0/14       20
2 ADbB 5.8.248.0/21      20
3 ADbB 5.39.200.0/21   20
4 ADbB 5.45.32.0/20    20
5 ADbB 5.100.240.0/21 20
6 ADbB 5.104.72.0/21  20
7 ADbB 5.133.64.0/18 20
8 ADbB 5.172.176.0/21 20
9 ADbB 5.180.0.0/14  20
10 ADbB 5.199.184.0/21 20
```





```
[REDACTED] > tool traceroute 169.254.0.10
```

#	ADDRESS	LOSS	SENT	LAST	AVG
1		100%	2	timeout	
2		100%	2	timeout	
3		100%	1	timeout	
4		100%	1	timeout	
5		100%	1	timeout	



IMPORTANTE!



SEMPRE anunciar os prefixos originados a partir de seu AS apenas com recursos pertencentes ao mesmo, caso contrário, podemos cometer um erro chamado de "Route Leaking" que pode atrapalhar o funcionamento da Internet.



O anúncio de prefixos não pertencentes ao AS em questão também pode ser utilizado com princípios maliciosos, como tentativas de "Hijacking".

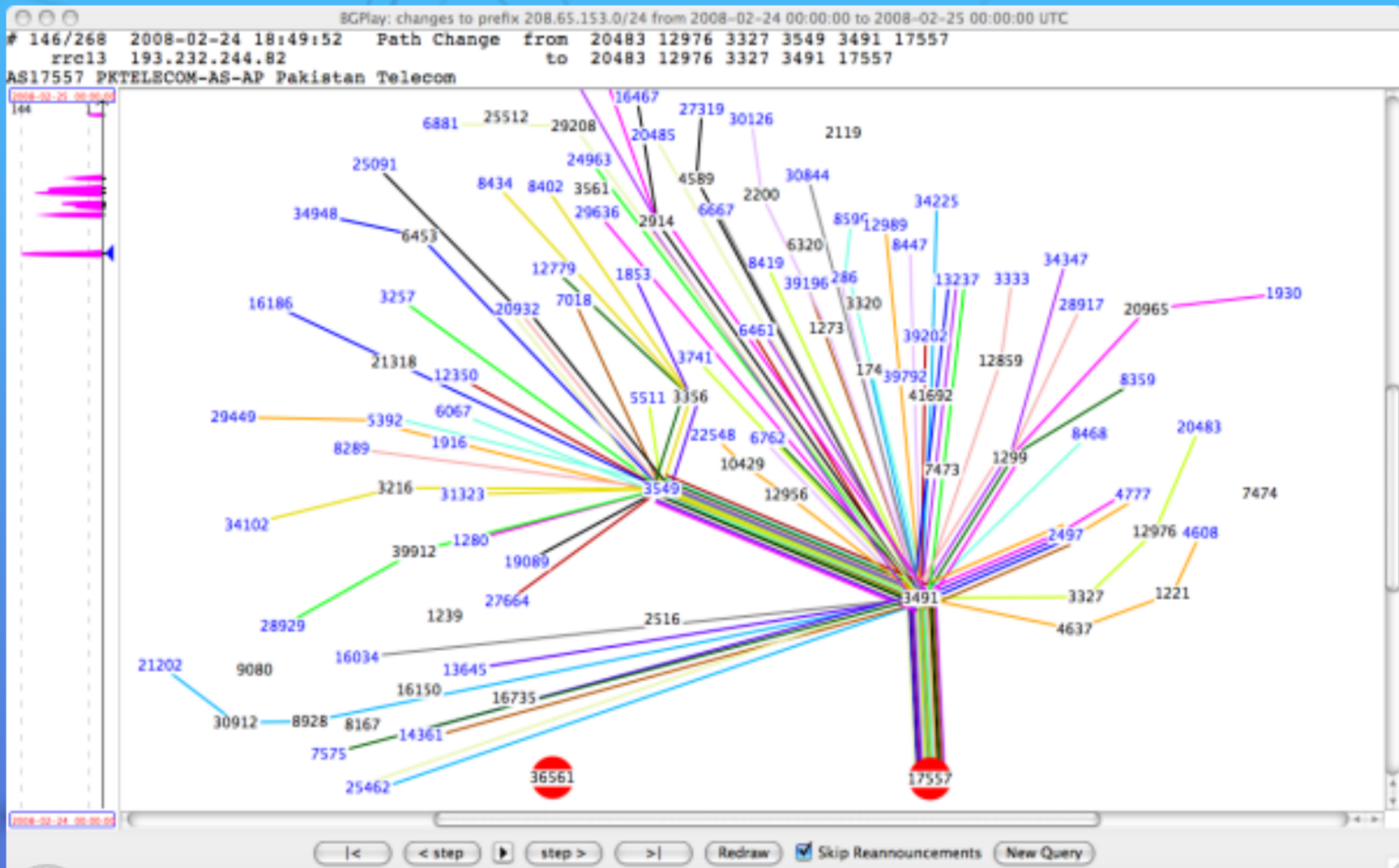


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O anúncio de prefixos não pertencentes ao AS em questão também pode ser utilizado com princípios maliciosos, como tentativas de "Hijacking".

(24 de fevereiro de 2008)



Prezi

Boas práticas para o roteador de borda:

"Este ativo deve estar plenamente configurado com ênfase em sua principal função" (Oliveira, 2016).

Basicamente precisamos ter:

- ✓ Sessões BGP;
- ✓ Tabelas e filtros de Roteamento;
- ✓ ACL's essenciais;

São alguns recursos desnecessários:

- ✗ DHCP;
- ✗ DNS recursivo;
- ✗ Hotspot;
- ✗ NTP Server;
- ✗ FTP;
- ✗ IGP nas interfaces de sessões como o OSPF.
- ✗ IPv6 RA (Router Advertisement) nas interfaces de sessões.



Alguns serviços desnecessários mal configurados, podem ser tornar potenciais vulnerabilidades exploradas para amplificação de trafego (muito usado para ataques DDoS).

E outras "coisas"...

Simples exemplo em cenário real:
(Entre as Adversões de acordo com a função e necessidade)



Boas práticas para o roteador de borda:

"Este ativo deve estar plenamente configurado com ênfase em sua principal função" (*Oliveira, 2016*).

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Alguns serviços desnecessários mal configurados, podem ser tornar potenciais vulnerabilidades exploradas para amplificação de trafego (muito usado para ataques DDoS).

E outras "coisas"...

- ✘ DHCP;
- ✘ DNS recursivo;
- ✘ Hotspot;
- ✘ NTP Server;
- ✘ FTP;
- ✘ IGP nas interfaces de sessões como o OSPF.
- ✘ IPv6 RA (Router Advertisement) nas interfaces de sessões.

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E outras "coisas"...



Alguns serviços desnecessários mal configurados, podem ser tornar potenciais vulnerabilidades exploradas para amplificação de tráfego (muito usado para ataques DDoS).

Simple exemplo em cenário real:

(Lembre-se: Adeque-os de acordo com a função e necessidade)

```
[redacted] > /system package print
Flags: X - disabled
#  NAME          VERSION
0  routers-tile  6.34.6
1  system        6.34.6
2  X wireless-cm2 6.34.6
3  ipv6          6.34.6
4  X wireless-fp  6.34.6
5  X hotspot     6.34.6
6  X dhcp        6.34.6
7  X mpls        6.34.6
8  routing       6.34.6
9  X ppp         6.34.6
10 security     6.34.6
11 advanced-tools 6.34.6
```

Fonte: Autoria própria, 2016.

```
[redacted] > /ip service print
Flags: X - disabled, I - invalid
#  NAME      PORT ADDRESS
0  XI telnet  23
1  XI ftp    21
2  www       [redacted]
3  ssh       [redacted]
4  XI www-ssl 443
5  XI api    8728
6  winbox    [redacted]
7  XI api-ssl 8729
```

Fonte: Autoria própria, 2016.

Boas práticas para o ativo de borda

- ✓ Logs em loghost centralizado.
- ✓ Otimizando o RouterOS.

Monitoramento e Armazenamento de logs:

Para o Monitoramento de CPU, temperatura e tráfego, podemos utilizar o protocolo SNMP.

Uma boa prática é manter os logs em um loghost centralizado.



Dica básica para Performance no RouterOS:

FastPath:

- ✓ Permita um grande número de uso de CPU no encaminhamento de pacotes.
- ✓ Use em cenários de alto throughput.



Fasttrack:

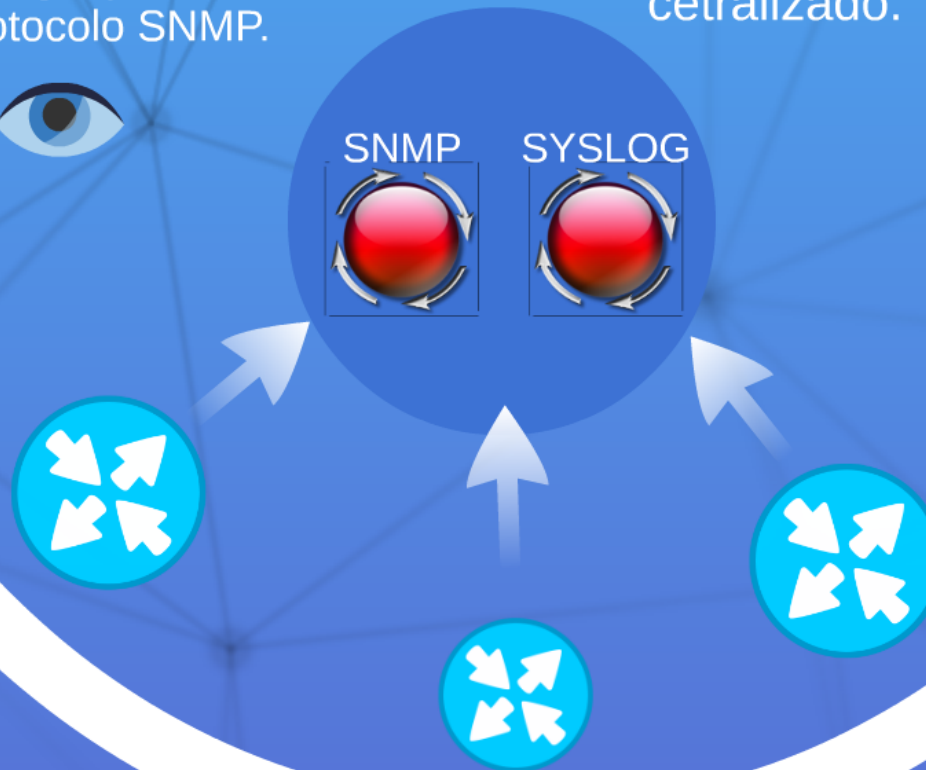


Monitoramento e Armazenamento de logs:

Para o Monitoramento de CPU, temperatura e tráfego, podemos utilizar o protocolo SNMP.



Uma boa prática é manter os logs em um loghost centralizado.



Dica básica para Performance no RouterOS:

FastPath:

- ✓ Permite um ganho incrível de uso de CPU no encaminhamento de pacotes.
- ✓ Útil em cenários de **alto throughput**.

Fasttrack:

FastTrack	
Without	With
363Mbps	890Mbps
CPU 100%	CPU 86%
41% CPU on firewall	6% CPU on firewall

Router on RYU1 - with single TCP stream
<http://wiki.mikrotik.com/wiki/Manual:FastTrack>

Condições

IPv4 handler
IPv4 fast path is automatically used if following conditions are met:

- firewall rules are not configured;
- firewall address lists are not configured;
- **Traffic flow is disabled** (/ip firewall rule action fast-track restriction removed in 6.33);
- Simple and queue trees with parent-qosbar are not configured;
- no mesh, meta-router interface configuration;
- sniffer, sniffer and traffic generator is not running;
- connection tracking is not active;
- ip accounting is disabled (ip accounting enabled=no);
- VRFs are not set (ip route vrf is empty);
- Hotspot is not used (ip hotspot has no interfaces);
- ipsec policies are not configured (ROS v6.8);
- no active mac-arp, mac-replication, mac-wireless sessions restriction removed in 6.33;
- fast mac-scan is not actively used;
- fast ip-scan is not actively used;
- route cache must be enabled

Fonte: https://wiki.mikrotik.com/wiki/Manual:Fast_Path

```
ip firewall rule fast-track
chain=forward action=fast-track
action=accept chain=forward src-address=192.168.1.1/24
action=accept chain=forward src-address=192.168.1.1/24
```

Fonte: Adorno próprio, 2017.



⚠ Observação: O FastTrack até o momento está disponível para IPv4.

FastPath:

- ✓ Permite um ganho incrível de uso de CPU no encaminhamento de pacotes.
- ✓ Útil em cenários de **alto throughput**.

Condições

IPv4 handler

IPv4 fast path is automatically used if following conditions are met:

- firewall rules are not configured;
- firewall address lists are not configured;
- ~~Traffic flow is disabled~~ `/ip traffic flow enabled=no` restriction removed in 6.33;
- Simple and queue trees with parent=global are not configured;
- no mesh, metarouter interface configuration;
- sniffer, torch and traffic generator is not running;
- connection tracking is not active;
- ip accounting is disabled (`/ip accounting enabled=no`);
- VRFs are not set (`/ip route vrf` is empty);
- Hotspot is not used (`/ip hotspot` has no interfaces);
- IpSec policies are not configured (ROS v6.8);
- ~~no active mac ping, mac telnet or mac winbox sessions~~ restriction removed in 6.33;
- `/tool mac-scan` is not actively used;
- `/tool ip-scan` is not actively used;
- route cache must be enabled



FastTrack

Without	With
360Mbps	890Mbps
CPU 100%	CPU 86%
44% CPU on firewall	6% CPU on firewall

* tested on RB2011 with single TCP stream

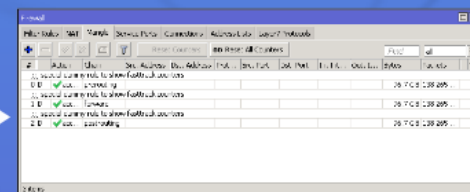
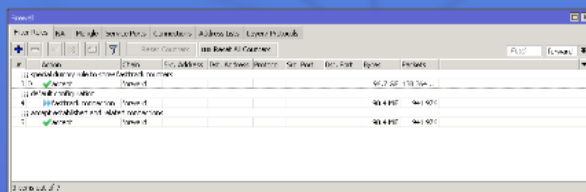
* tested on RB2011 with single TCP stream

Fonte: <https://wiki.mikrotik.com/wiki/Manual:IP/Fasttrack>



```
/ip firewall filter
add action=fasttrack-connection chain=forward comment=\
  "Estabelecidas / Relacionadas - Fasttrack" connection-state=\
  established,related
add action=accept chain=forward comment="Aceita Estabelecidas / Relacionadas" \
  connection-state=established,related
```

Fonte: Autoria própria, 2017.



Firewall

Filter Rules NAT Mangle Service Ports Connections Address Lists Layer7 Protocols

+ - ✓ ✕ [icon] [icon] Reset Counters 00 Reset All Counters Find forward

#	Action	Chain	Src. Address	Dst. Address	Protocol	Src. Port	Dst. Port	Bytes	Packets
;;; special dummy rule to show fasttrack counters									
0	D ✓ accept	forward						96.7 GiB	138 264 ...
;;; default configuration									
4	▶▶ fasttrack connection	forward						90.4 MiB	941 976
;;; accept established and related connections									
5	✓ accept	forward						90.4 MiB	941 976

3 items out of 7

Firewall

Filter Rules NAT Mangle Service Ports Connections Address Lists Layer7 Protocols

+ - ✓ ✗ 📄 🏠 🏠 Reset Counters 00 Reset All Counters Find all

#	Action	Chain	Src. Address	Dst. Address	Prot...	Src. Port	Dst. Port	In. Int...	Out. I...	Bytes	Packets
;;; special dummy rule to show fasttrack counters											
0	D ✓ acc...	prerouting								96.7 GiB	138 265 ...
;;; special dummy rule to show fasttrack counters											
1	D ✓ acc...	forward								96.7 GiB	138 265 ...
;;; special dummy rule to show fasttrack counters											
2	D ✓ acc...	postrouting								96.7 GiB	138 265 ...

3 items



Observação: O FastTrack até o momento está disponível para IPv4.



Atenção ao uso seguintes recursos:

- ✓ SNMP com configurações default;
- ✓ MNDP (Mikrotik Neighbor Discovery Protocol) em interfaces não necessárias como upstreams;
- ✓ RoMON com configurações default.



Não se esqueça!

- ✓ Política de backup

👤	-PTT...	4C:5E:0C:4A:D7	Backbone	Mikro Tik	6.34.6 (b...	CCR1036-12G-4S
👤	-PTT...	4C:5E:0C:25:6A:		Mikro Tik	6.35.4 (st...	CCR1016-12G
👤	-PTT...	4C:5E:0C:C8:ED		Mikro Tik	6.36.3 (st...	CCR1036-8G-2S+
👤	-PTT...	90:E2:BA:84:78:		Mikro Tik	6.38.5 (st...	x86
👤	-PTT...	4C:5E:0C:25:9F:		Mikro Tik	6.40.3 (st...	CCR1036-8G-2S+
👤	-PTT...	4C:5E:0C:4D:60		Mikro Tik	6.40.2 (st...	CCR1036-8G-2S+
👤	-PTT...	D4:CA:6D:77:E1		Mikro Tik	6.38.5 (st...	CCR1036-12G-4S
👤	-PTT...	4C:5E:0C:02:FF:		Mikro Tik	6.40.3 (st...	CCR1036-12G-4S
👤	-PTT...	D4:CA:6D:74:53		Mikro Tik	6.38.7 (b...	CCR1036-8G-2S+
👤	-PTT...	E4:8D:8C:10:AE		Mikro Tik	6.37.4 (b...	CCR1009-7G-1C-1S+
👤	-PTT...	4C:5E:0C:C5:E8		Mikro Tik	6.37.3 (st...	CCR1036-8G-2S+
👤	-PTT...	4C:5E:0C:4E:56:		Mikro Tik	6.38.7 (b...	CCR1072-1G-8S+
👤	-PTT...	6C:3B:6B:35:F4:		Mikro Tik	6.38.7 (b...	CCR1009-7G-1C-1S+
👤	-PTT...	D4:CA:6D:22:F5		Mikro Tik	6.36.3 (st...	CCR1072-1G-8S+
👤	-PTT...	6C:3B:6B:E4:87:		Mikro Tik	6.37.3 (st...	CCR1036-8G-2S+
👤	-PTT...	00:0C:42:5F:07:!		Mikro Tik	6.37.5 (b...	CCR1009-8G-1S
👤	-PTT...	4C:5E:0C:02:88:		Mikro Tik	6.39.2 (st...	x86
👤	-PTT...	D4:CA:6D:74:00		Mikro Tik	6.29.1	CCR1036-12G-4S
👤	-PTT...	00:90:0B:2A:65:!		Mikro Tik	6.34.6 (b...	CCR1036-12G-4S
👤	-PTT...	4C:5E:0C:25:85:		Mikro Tik	6.38.7 (b...	CCR1036-12G-4S
👤	-PTT...	4C:5E:0C:C8:E2		Mikro Tik	6.40.3 (st...	CCR1036-8G-2S+
👤	-PTT...	64:D1:54:D5:78:		Mikro Tik	6.34.6 (b...	CCR1072-1G-8S+
👤	-PTT...	44:D9:E7:95:40:		Mikro Tik	6.37.5 (b...	RB1100AHx2
👤	-PTT...	00:0C:42:5F:07:!		Mikro Tik	6.37.5 (b...	CCR1009-8G-1S
👤	-PTT...	4C:5E:0C:02:FF:		Mikro Tik	6.40.3 (st...	CCR1036-12G-4S
👤	-PTT...	4C:5E:0C:25:85:		Mikro Tik	6.38.7 (b...	CCR1036-12G-4S
👤	-PTT...	E4:8D:8C:0F:57:		Mikro Tik	6.37.5 (b...	CCR1009-8G-1S-1S+
👤	-PTT...	4C:5E:0C:13:B7:		Mikro Tik	6.40.3 (st...	CCR1072-1G-8S+
👤	-PTT...	4C:5E:0C:25:6A:		Mikro Tik	6.35.4 (st...	CCR1016-12G
👤	-PTT...	4C:5E:0C:C5:E8		Mikro Tik	6.37.3 (st...	CCR1036-8G-2S+
👤	-PTT...	4C:5E:0C:4E:56:		Mikro Tik	6.38.7 (b...	CCR1072-1G-8S+
👤	-PTT...	D4:CA:6D:77:E1		Mikro Tik	6.38.5 (st...	CCR1036-12G-4S

Resultados... Como Analisar?

As boas práticas devem ser levadas em consideração e aplicadas sempre que possível e de acordo com o cenário.
O resultado vem através do conjunto delas.



Como testar?

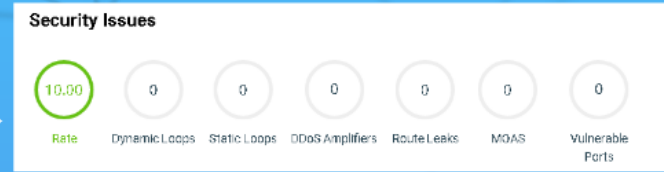
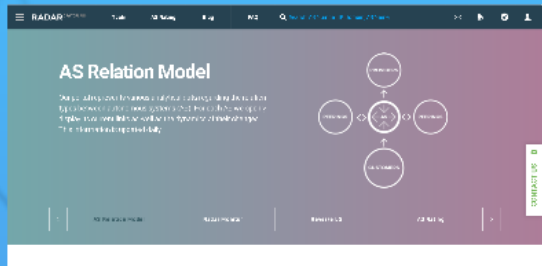


Estatísticas relevantes - Case RadarWISP



O resultado vem através do conjunto delas.

Ferramenta de análise "Radar by qrator"



Resultados de análise do site Radar byQrator

Fonte: <https://radar.qrator.net>, 2016

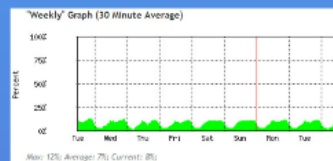
Como testar?



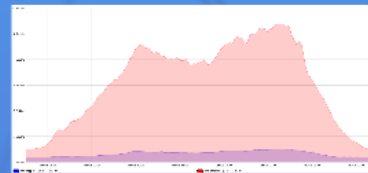
www.nmap.org - <https://www.nmap.org>



Estatísticas relevantes - Case RadarWISP



Amostra do gráfico de processamento, 2016 - ativo de borda - Hardware: RouterBoard CCR1072-1G-9S+

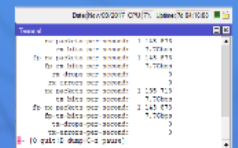


Amostra do gráfico em throughput acima de 5Gbps (em uma interface) - Hardware: RouterBoard CCR1072-1G-9S+



Uso de boas praticas + Route Server

Fonte: Autoria própria, 2017



Ferramenta de análise "Radar by qrator"

The screenshot displays the RADAR QRATOR LABS website interface. The top navigation bar includes a menu icon, the site name "RADAR QRATOR LABS", and links for "Tools", "AS Rating", "Blog", and "FAQ". A search bar is present with the placeholder text "Search: AS Number, IP, Domain, AS Name". On the right side of the navigation bar, there are icons for email, a notification bell, a checkmark, and a user profile.

AS Relation Model

Our portal represents various analytical data regarding the relation types between autonomous systems (AS). For each AS we openly display its current links as well as the dynamics of their changes. This information is updated daily.

The central diagram illustrates the AS Relation Model. It features a central circle labeled "AS" with four arrows pointing towards it from the top, bottom, left, and right. Surrounding this central circle are four other circles: "PROVIDERS" at the top, "CUSTOMERS" at the bottom, and two "PEERINGS" circles on the left and right. The "PEERINGS" circles are connected to the central "AS" circle by double-headed arrows (<>).

At the bottom of the page, there is a horizontal navigation bar with five buttons: "<", "AS Relation Model", "Radar Monitor", "Reverse LG", "AS Rating", and ">". A vertical "CONTACT US" button is located on the right side of the page.

Security Issues



10.00

Rate



0

Dynamic Loops



0

Static Loops



0

DDoS Amplifiers



0

Route Leaks



0

MOAS



0

Vulnerable
Ports

Resultados de análise do site Radar byQrator

Fonte: <https://radar.qrator.net>, 2016



Port Forwarding Tester

your external address

168.227.31.252

open port finder

Remote Address Port Number
[Use Current IP](#)

Check a port's status by entering an address and port number above.

about

The open port checker is a tool you can use to check your external IP address and detect open ports on your connection. This tool is useful for finding out if your port forwarding is setup correctly or if your server applications are being blocked by a firewall. This tool may also be used as a port scanner to scan your network for ports that are commonly forwarded. It is important to note that some ports, such as port 25, are often blocked at the ISP level in an attempt to prevent malicious activity.

For more a comprehensive list of TCP and UDP ports, check out [this Wikipedia article](#).

If you are looking for a software solution to help you configure port forwarding on your network, try using this powerful [Port Forwarding Wizard](#).

If my tool has been helpful to you, check out my [desktop wallpaper](#) site or follow me on Twitter [@kirkouimet](#). Also, if your router is causing you massive grief try picking up a cheap Netgear N600 on [Amazon](#).

common ports

- 21 FTP
- 22 SSH
- 23 TELNET
- 25 SMTP
- 53 DNS
- 80 HTTP
- 110 POP3
- 115 SFTP
- 135 RPC
- 139 NetBIOS
- 143 IMAP
- 194 IRC
- 443 SSL
- 445 SMB
- 1433 MSSQL
- 3306 MySQL
- 3389 Remote Desktop
- 5632 PCAnywhere
- 5900 VNC
- 6112 Warcraft III
- Scan All Common Ports

accessível em: <https://www.yougetsignal.com/tools/open-ports/>

To manually test an IP address

```
dig +short test.openresolver.com TXT @1.2.3.4
```

(replace 1.2.3.4 with the IP address or domain name of the DNS server you are testing)

If you get "open-resolver-detected" in response, then you have a problem :)

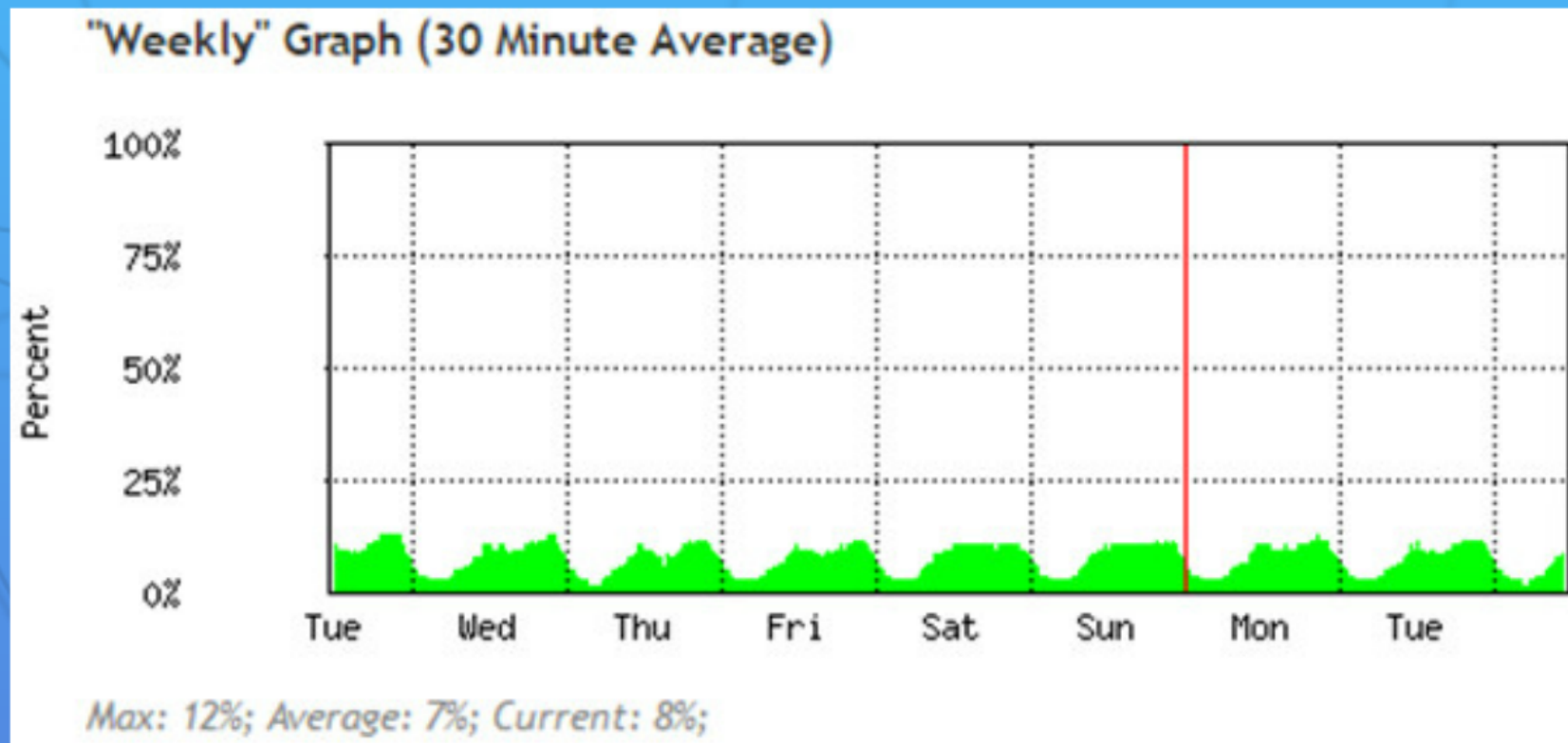
Or, use a form:

accessível em: <http://openresolver.com/>

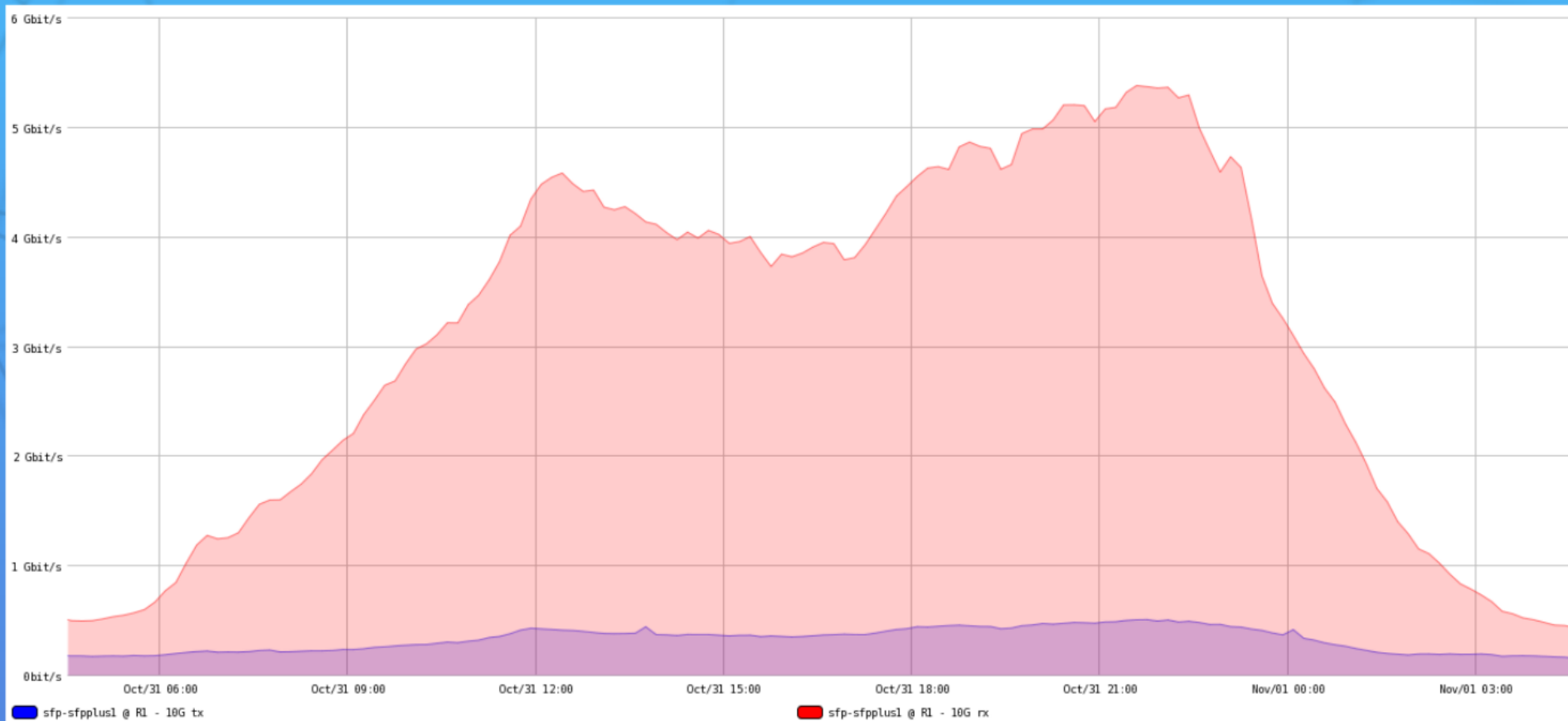


NMAP

acessível em: <https://nmap.org/>



*Amostra do gráfico de processamento, 2016 - ativo de borda -
Hardware: RouterBoard CCR1072-1G-8S+*

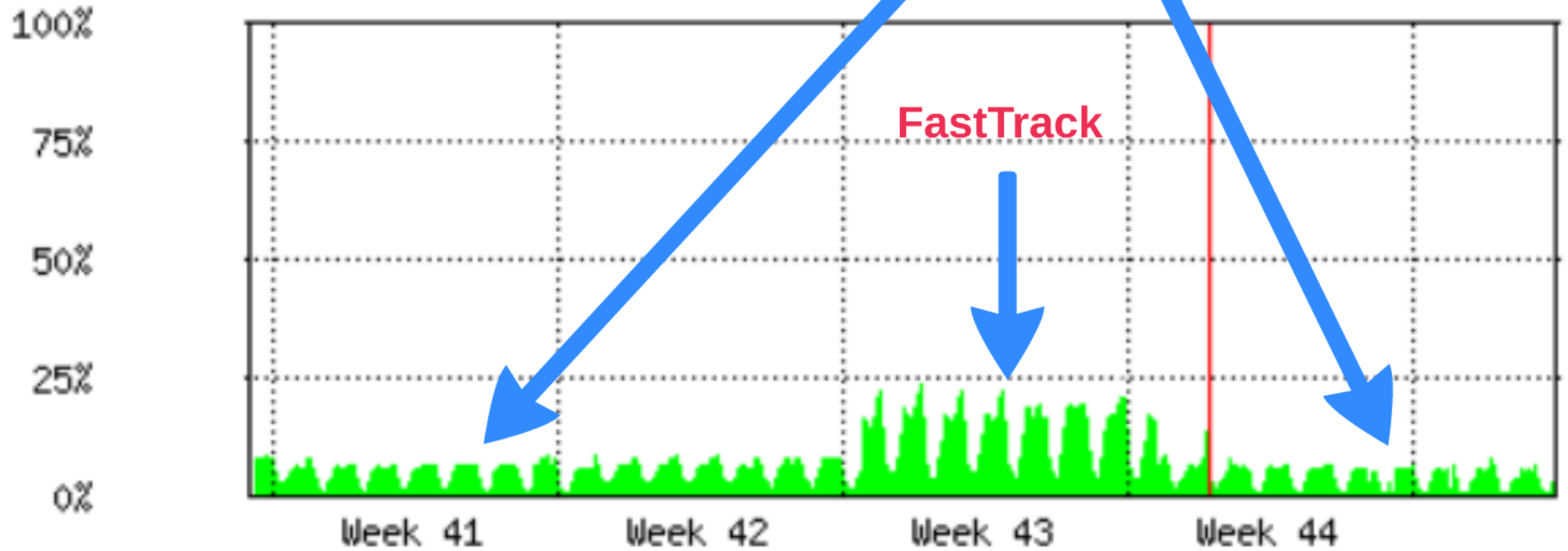


Amostra do gráfico em throughput acima de 5Gbps (em uma interface) - Hardware: RouterBoard CCR1072-1G-8S+

6 Gbit/s

5 Gbit/s

"Monthly" Graph (2 Hour Average)



Max: 32%; Average: 6%; Current: 2%;

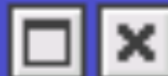
Uso de boas praticas + Route Server

Fonte: Autoria própria, 2017

Date: Nov/09/2017 CPU: 7% Uptime: 7d 04:16:08



Terminal



```
rx-packets-per-second: 1 143 873
rx-bits-per-second:    7.7Gbps
fp-rx-packets-per-second: 1 143 873
fp-rx-bits-per-second: 7.7Gbps
rx-drops-per-second: 0
rx-errors-per-second: 0
tx-packets-per-second: 1 135 713
tx-bits-per-second:    7.7Gbps
fp-tx-packets-per-second: 1 143 873
fp-tx-bits-per-second: 7.7Gbps
tx-drops-per-second: 0
tx-errors-per-second: 0
```

-- [Q quit | D dump | C-z pause]

Referências Bibliográficas:

- ✓ <http://nic.br/>
- ✓ <https://wiki.mikrotik.com>
- ✓ <https://cert.br>
- ✓ <http://www.rfc-editor.org/info/rfc1918>
- ✓ <http://www.team-cymru.org/>
- ✓ <https://tools.ietf.org/html/bcp194>
- ✓ Artigo: "BOAS PRÁTICAS EM ROTEAMENTO DE BORDA PARA SISTEMAS AUTONOMOS PROVEDORES DE ACESSO À INTERNET EM PROCESSO DE DUAL STACK" João Alberto B. Oliveira, 2016



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- ✓ UEG - Campus Trindade-GO
- ✓ NIC.br

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Wardner Maia (MD Brasil)

Dúvidas?



Obrigado!



