

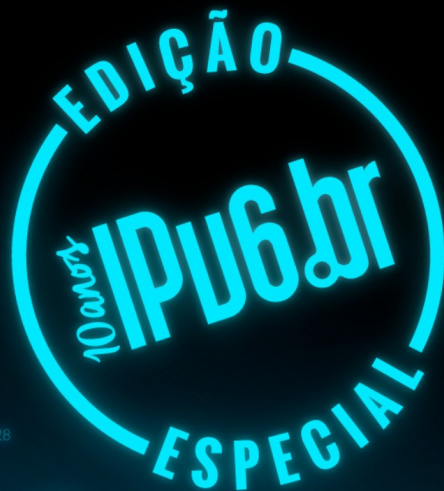


Fórum Regional IX.br - SP

Como ir do IPv4 para o IPv6, passando pelo CGNAT e NAT64.

Adalberto Lins
adalberto@cisco.com

Março de 2019

[Sobre](#)[Agenda](#)[Local](#)[Hospedagem](#)[Dicas de São Paulo](#)[Jantar](#)[Contato](#)[egi.br](#) [nic.br](#)

FÓRUM BRASILEIRO DE IPv6

SÃO PAULO-SP
ESPAÇO CITRON
09.10.2018

fe80::fa16:54ff:fe18:8928

ff02::1:ffbf:fa18

2001:0:beba:4567::coca:co1a

FF3E:20:2001:DB8::CADE:CAFE

64:ff9b::c000:0221

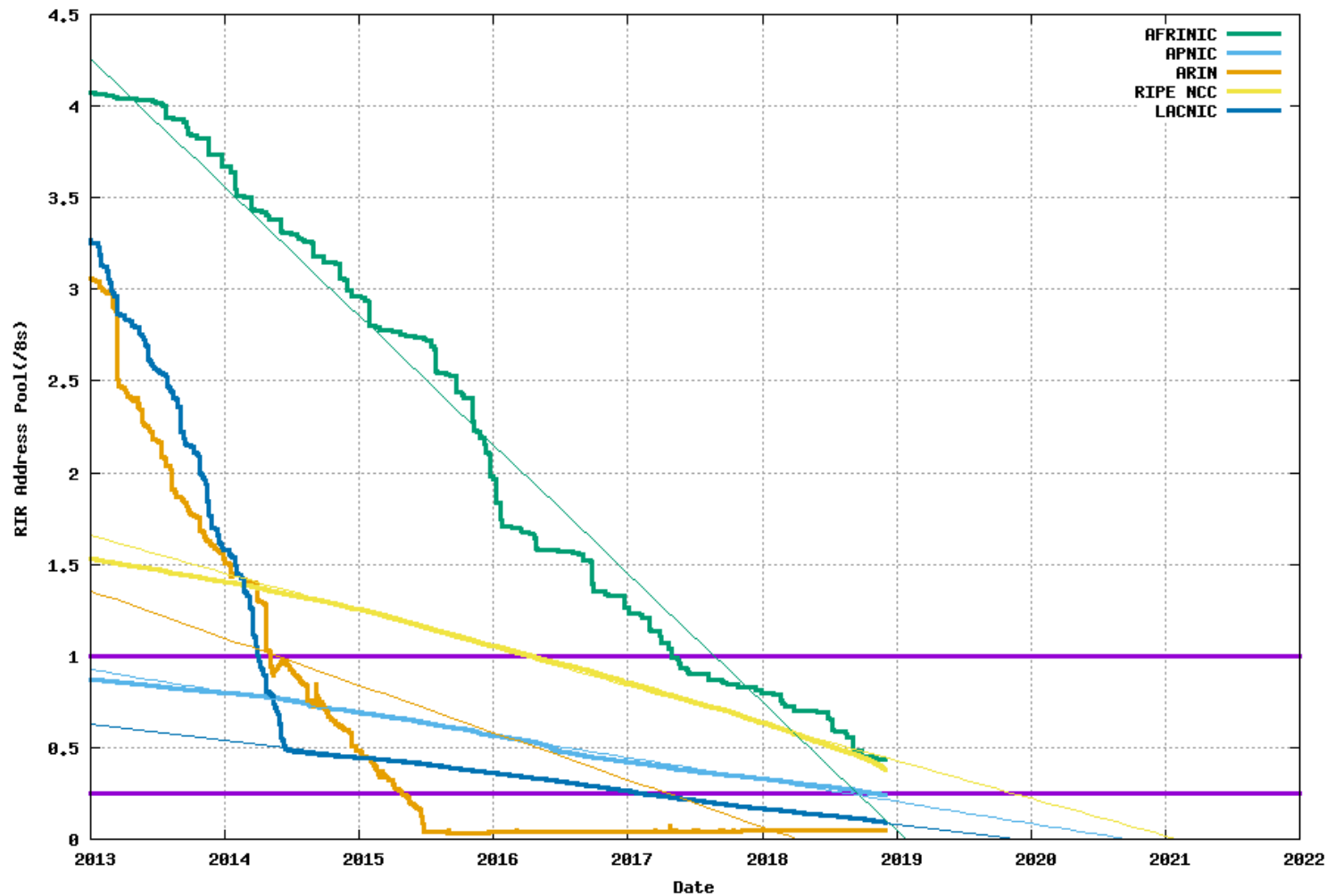
2001:db8::1

2002:09fe:fdfe::ca5a

Perguntas

1. Esse assunto é relevante para vocês?
2. Tem IPv4 válido sobrando para atender? **SEM CGNAT**
3. Quem está fazendo CGNAT?
4. Você se sente a vontade para experimentar e implementar IPv6?
5. Quem já está fazendo peering e recebendo IPV6 na Borda BGP?
6. Quem já tem IPv6 implementado em clientes ou em piloto?

RIR IPv4 Address Run-Down Model



Esgotamento no LACNIC

Política implemetada em 2011 com 3 fases:

- FASE 1 “Estoque” /9 – Mai 2014
- FASE 2 “Estoque” /10 – jun 2014 (esgotamento)
- FASE 3 (atual) – Jan 2017
 - Alocação inicial somente (/24 a /22)

Previsão atual de esgotamento: **Jan/2020**

Ricardo Patara (NIC.br)

Panorama do esgotamento do IPv4 e implantação do IPv6 na Internet

10anos.ipv6.br - Out/2018

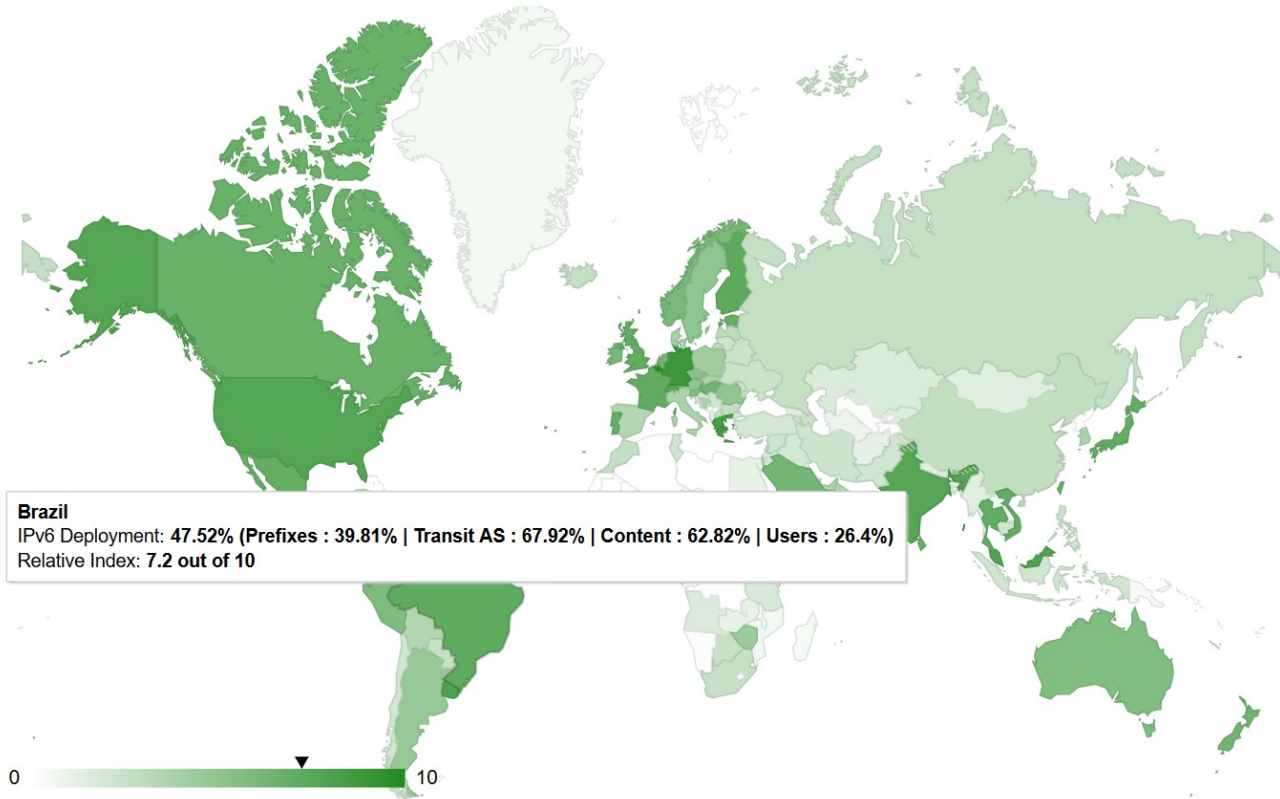
Google IPv6 Country Rank

Per-country ranking table based on data from [Google IPv6 Statistics](#) page.

#	Country	Adoption	Latency	Impact
1	 Belgium	53.78%	0ms	-0.01%
2	 Germany	40.59%	0ms	-0.0%
3	 Greece	36.44%	-140ms	-0.05%
4	 United States	34.62%	0ms	0.01%
5	 India	32.9%	-10ms	-0.05%
6	 Malaysia	31.49%	-40ms	-0.04%
7	 Uruguay	30.57%	-480ms	-0.03%
8	 Switzerland	28.91%	0ms	0.0%
9	 Luxembourg	28.1%	0ms	-0.02%
10	 Japan	27.09%	0ms	0.0%
11	 Brazil	26.45%	-50ms	0.08%
12	 Vietnam	24.9%	0ms	0.01%
13	 Estonia	23.87%	-10ms	-0.01%
14	 France	23.83%	0ms	0.0%
15	 Mexico	22.21%	-30ms	0.0%

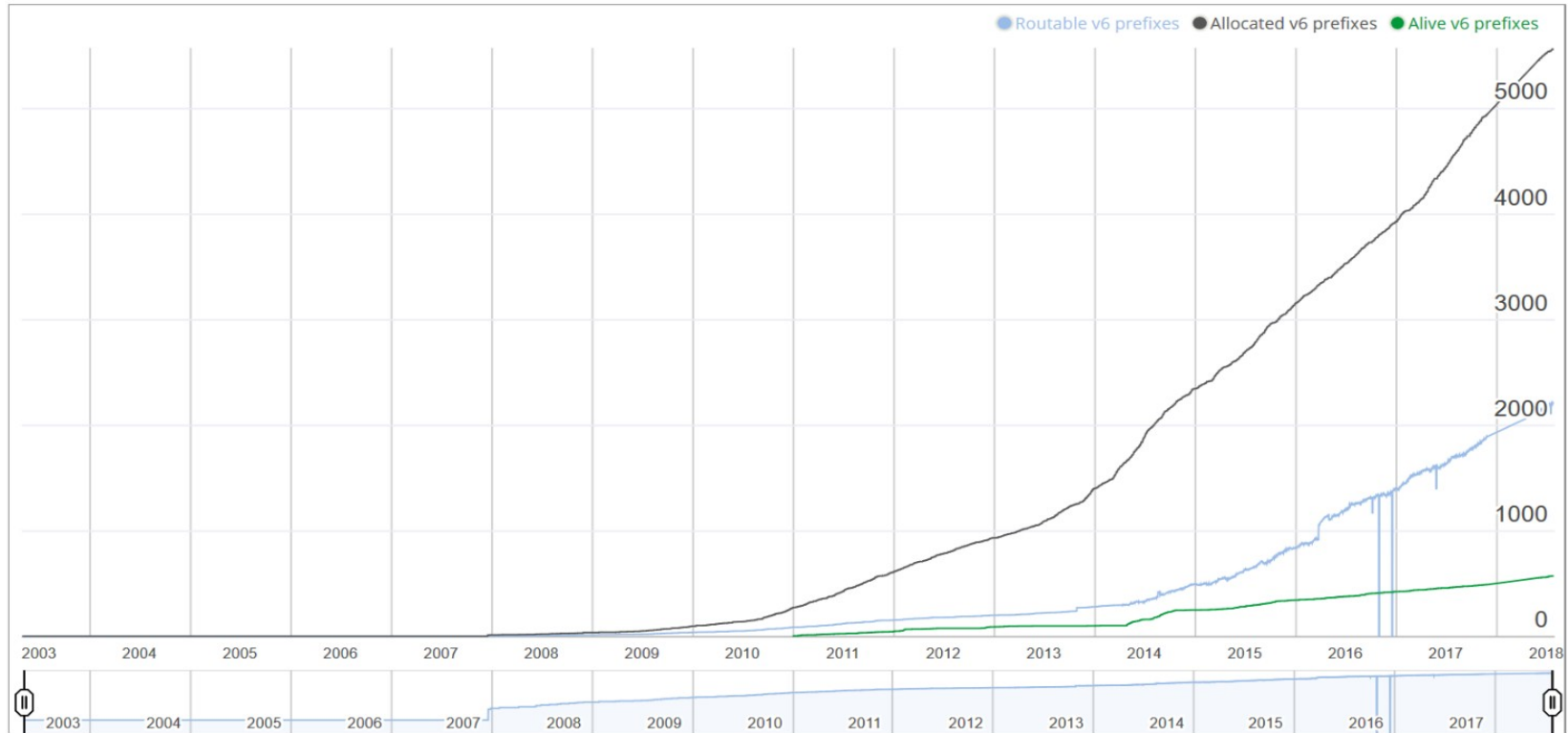
Display global data

[World](#) | [Africa](#) | [Asia](#) | [America](#) | [Europe](#) | [Oceania](#)



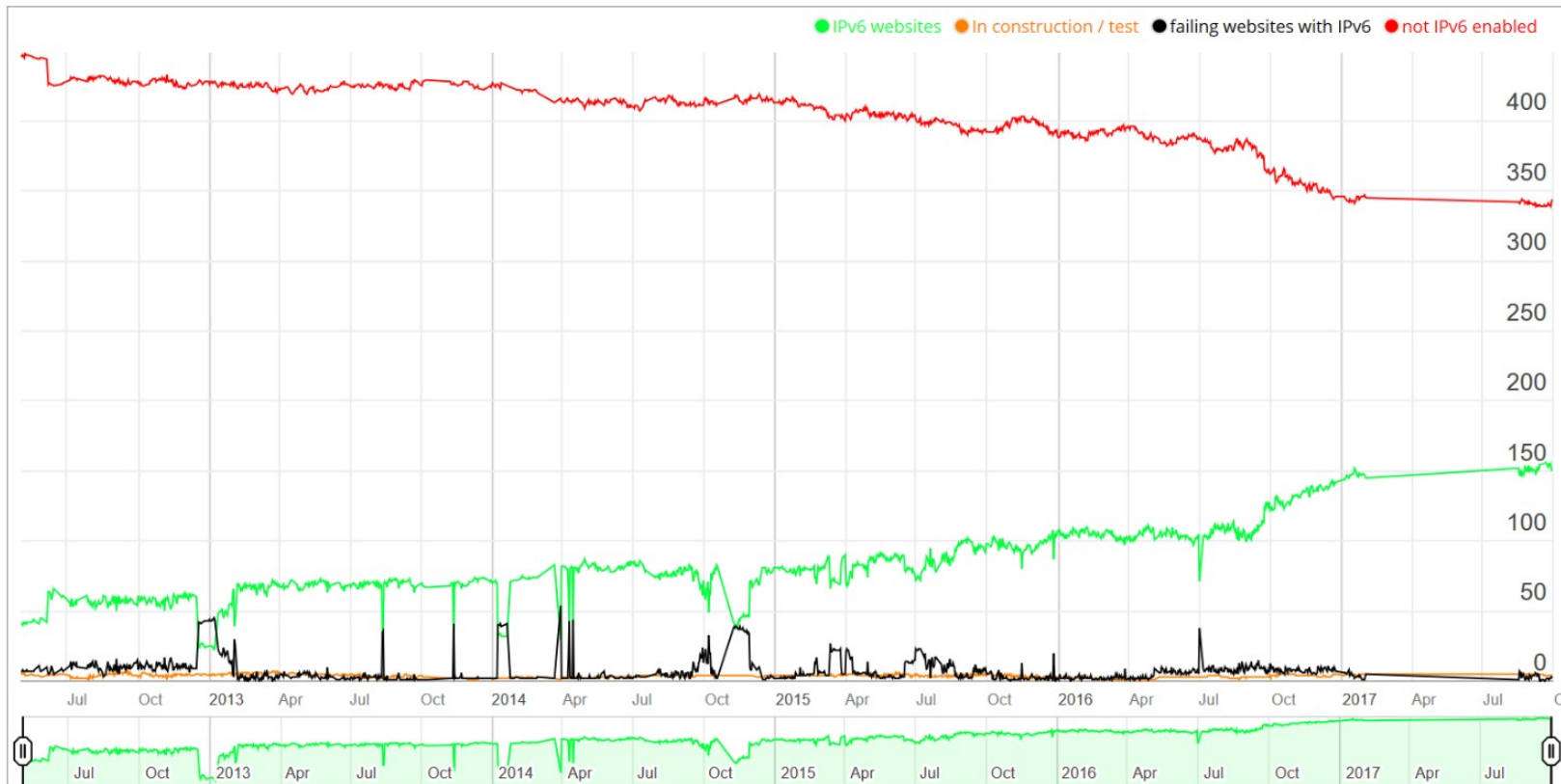
Brazil

Display IPv6 Prefixes Data ⓘ



Brazil

Display Content Data ⓘ



“O dado que é público é que a rede da VIVO como um todo somando todos os produtos é em torno de quase 50% de tráfego IPv6. Na móvel ele é ainda mais concentrado” ... “**esta em torno de 70%**”.

“O Nat64 passa a fazer sentido quando ele passa da metade, pois passamos a economizar efetivamente”

Fábio Scartoni (Vivo)

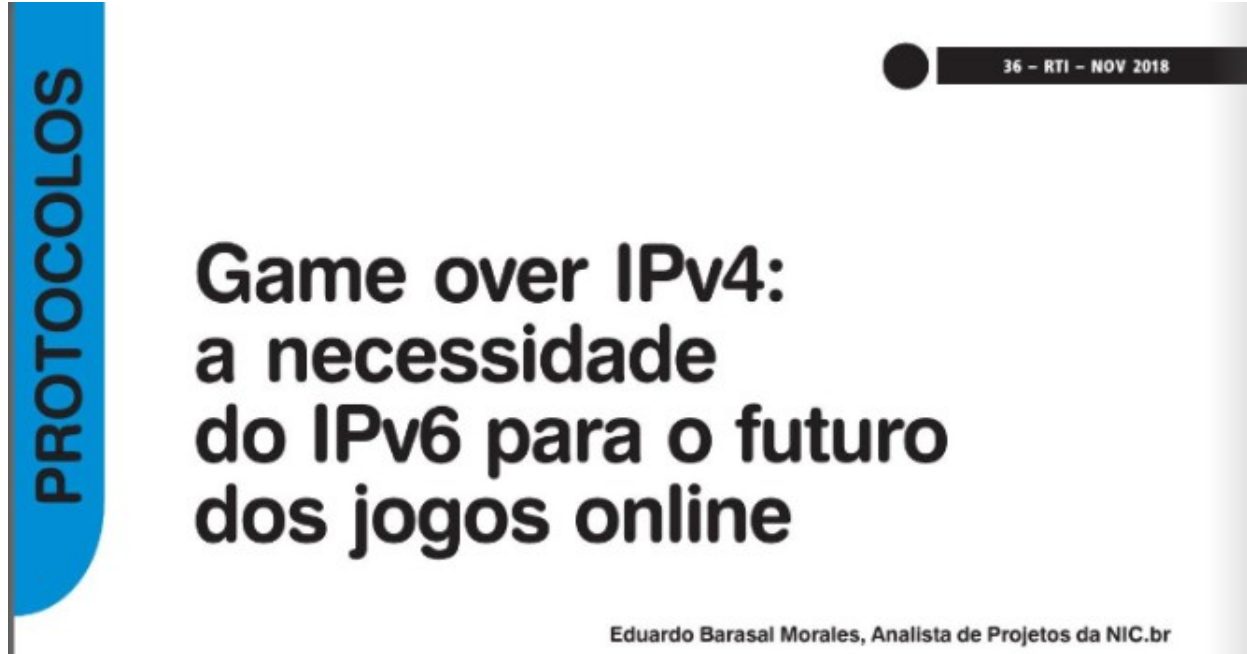
Painel: Desafios da implantação do IPv6 e desligamento do IPv4

Fórum Brasileiro de IPv6 – 09.10.2018

Problemas conhecidos do CGNAT

- On-line gaming
- Video streaming (Netflix, Hulu, ...)
- IP cameras
- Security
- BitTorrent/Limewire (seeding – uploading)
- Port forwarding (Surveillance, Home-Automation)
- VoIP
- UPnP-IGD (Universal Plug & Play - Internet Gateway Device protocol)
- NAT-PMP (NAT Port Mapping Protocol)
- Other NAT Traversal mechs
- AJAX (Asynchronous Javascript And XML)
- FTP (big files)
- Tunnels, VPN, IPsec, ...

Esforços já adiantados para concluir as últimas pendências práticas



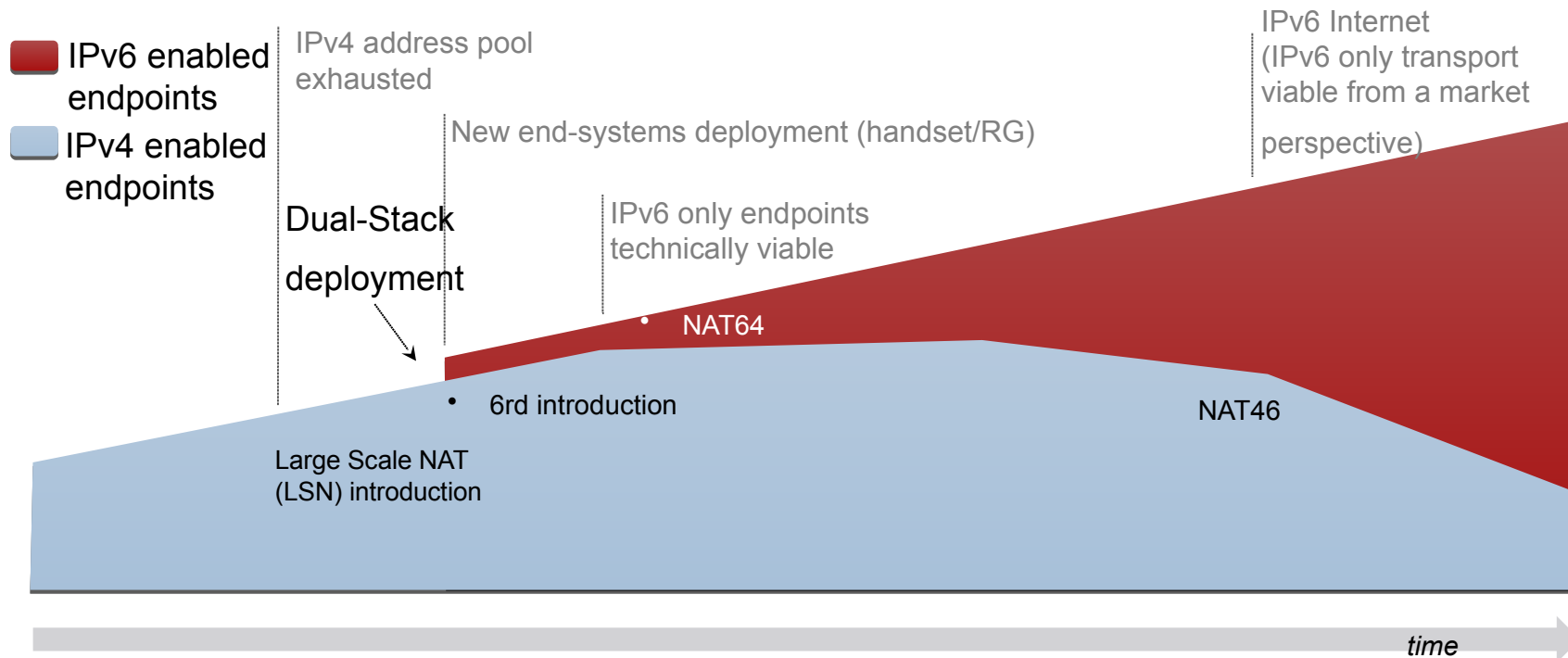
Internet Society IETF Meeting Nov/2018



- **Trusted Systems, IoT & IPv6**
- **IPv6, NTP, Routing Security & IoT**
- **IPv6, TLS, DNS Privacy & Other Crypto**

<https://www.internetsociety.org/issues/ipv6/>

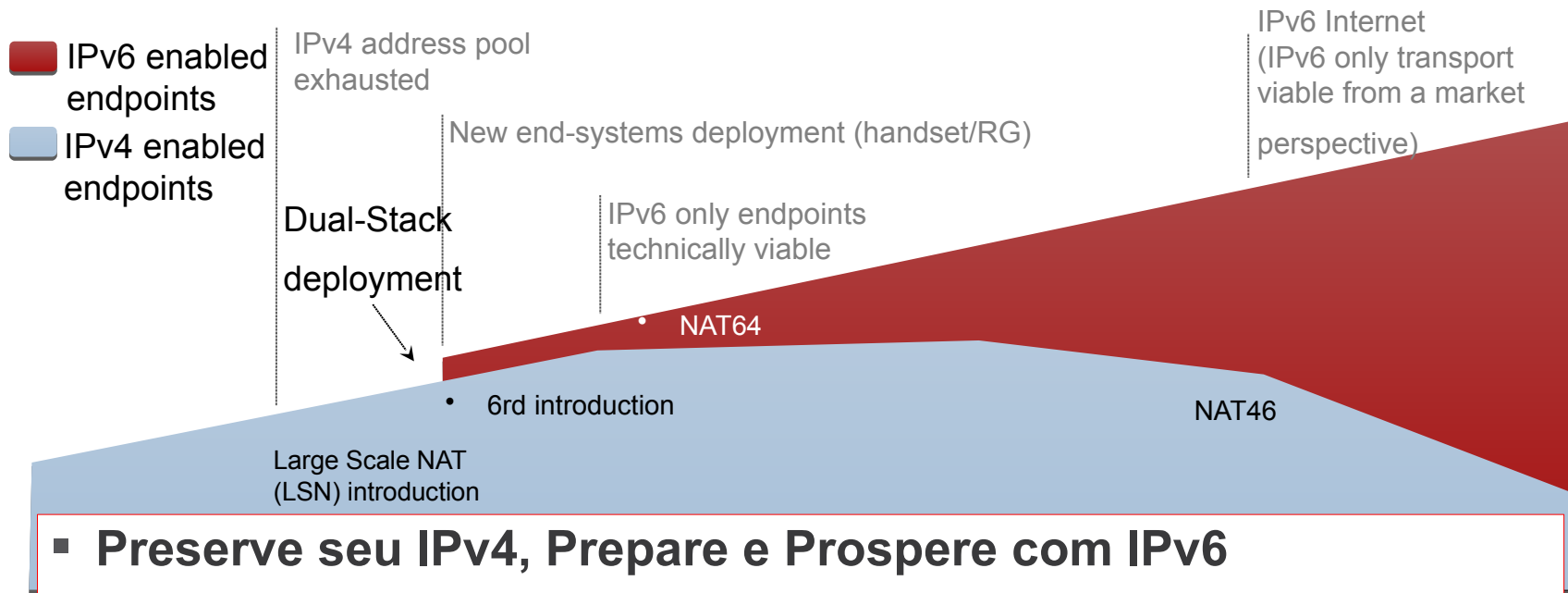
Key Takeaway – No one size fits all Multiple technology adoption scenarios



- Preserve IPv4, Prepare and Prosper with IPv6

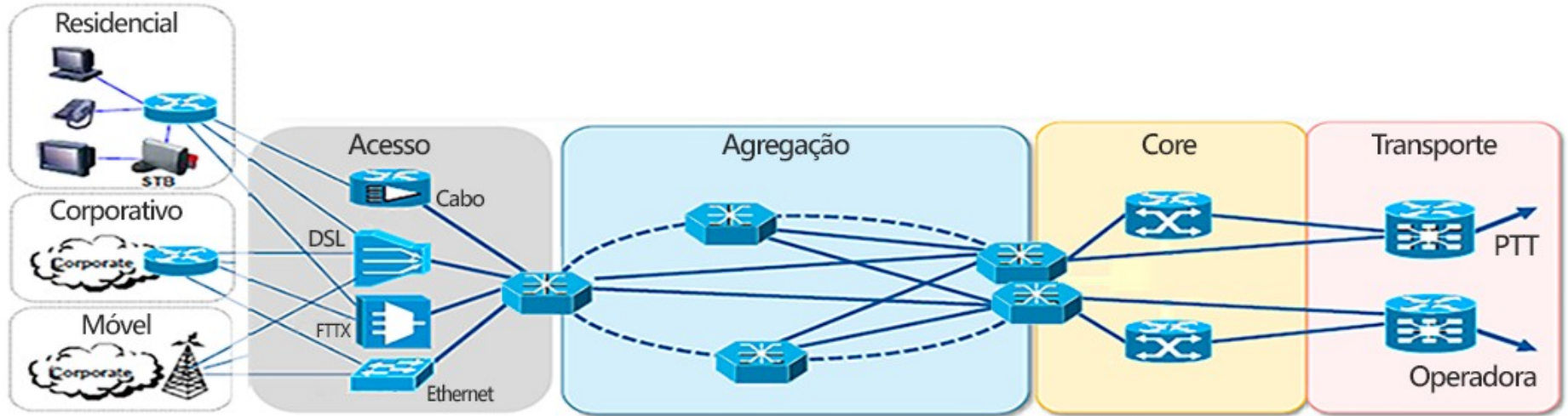
- Remember: IPv6 Makes IPv4 network with NAT44 works better

Key Takeaway – No one size fits all Multiple technology adoption scenarios



- **Preserve seu IPv4, Prepare e Prospere com IPv6**
- **LEMBRE-SE: IPv6 torna a rede IPv4 com NAT44 muito melhor**

Topologia de Referencia



CPE
WiFi
SD WAN
Security
IPv6

FTTH, PON
GPON, STP,
REP, 802.1Q
Etc,

OSPF, MPLS,
VPLS, L3VPN

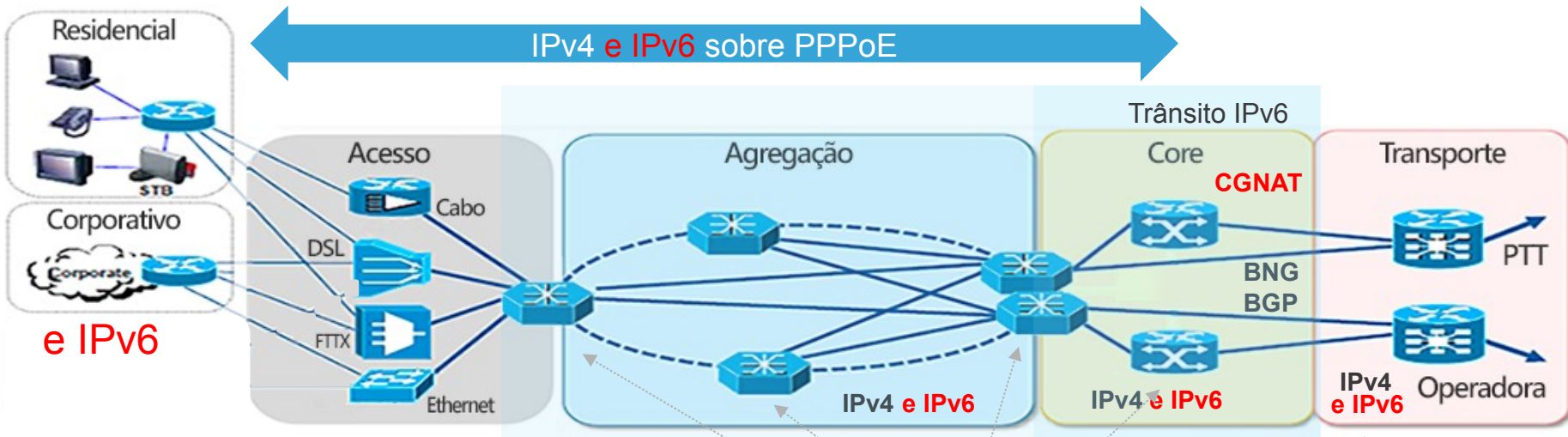
Segment Routing
BGP-eVPN
DWDM

BGP, BNG
(PPPoE/IPoE/BRAS)
CGNAT,
NAT64

BGP
BGP Full
IPv4/IPv6
DDoS

Qual parte do backbone precisa fornecer trânsito IPv6 ?

e IPv6



• Peering IPv6

- Endereçamento IPv6
- Roteamento IPv6
- Serviços IPv6



INTERNET

179.160.44.52 /28
2804:414:1004::/56



Cisco 2900
BGP



Cisco NCS-540
Core

Cisco ASR 9001-S
BORDA

TOPOLOGIA FISICA DO LAB

Cisco ASR 1001-X
BORDA

Borda

Bridge Domain

Serviços
Borda BGP

Autenticação BNG
Concentrador PPPoE
CGNAT / NAT64

2804:414:1004:1::/64



192.168.10.9 /24
Servidor
Software de Gestão
Autenticação

CGNAT

179.160.44.52 => 100.64.20.0 / 24

NAT64

64:FF9B::/96 => IP PUBLICO

PE

172.16.1.0 /24

172.16.2.0 /24

P

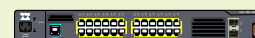
P

P

P

Anel
OSPF / MPLS
L2VPN

172.16.3.0 /24



ANEL
Cisco ASR 920
Cisco IE 3400

P

172.16.4.0 /24



Agregação

PE

172.16.5.0 /24

PE

2804:414:1004:1::/64

100.64.20.2 /24



Cisco 1900
CPE - Cliente
PPPoE



192.168.1.0 /24

2804:414:1004:1::/64

100.64.20.3 /24



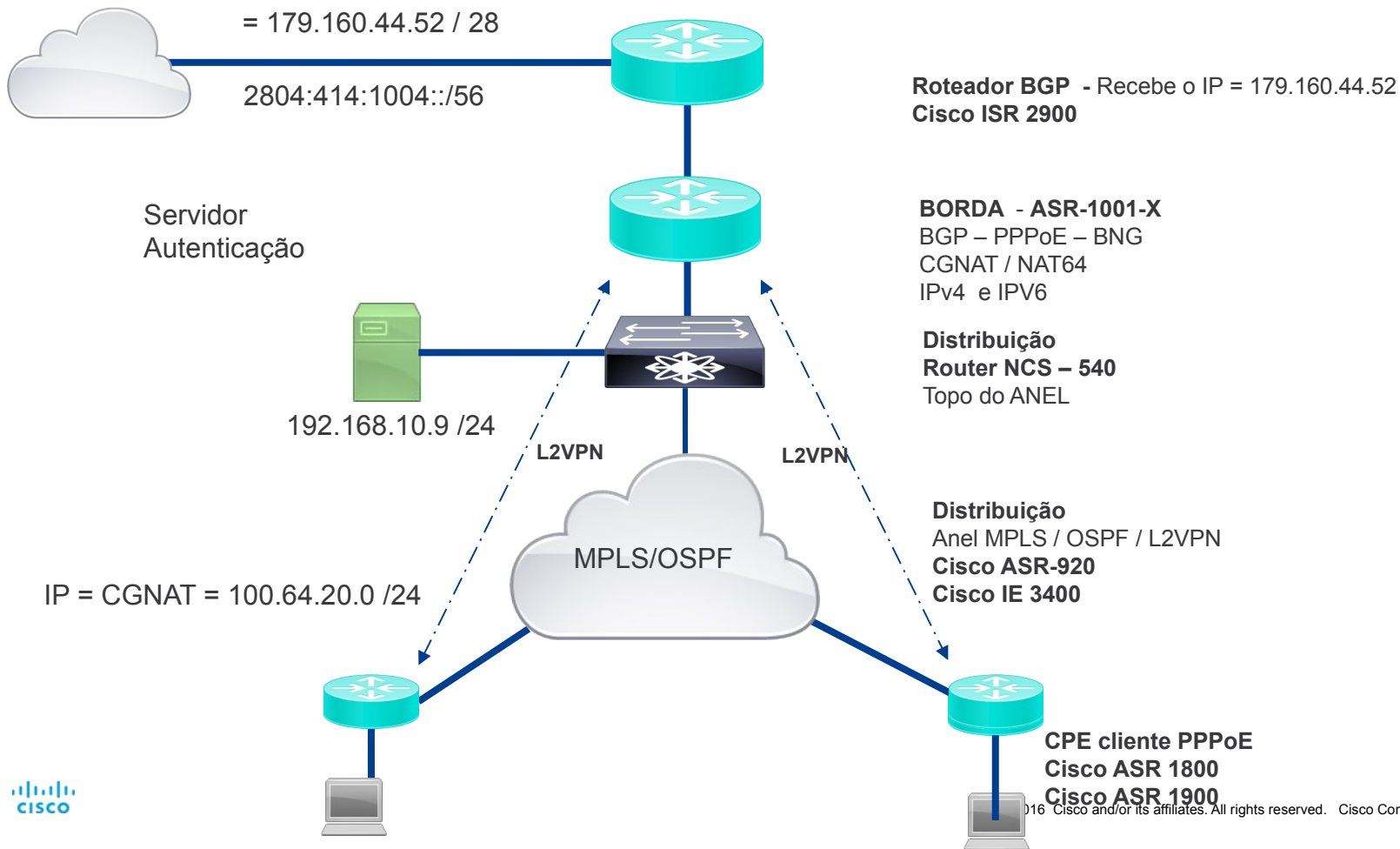
Cisco 1800
CPE - Cliente
PPPoE



192.168.1.0 /24

Acesso

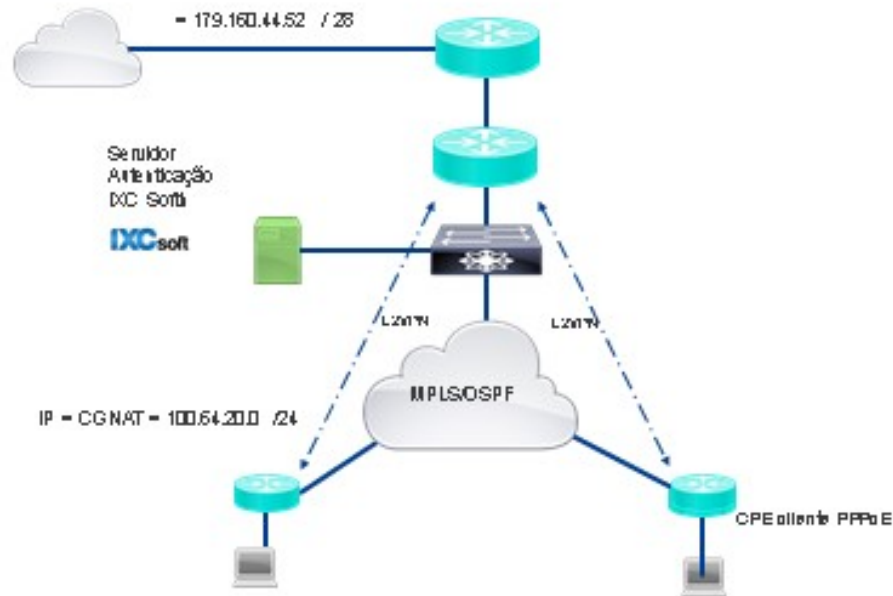
TOPOLOGIA LOGICA DO LAB



Partindo de um Ambiente IPv4 Only

ASR – 1001-X

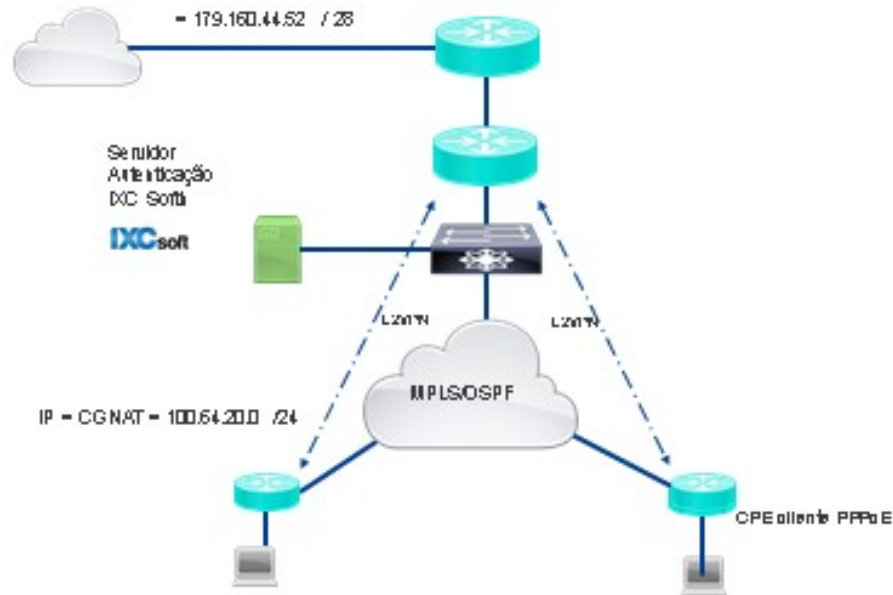
- BGPv4
- PPPoE IPv4
- BNG – RADIUS
- CGNAT



Partindo de um Ambiente IPv4 Only

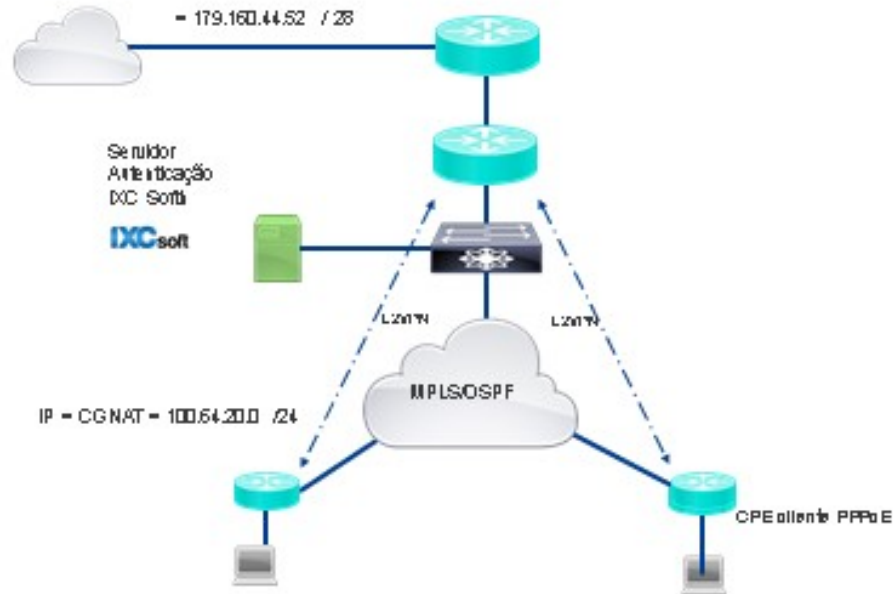
ASR – 1001-X

- BGPv4 **BGPv6**
- PPPoE **IPv6**
- BNG – RADIUS
- CGNAT



ASR – 1001-X

- BGPv4 **BGPv6**
- PPPoE **IPv6**
- BNG – RADIUS
- CGNAT **NAT64**



Mais informações

➔ Tutorial NIC.br

Como ir do IPv4 para o IPv6, passando pelo CGNAT e NAT64.

<https://tutoriais.semanainfrabr.nic.br/2018/>

➔ Canal ISP.Express

<https://isp.express/>

➔ Cursos e Eventos NIC.br

<http://ipv6.br/>

➔ Estatísticas IPv6 - CISCO

6lab.cisco.com/stats/

➔ IPv6 Country Rank

<https://www.aelius.com/njh/google-ipv6/>

OBRIGADO !!!



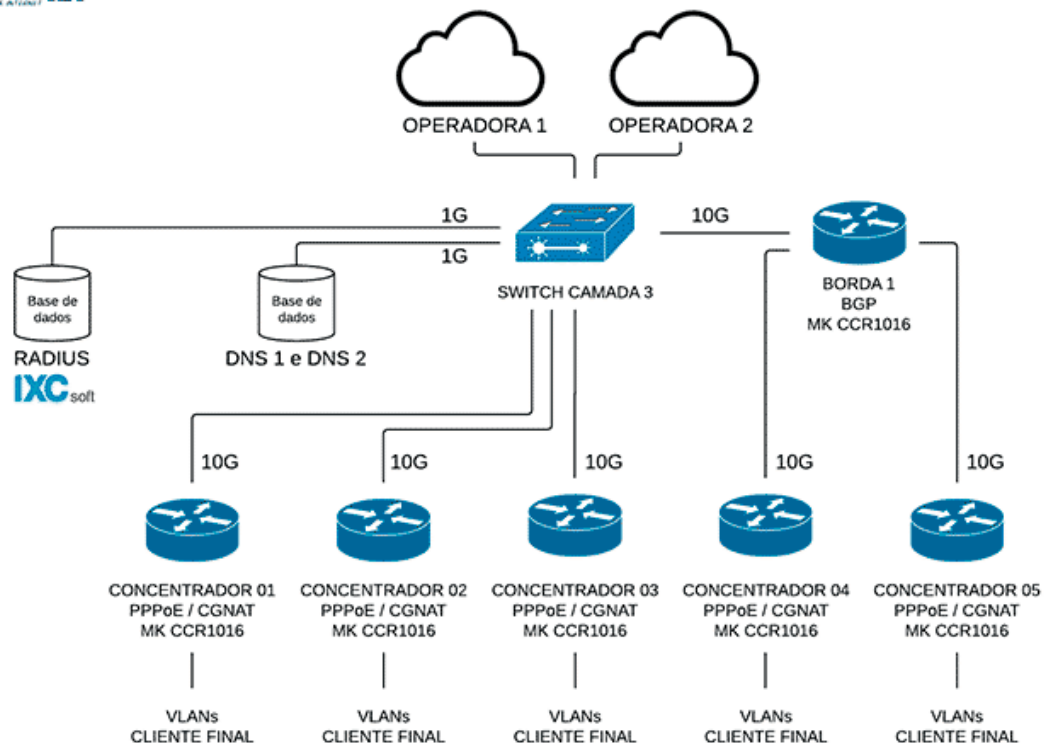
Adalberto Lins
Adalberto@cisco.com



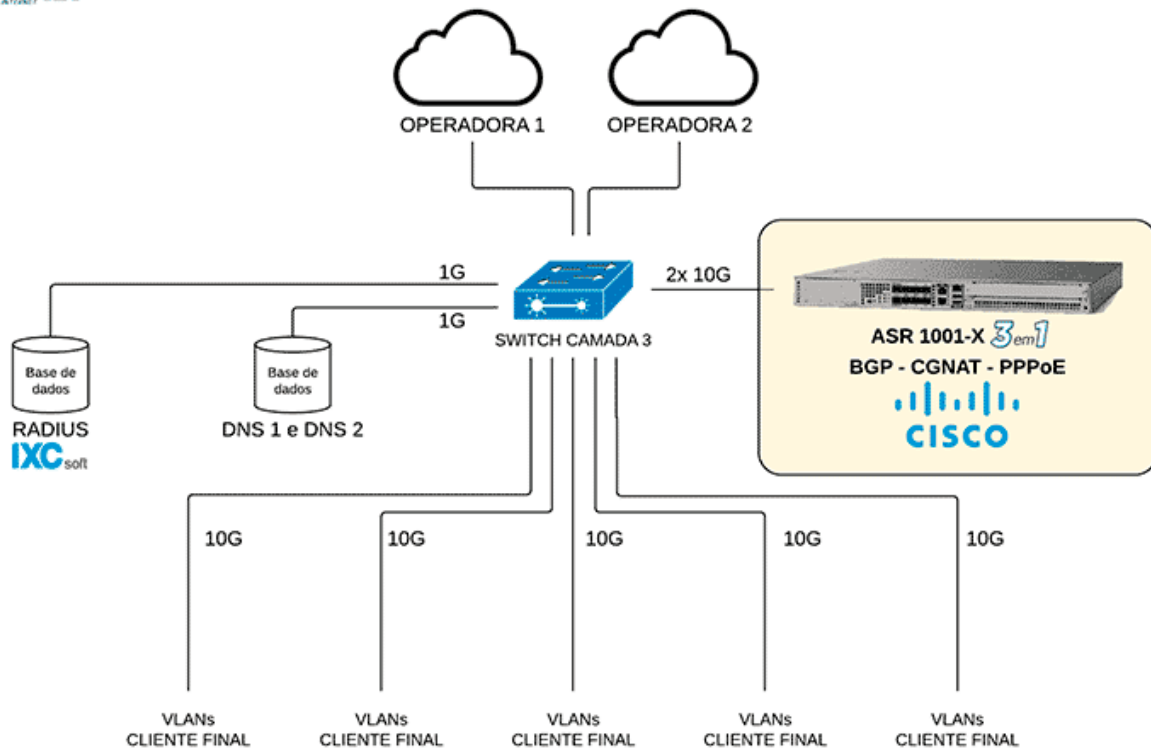


FUNCIONALNET
PROVEDOR DE ACESSO À INTERNET

Case Funcional :: Topologia Anterior

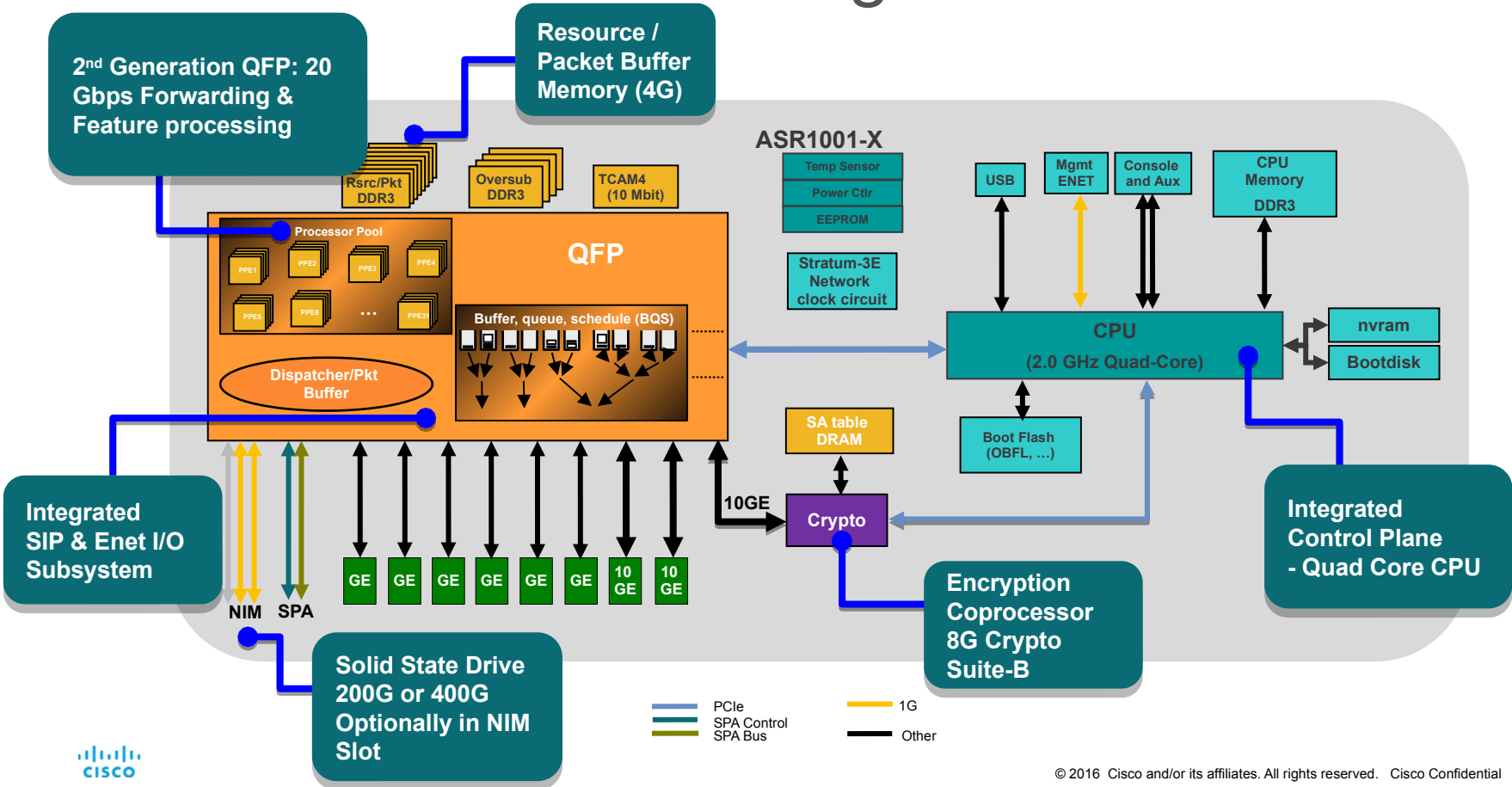


Case Funcional :: Topologia Atual

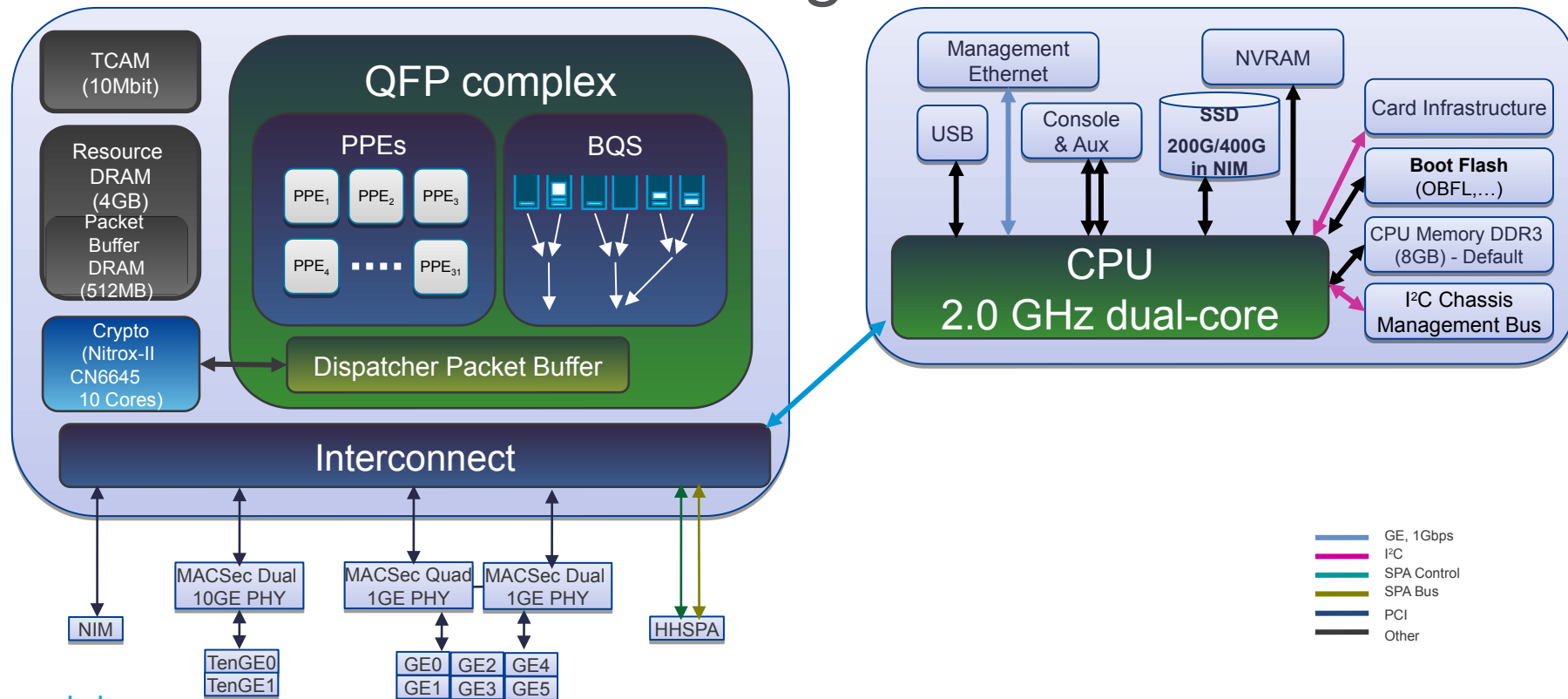


Slides de Backup

ASR 1001-X Block Diagram



ASR 1001-X Block Diagram



Lab 1:

Partindo de um Ambiente IPv4 Only

EQUIPAMENTOS DO LAB

ASR- 1001-X

1 RU

20G

6 x PORT GIGA + 2 x PORT
10GIGA+ 4K PPPoE + CGNAT 2
MILHOES DE SESSÕES + BGP
+FIREWALL
1.000.000 IPv4 or 1.000.000
IPv6 routes Up- grade até 8K
PPPoE
FIREWALL

BGP
BNG
CGNAT

ASR- 9001

2 RU

24 ports on the faceplate :
4 X 10G
20X1G, 4X 10G,
12X 10G
2X100G(QSFP28)
PAYG mode for **120G**,
4 FULL TABLE BGP
BNG 32 MIL SESSÕES PPPoE
IPoE
Mac-sec
MPLS FULL
SATELITE c/ ASR 920
FIREWALL

BGP
BNG

NCS 540

1 RU

24X1G/10G , 8X 25G,
2X 100G
FULL MPLS, VPLS,L3VPN
BNG-eVPN
Mac-sec
SATELITE

AGREGAÇÃO
ACESSO

ASR- 920

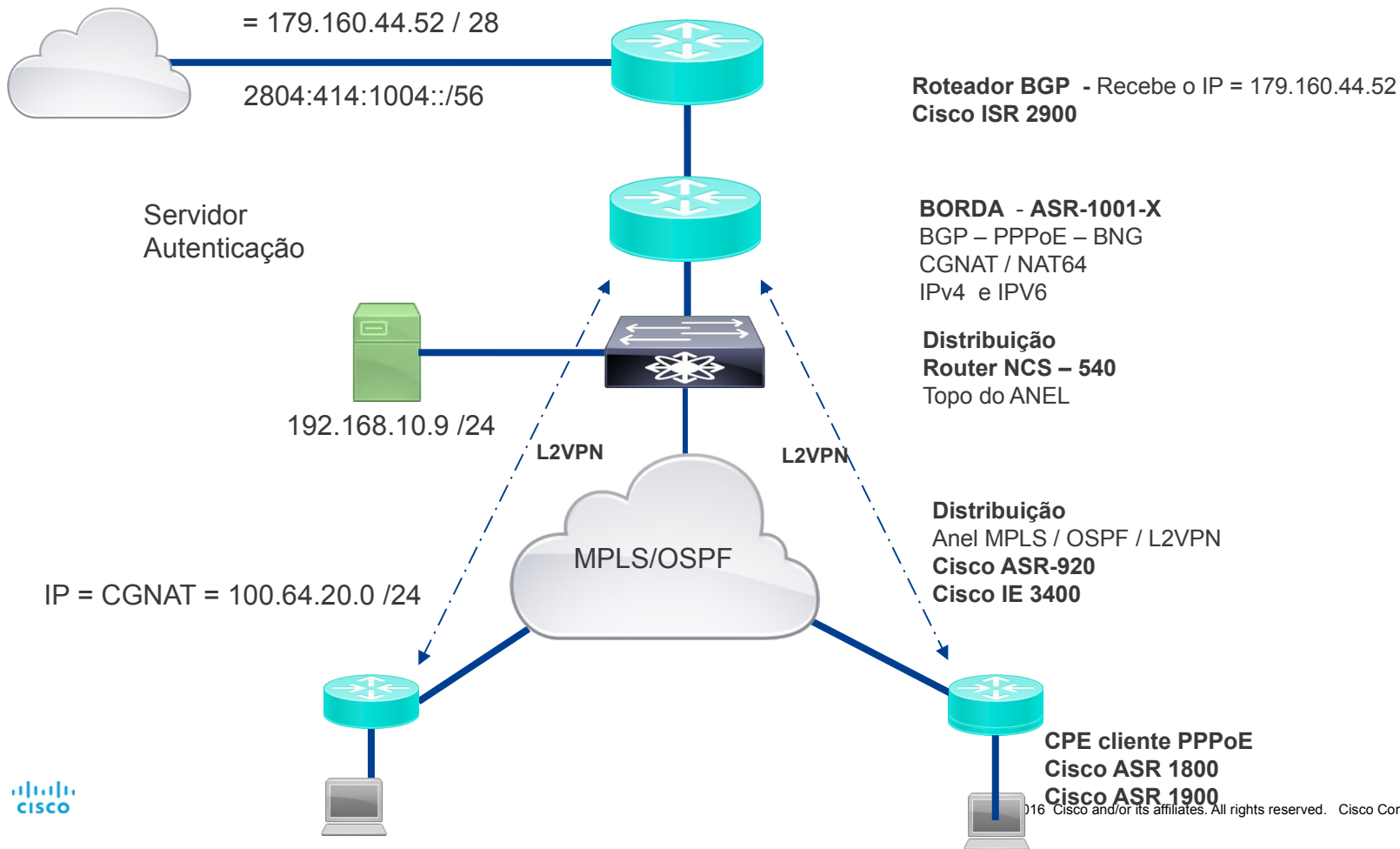
1 RU

24 ports on the faceplate :
24X1G, 4X 10G,
FULL MPLS, VPLS,L3VPN
BNG-eVPN
Mac-sec
SATELITE

AGREGAÇÃO
ACESSO



TOPOLOGIA LOGICA DO LAB





INTERNET

179.160.44.52 /28
2804:414:1004::/56



Cisco 2900
BGP



Cisco NCS-540
Core

Cisco ASR 9001-S
BORDA

TOPOLOGIA FISICA DO LAB

Cisco ASR 1001-X
BORDA

Borda

Bridge Domain

Serviços
Borda BGP

Autenticação BNG
Concentrador PPPoE
CGNAT / NAT64

2804:414:1004:1::/64



192.168.10.9 /24
Servidor
Software de Gestão
Autenticação

CGNAT

179.160.44.52 => 100.64.20.0 / 24

NAT64

64:FF9B::/96 => IP PUBLICO

PE

172.16.1.0 /24

172.16.2.0 /24

P

P

P

P

Anel
OSPF / MPLS
L2VPN

172.16.3.0 /24



ANEL
Cisco ASR 920
Cisco IE 3400

P

172.16.4.0 /24



Agregação

PE

172.16.5.0 /24

PE

2804:414:1004:1::/64

100.64.20.2 /24



Cisco 1900
CPE - Cliente
PPPoE



192.168.1.0 /24

2804:414:1004:1::/64

100.64.20.3 /24



Cisco 1800
CPE - Cliente
PPPoE

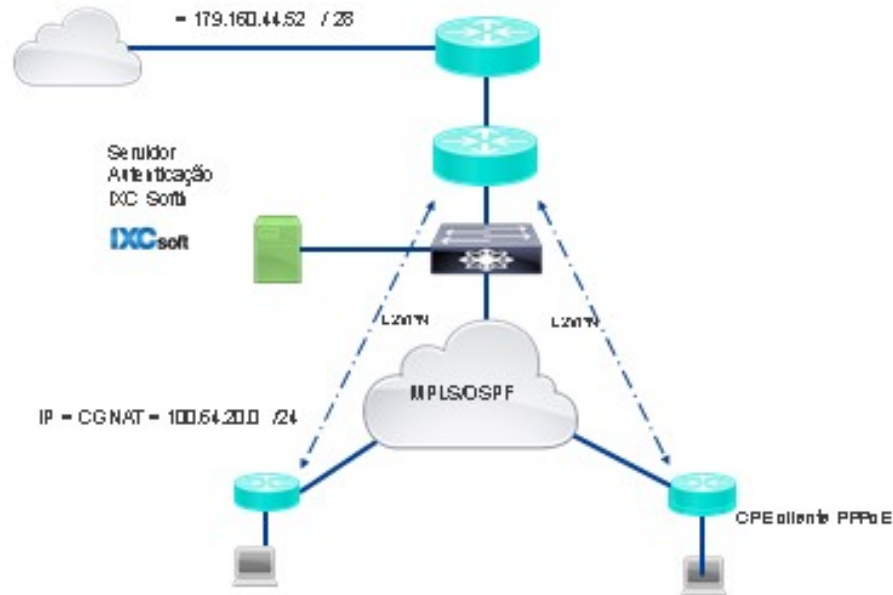


192.168.1.0 /24

Acesso

ASR – 1001-X

- BGPv4
- PPPoE IPv4
- BNG – RADIUS
- CGNAT



CONFIGURAÇÃO DO POOL PPPoE CGNAT - BNG SR 1001-X

```
interface Virtual-Template10
  mtu 1480
  ip unnumbered Loopback10
  no ip unreachable
  no ip proxy-arp
  ip nat inside
  no ipv6 nd ra suppress
  peer default ip address pool v4cgn-pool1
  ppp authentication chap pap calin
  ppp ipcp dns 8.8.8.8 8.8.4.4
```

```
ip local pool v4cgn-pool1 100.64.20.10 100.64.20.110
```

CONFIGURAÇÃO CGNAT - BNG SR 1001-X

```
ip nat settings mode cgn
```

```
access-list 1 permit 100.64.20.0 0.0.0.255
```

```
ip nat pool POOL_CGNAT 179.150.55.106 179.150.55.106 prefix-length 28
```

```
ip nat inside source list 1 pool POOL_CGNAT
```

```
ip nat settings pap bpa set—size 512 step-size 8
```

Proporção de Tradução x alocação de portas

1 IP Valido == > 100 Ips de CGNAT = 512 portas

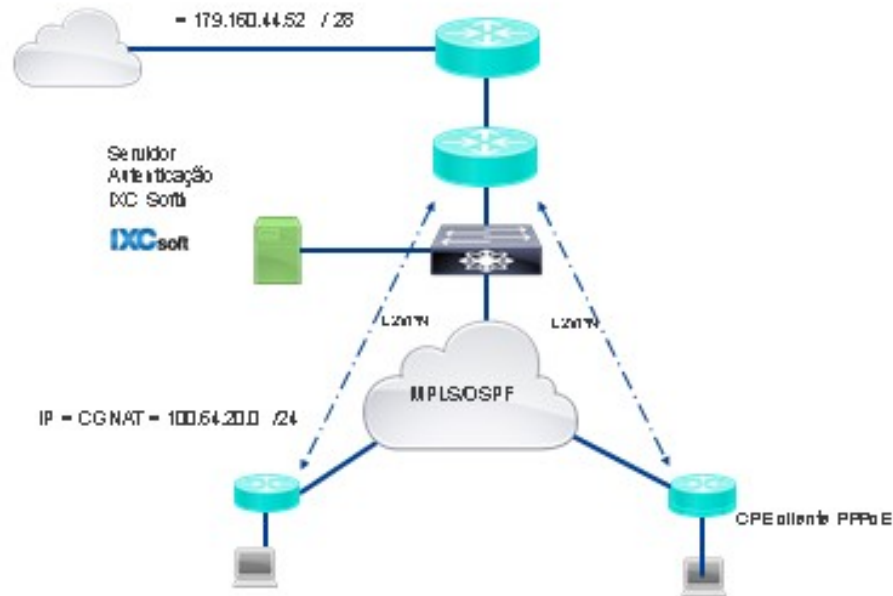
```
ip nat log translations flow-export v9 udp destination 192.168.10.16 2055
```

Passo 1: Preparando o Backbone IPv6

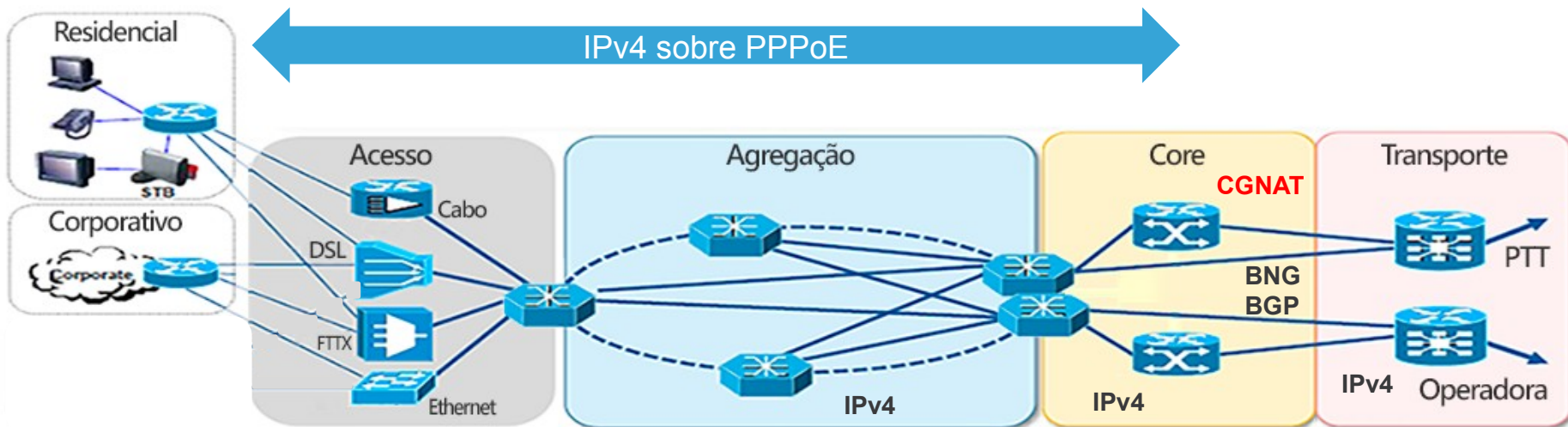
IPv6 sobre PPPoE
Dual Stack CGNAT

ASR – 1001-X

- BGPv4 BGPv6
- PPPoE IPv6
- BNG – RADIUS
- CGNAT

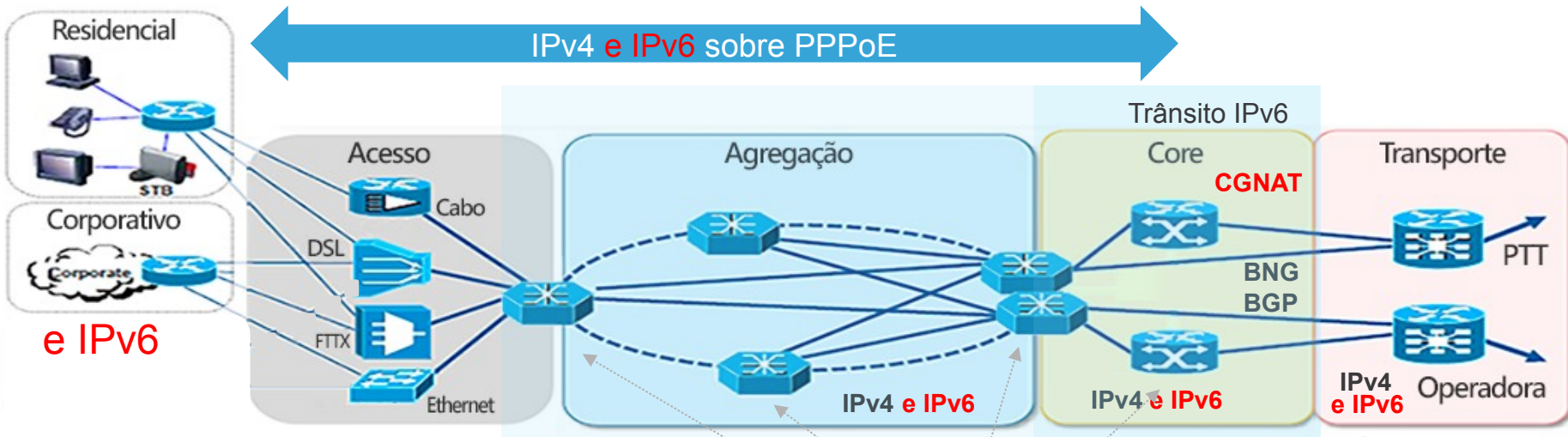


Qual parte do backbone precisa fornecer trânsito IPv6 ?



Qual parte do backbone precisa fornecer trânsito IPv6 ?

e IPv6



• Peering IPv6

- Endereçamento IPv6
- Roteamento IPv6
- Serviços IPv6

CONFIGURAÇÃO DE INTERFACES E POOL PPPoE IPv6 - BNG

BGPv6 SR 1001-X

```
interface GigabitEthernet0/0/1
description BGP_ISR2900
ip address 172.31.200.2 255.255.255.0
ip nat outside
negotiation auto
ipv6 address 2804:414:1004:5::1/64
ipv6 enable
```

```
router bgp 65500
bgp router-id 172.31.200.2
bgp log-neighbor-changes
neighbor 2804:414:1004:5::2 remote-as 65600
neighbor 2804:414:1004:5::2 description BGP_ISR2900
neighbor 172.31.200.1 remote-as 65600
neighbor 172.31.200.1 description BGP_ISR2900
```

CONFIGURAÇÃO DE INTERFACES E POOL PPPoE IPv6 - BNG BGPv6 SR 1001-X

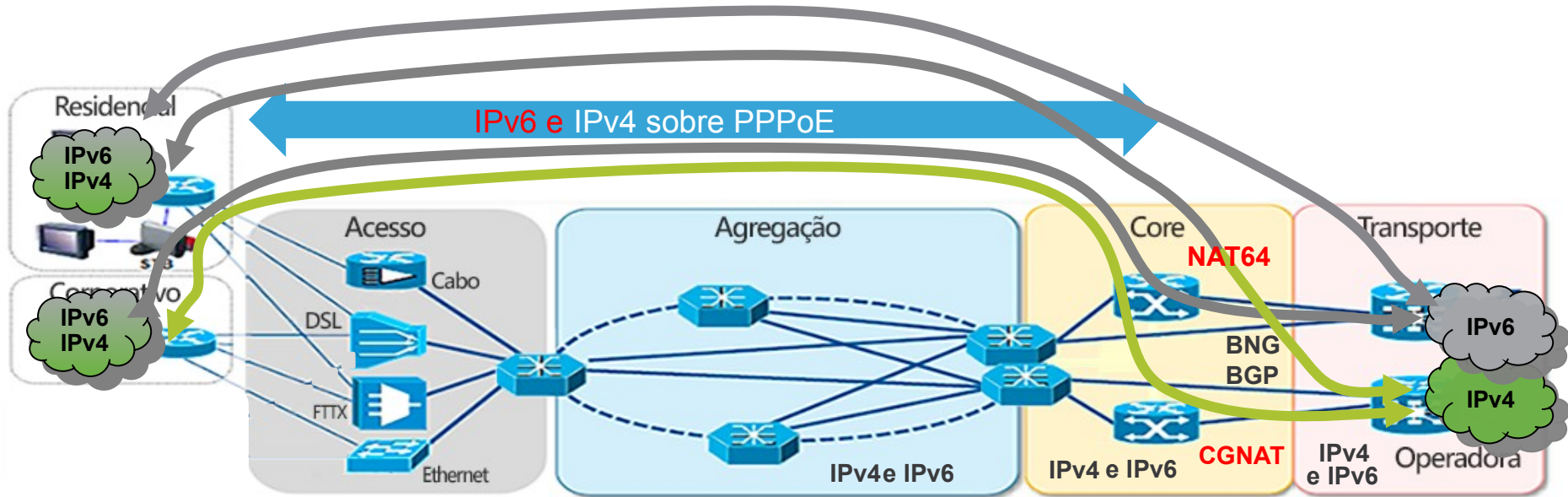
```
interface Virtual-Template10
  ipv6 unnumbered Loopback10
  ipv6 enable
  ipv6 nd managed-config-flag
  ipv6 nd other-config-flag
  ipv6 nd router-preference High
  ipv6 dhcp server dhcpv6
  peer default ipv6 pool v6-pool1
  ipv6 dhcp pool dhcpv6
    prefix-delegation pool dhcpv6-pool1 lifetime 1800 600
    dns-server 2001:4860:4860::8888
    domain-name cisco.ainet.com.br

  ipv6 local pool dhcpv6-pool1 2804:414:1004:4::/64
```

Lab 3: NAT64 – IPv6

CGNAT

Onde Chegamos



CONFIGURAÇÃO DE NAT64

```
interface GigabitEthernet0/0/1  
  nat64 enable
```

```
ipv6 access-list MYLIST  
  permit ipv6 64:FF9B::/96 any  
  permit ipv6 2804:414:1004:4::/64 any  
  permit ipv6 2804:414:1004::/56 any  
  permit ipv6 2804:414:1004:1::/64 any
```

```
nat64 prefix stateful 2804:414:1004::/96  
nat64 v4 pool NAT64 172.31.201.2 172.31.201.3  
nat64 v6v4 list MYLIST pool NAT64 overload
```

O que falta ser tratado?

