Flock of birds

Scaling Route Servers Easily

Antonio M. Moreiras – IX.br

CGI.br is the Brazilian Internet Stering Committee

Multistakeholder Committe - Internet Governance in Brazil

The CGI.br is comprised of members from the government, the corporate sector, the third sector and the academic community, and as such constitutes a unique Internet governance model for the effective participation of society in decisions involving network implementation, management and use. Based on the principles of multilateralism, transparency and democracyl

Brasil Internet Exchange

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Brazilian Network Information Center
- civil non-profit corporation
- executive arm of CGI.br

registro.br
- ccTLD '.br'
- Brazilian NIR

cert.br
- security incident response
- CSIRTs fostering and coordenation

cetic.br
- ICT indicators

ceptro.br
- IPv6 and best practices trainings for ISPs and ASs
- quality measurements on the Internet
- projects to foster the Internet development in Brazil

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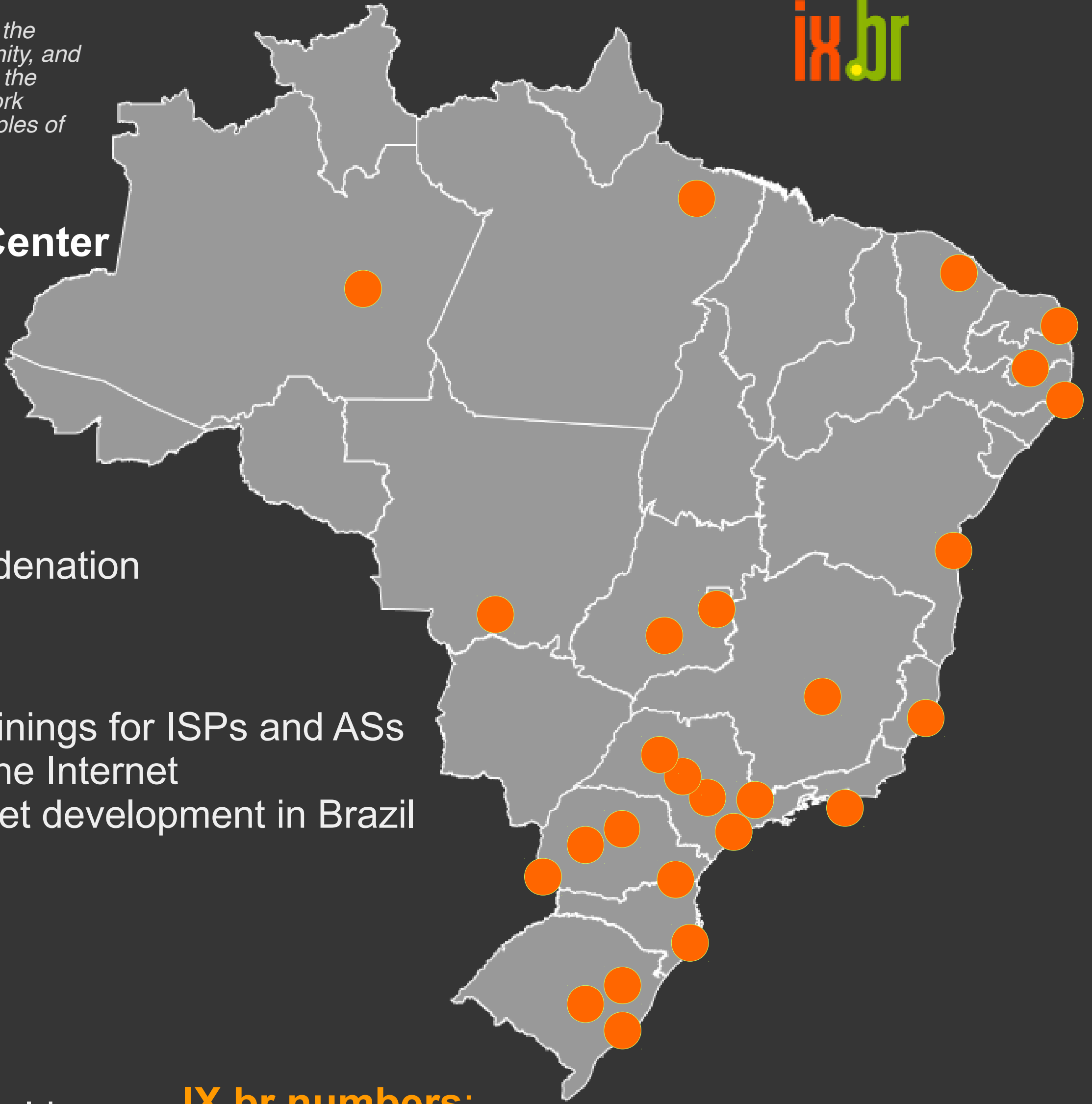
- Internet Exchanges

ceweb.br
- Web related projects

W3C Brasil
- Brazilian office of W3C (World Wide Web Consortium)



IX.br numbers:

> **26** independent Internet Exchanges
> **1300+** ASs participants, and
2 Tbps of peak traffic at all IXs aggregated
> **940+** ASs, **30** PoPs (PIXs), and
1.5 Tbps at IX.br São Paulo, SP

IX.br

- 26 Internet Exchanges
- IX.br São Paulo is the biggest:
  - Around 1000 Autonomous Systems
  - Most of them are in the multilateral peering agreement
  - 4 route servers
    - Participants are required to have BGP sessions with all 4, for redundancy

Route server problems

- Quagga can’t deal with more than 1000 BGP sessions (due to the way sockets are implemented with select)
  - We had to separate IPv4 and IPv6 in different processes
  - Performance problems:
    - Quagga showed to be sensible to BGP session oscillations
    - Quagga can’t use more than 1 core (it’s one single process)…

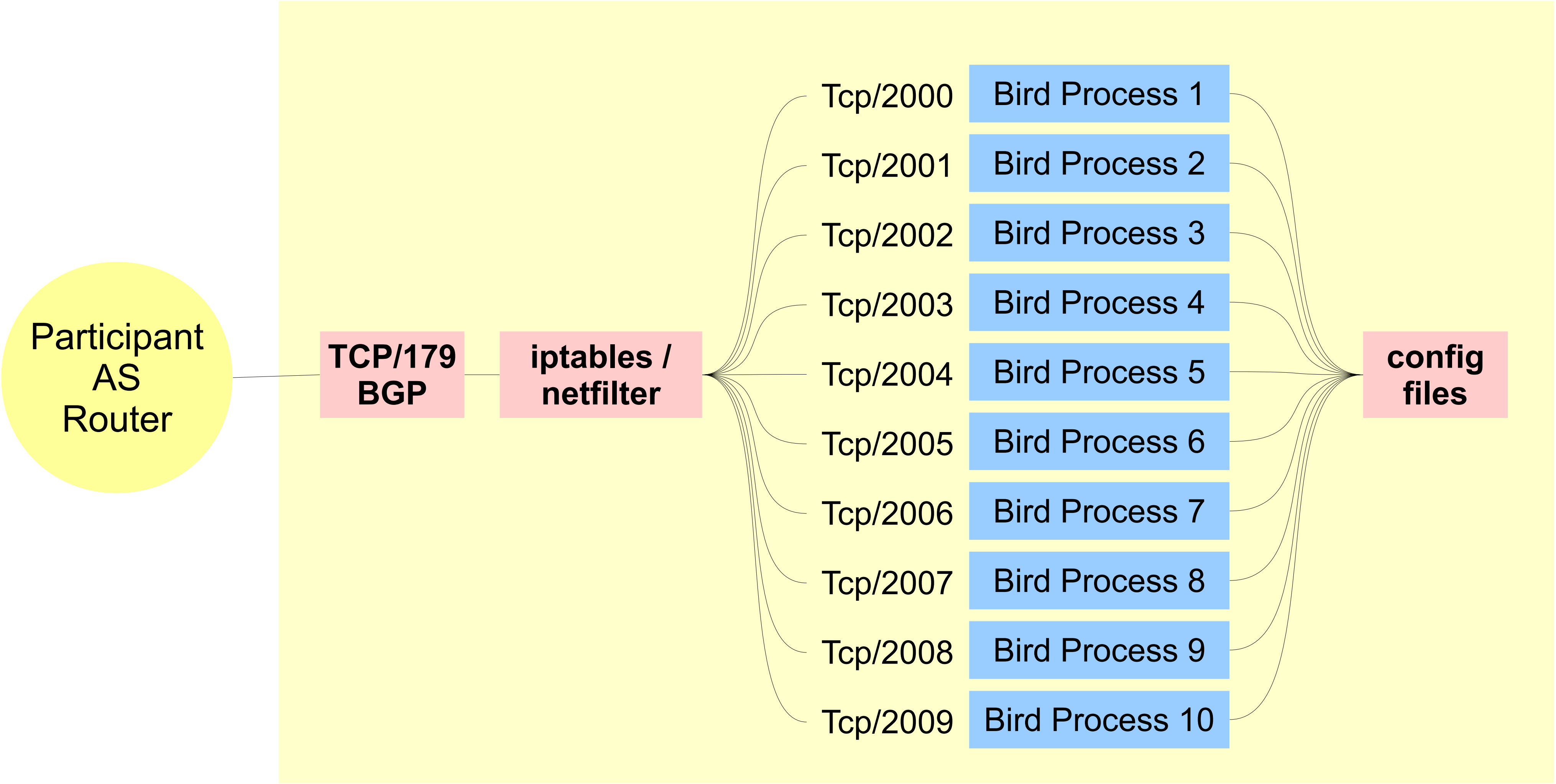
Bird?

- Bird stable version 1.4.5 over Linux was not able to scale above 1,000 peers due to SELECT function on code for sockets allocation
- Laboratory tests with Bird version 1.5 over Linux showed to solve this issue, but the code seems to be not mature enough for production
- It’s still one single process

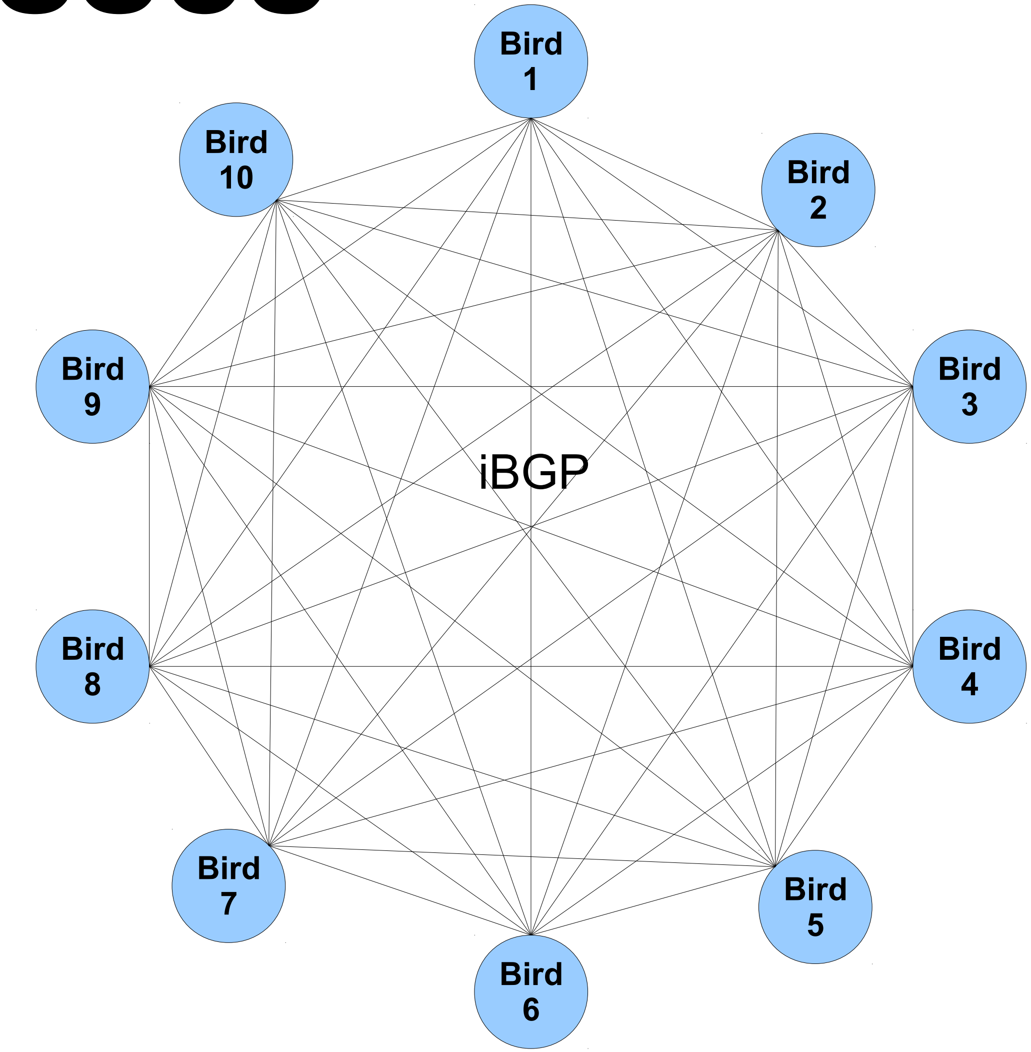
Adopted solution

- Multiple BIRD processes, instead of a single one, sharing the load
  - Each process in a different port (and IP)
  - Each process with a different BGP Router ID (and not the same as the public IP)
  - Each process share the same configuration files (for the client sessions)
  - Full mesh between the BIRD processes
  - Passive mode
  - Linux netfilter does the ‘magic’ of load sharing

“Multi BIRD”


Participant AS Router
TCP/179 BGP
iptables / netfilter
Tcp/2000
Tcp/2001
Tcp/2002
Tcp/2003
Tcp/2004
Tcp/2005
Tcp/2006
Tcp/2007
Tcp/2008
Tcp/2009
Bird Process 1
Bird Process 2
Bird Process 3
Bird Process 4
Bird Process 5
Bird Process 6
Bird Process 7
Bird Process 8
Bird Process 9
Bird Process 10
config files

Full mesh between processes



Config excerpts

```
log syslog all;
router id 187.16.217.255;
listen bgp port 2002;
define myas = 26162;
define MyLoIP = 127.0.0.12;
protocol device { }
protocol kernel { import none; }

include "/etc/bird/templates/peers*.conf";
include "/etc/bird/templates/rspeers*.conf";
include "/etc/bird/functions/*.conf";

#iBGP (loopback interface)
protocol bgp ibgp_p2000 from RSPEERS { neighbor 127.0.0.10 port 2000 as myas; source address MyLoIP; }
protocol bgp ibgp_p2001 from RSPEERS { neighbor 127.0.0.11 port 2001 as myas; source address MyLoIP; }
#this peer
#protocol bgp ibgp_p2002 from RSPEERS { neighbor 127.0.0.12 port 2002 as myas; source address MyLoIP; }
protocol bgp ibgp_p2003 from RSPEERS { neighbor 127.0.0.13 port 2003 as myas; source address MyLoIP; }
protocol bgp ibgp_p2004 from RSPEERS { neighbor 127.0.0.14 port 2004 as myas; source address MyLoIP; }
protocol bgp ibgp_p2005 from RSPEERS { neighbor 127.0.0.15 port 2005 as myas; source address MyLoIP; }
protocol bgp ibgp_p2006 from RSPEERS { neighbor 127.0.0.16 port 2006 as myas; source address MyLoIP; }
protocol bgp ibgp_p2007 from RSPEERS { neighbor 127.0.0.17 port 2007 as myas; source address MyLoIP; }
protocol bgp ibgp_p2008 from RSPEERS { neighbor 127.0.0.18 port 2008 as myas; source address MyLoIP; }
protocol bgp ibgp_p2009 from RSPEERS { neighbor 127.0.0.19 port 2009 as myas; source address MyLoIP; }

#peers (clients)
include "/etc/bird/peers/*.conf";
```

Config excerpts

```
# as22548.conf - last change: 2016-11-01 02:15:02

# asn,description,mark,filters
# 22548,V4_AS22548,22548,28571 61580

# ipv4,asn,description,maximum_prefix,password,passive,shutdown
# 187.16.217.2,22548,V4_AS22548,100,,True,False

filter bgp_in_as22548
{
    if (DenyATMv4BlockPrefix()) then reject;
    bgp_in(22548);
    bgp_community.add((26162,22548));
    accept;
}

filter bgp_out_as22548
{
    # filter as28571 - USP - mark 28571
    if (26162,28571) ~ bgp_community then reject;
    # filter as61580 - OpenCDN.nic.br - mark 61580
    if (26162,61580) ~ bgp_community then reject;
    accept;
}

protocol bgp as22548_187_16_217_2 from PEERS {
    description "as22548 ATM IPv4 - V4_AS22548";
    neighbor 187.16.217.2 as 22548;
    passive on;
    import limit 100 action restart;
    import filter bgp_in_as22548;
    export filter bgp_out_as22548;
}
```

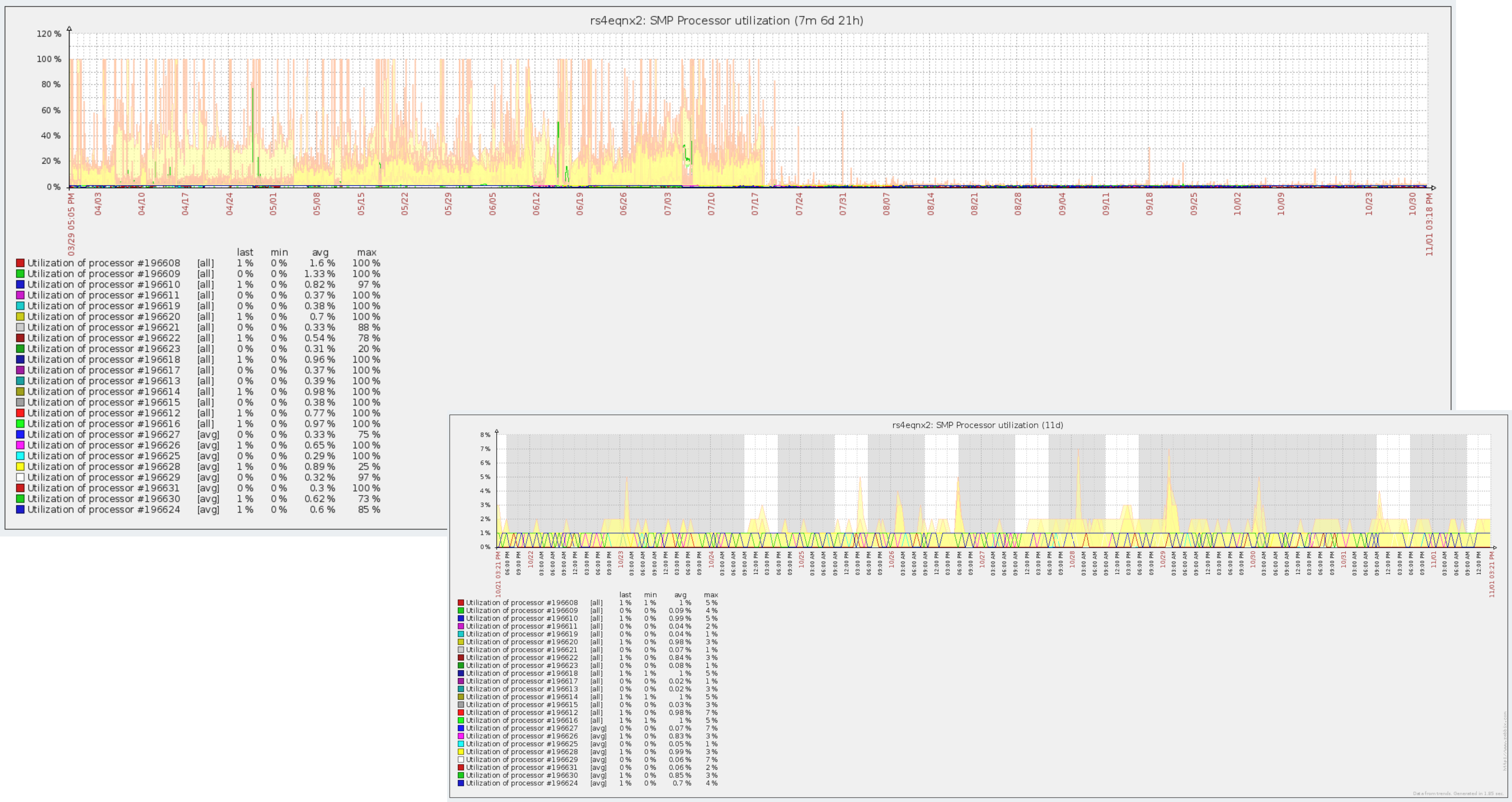
Config excerpts

```
# port redirecting - load sharing
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 10 --packet 0 -j DNAT -to-destination
187.16.216.254:2000
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 9 --packet 0 -j DNAT -to-destination
187.16.216.254:2001
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 8 --packet 0 -j DNAT -to-destination
187.16.216.254:2002
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 7 --packet 0 -j DNAT -to-destination
187.16.216.254:2003
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 6 --packet 0 -j DNAT -to-destination
187.16.216.254:2004
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 5 --packet 0 -j DNAT -to-destination
187.16.216.254:2005
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 4 --packet 0 -j DNAT -to-destination
187.16.216.254:2006
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 3 --packet 0 -j DNAT -to-destination
187.16.216.254:2007
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 2 --packet 0 -j DNAT -to-destination
187.16.216.254:2008
-A PREROUTING -p tcp -i em2.2012 --dport 179 -m state --state NEW -m
statistic --mode nth --every 1 --packet 0 -j DNAT -to-destination
187.16.216.254:2009
```

Results

- It worked very well!
- Smaller memory footprint than quagga (~ 4Gbytes)
- Better distribution of the load between the multiple cores/processors
- Smaller load, better performance

Results



rs4eqnx2: SMP Processor utilization (7m 6d 21h)

			last	min	avg	max
🟥	Utilization of processor #196608	[all]	1 %	0 %	1.6 %	100 %
🟩	Utilization of processor #196609	[all]	0 %	0 %	1.33 %	100 %
🟦	Utilization of processor #196610	[all]	1 %	0 %	0.82 %	97 %
🟪	Utilization of processor #196611	[all]	0 %	0 %	0.37 %	100 %
🟦	Utilization of processor #196619	[all]	0 %	0 %	0.38 %	100 %
🟨	Utilization of processor #196620	[all]	1 %	0 %	0.7 %	100 %
⬜	Utilization of processor #196621	[all]	0 %	0 %	0.33 %	88 %
🟥	Utilization of processor #196622	[all]	1 %	0 %	0.54 %	78 %
🟩	Utilization of processor #196623	[all]	0 %	0 %	0.31 %	20 %
🟦	Utilization of processor #196618	[all]	1 %	0 %	0.96 %	100 %
🟪	Utilization of processor #196617	[all]	0 %	0 %	0.37 %	100 %
🟦	Utilization of processor #196613	[all]	0 %	0 %	0.39 %	100 %
🟨	Utilization of processor #196614	[all]	1 %	0 %	0.98 %	100 %
⬜	Utilization of processor #196615	[all]	0 %	0 %	0.38 %	100 %
🟥	Utilization of processor #196612	[all]	1 %	0 %	0.77 %	100 %
🟩	Utilization of processor #196616	[all]	1 %	0 %	0.97 %	100 %
🟦	Utilization of processor #196627	[avg]	0 %	0 %	0.33 %	75 %
🟪	Utilization of processor #196626	[avg]	1 %	0 %	0.65 %	100 %
🟦	Utilization of processor #196625	[avg]	0 %	0 %	0.29 %	100 %
🟨	Utilization of processor #196628	[avg]	1 %	0 %	0.89 %	25 %
⬜	Utilization of processor #196629	[avg]	0 %	0 %	0.32 %	97 %
🟥	Utilization of processor #196631	[avg]	0 %	0 %	0.3 %	100 %
🟩	Utilization of processor #196630	[avg]	1 %	0 %	0.62 %	73 %
🟦	Utilization of processor #196624	[avg]	1 %	0 %	0.6 %	85 %

rs4eqnx2: SMP Processor utilization (11d)

			last	min	avg	max
🟥	Utilization of processor #196608	[all]	1 %	1 %	1 %	5 %
🟩	Utilization of processor #196609	[all]	0 %	0 %	0.09 %	4 %
🟦	Utilization of processor #196610	[all]	1 %	0 %	0.99 %	5 %
🟪	Utilization of processor #196611	[all]	0 %	0 %	0.04 %	2 %
🟦	Utilization of processor #196619	[all]	0 %	0 %	0.04 %	1 %
🟨	Utilization of processor #196620	[all]	1 %	0 %	0.98 %	3 %
⬜	Utilization of processor #196621	[all]	0 %	0 %	0.07 %	1 %
🟥	Utilization of processor #196622	[all]	1 %	0 %	0.84 %	3 %
🟩	Utilization of processor #196623	[all]	0 %	0 %	0.08 %	1 %
🟦	Utilization of processor #196618	[all]	1 %	1 %	1 %	5 %
🟪	Utilization of processor #196617	[all]	0 %	0 %	0.02 %	1 %
🟦	Utilization of processor #196613	[all]	0 %	0 %	0.02 %	3 %
🟨	Utilization of processor #196614	[all]	1 %	1 %	1 %	5 %
⬜	Utilization of processor #196615	[all]	0 %	0 %	0.03 %	3 %
🟥	Utilization of processor #196612	[all]	1 %	0 %	0.98 %	7 %
🟩	Utilization of processor #196616	[all]	1 %	1 %	1 %	5 %
🟦	Utilization of processor #196627	[avg]	0 %	0 %	0.07 %	7 %
🟪	Utilization of processor #196626	[avg]	1 %	0 %	0.83 %	3 %
🟦	Utilization of processor #196625	[avg]	0 %	0 %	0.05 %	1 %
🟨	Utilization of processor #196628	[avg]	1 %	0 %	0.99 %	3 %
⬜	Utilization of processor #196629	[avg]	0 %	0 %	0.06 %	7 %
🟥	Utilization of processor #196631	[avg]	0 %	0 %	0.06 %	2 %
🟩	Utilization of processor #196630	[avg]	1 %	0 %	0.85 %	3 %
🟦	Utilization of processor #196624	[avg]	1 %	0 %	0.7 %	4 %

Issues and workarounds

- Troubleshooting: in which process is each client?
  - We wrote some scripts to manage the multiple birds as a single router
- MD5 works only with active mode
  - We choosed one single bird process to configure all clients with MD5 in active mode
- Some (very few) clients have problems with passive mode in RSs
  - We configured them in the same process that we used for MD5 issue

Next steps with our RSs

- Substitute the IPv6 RS, that is still quagga, for the same solution with multiple bird processes
- Implement communities for filters between clients
- Implement mitigation of path hiding
- 2 route servers instead of 4, with external load balancers distributing the load between redundant servers
- Substitute Cisco for another solution
  - Multiple quagga?
  - GoBGP?

Obrigado! Dzięki!
Thanks!

www.ix.br

moreiras@nic.br

@moreiras