Transition Techniques

MAP, DS-Lite, NAT64/DNS64, and 464XLAT

Antonio M. Moreiras

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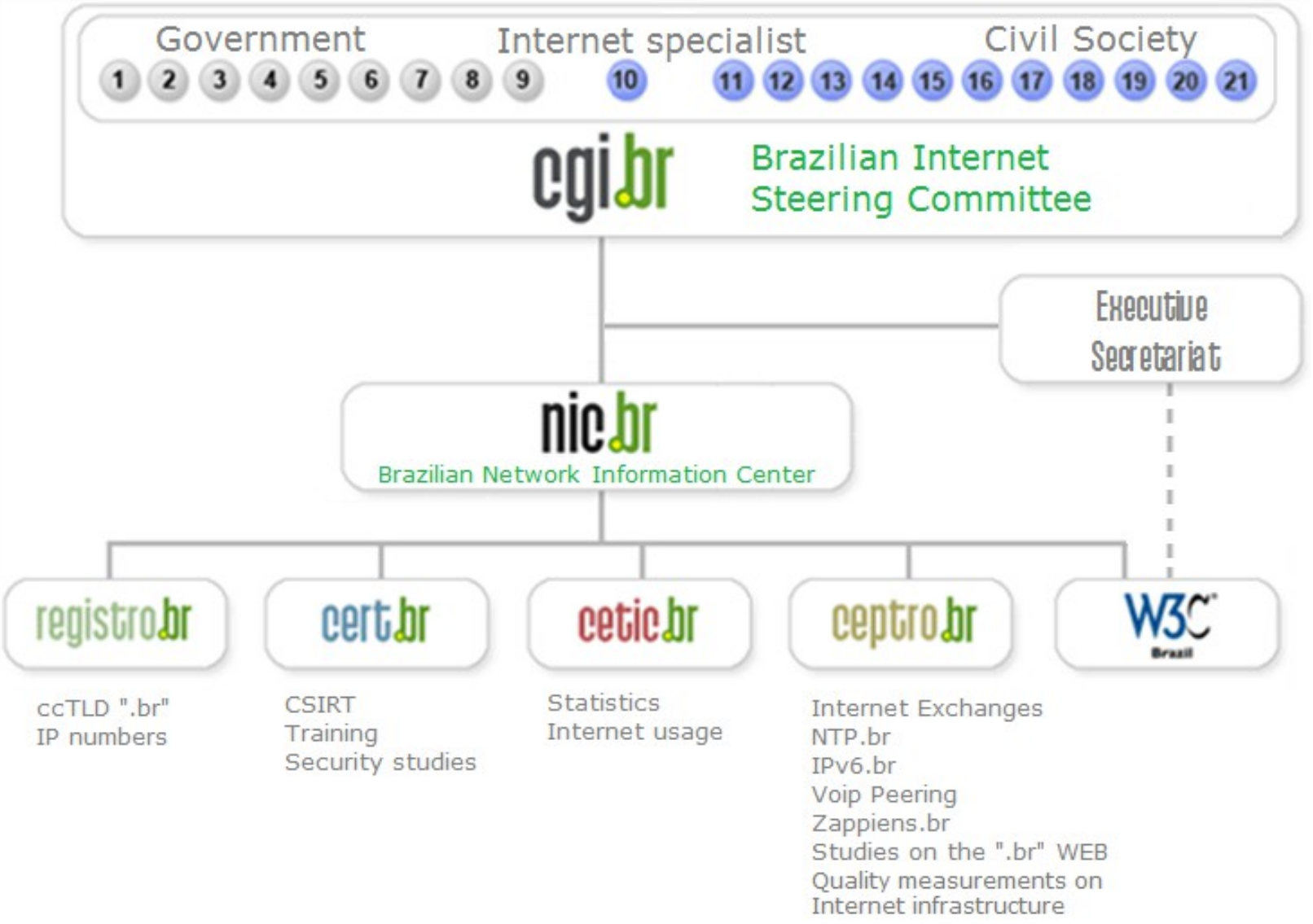
Agenda

- Who are we (NIC.br) ?
- The transition “problem”
- NAT444 and why we should think twice
- Transition techniques for ISPs
  - **DS-Lite**
  - **MAP**
  - **NAT64 e DNS64**
  - **464XLAT**

  Basic workings
  Tests
- Final remarks

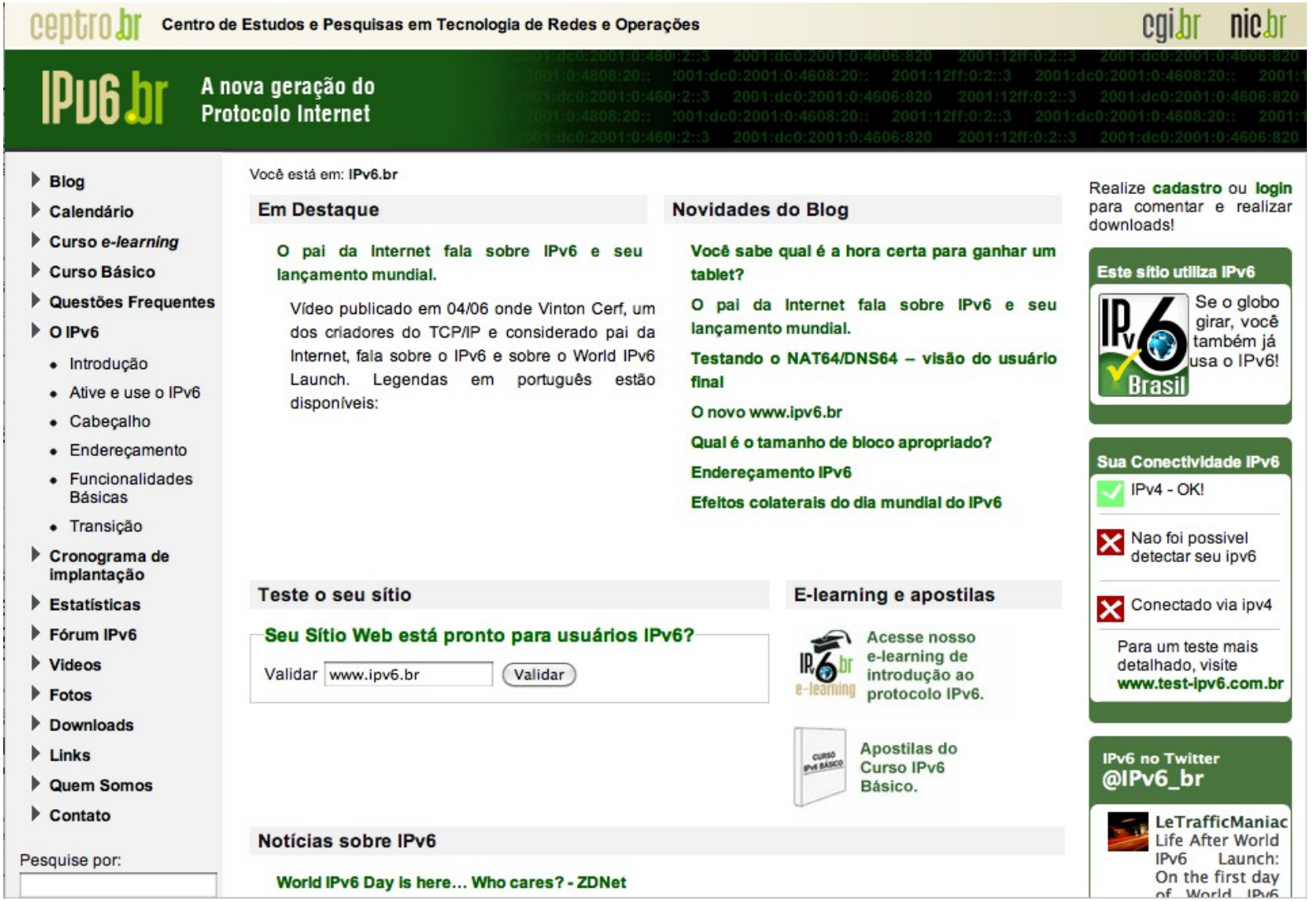
Internet Governance in Brazil



Some of our initiatives

- **Website:** http://ipv6.br (reference in portuguese)
- **E-learning:** Free download - Creative Commons
- **Trainings:**
  - 36h hands on training (lab multivendor)
  - Free of charge
  - ISPs and other Autonomous Systems
  - Brochures released in Creative Commons (portuguese and spanish)
  - 2700+ trained professionals (~ US$ 6.500.000 value)
- **Experimental IPv6 Transit – free of charge** – in PTTMetro São Paulo (our biggest IXP), for 45 Autonomous Systems
- **Events** (Brazilian IPv6 Forums, “Breakfast with IPv6”)
- **Coordination** meetings with telcos, ISPs, content providers, vendors, gov., etc

http://ipv6.br



IPv6 validator

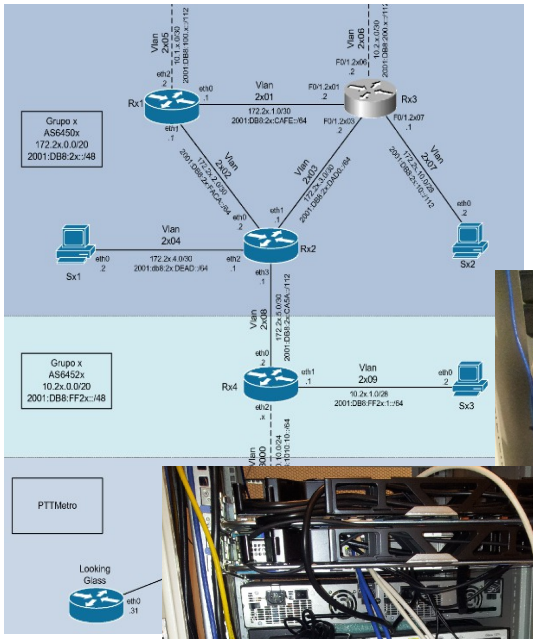
http://validador.ipv6.br/index.php?lang=en

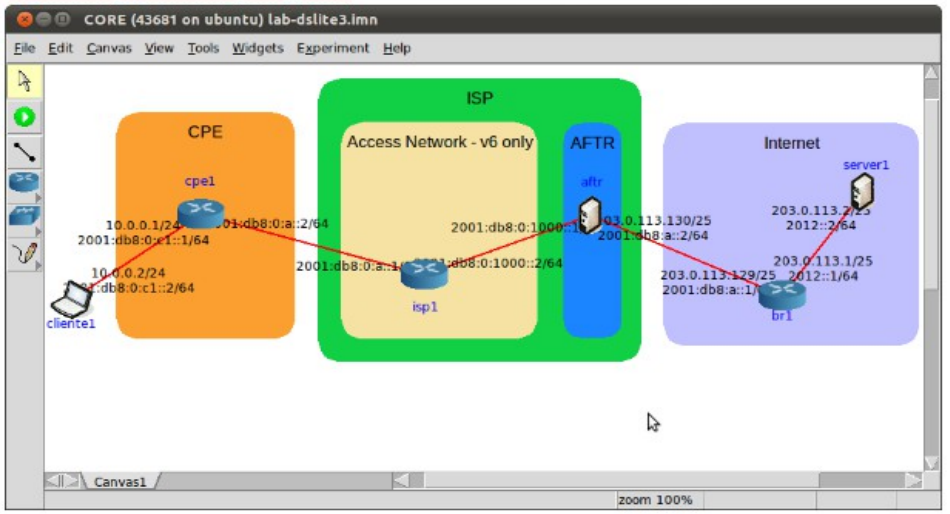
E-learning

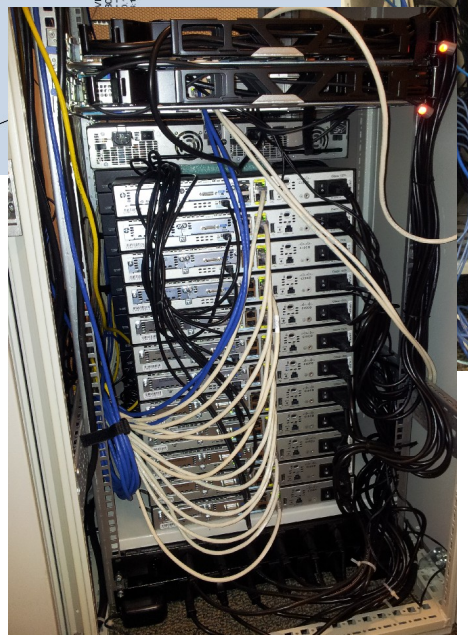
http://ipv6.br/curso

Capacity Building (trainings)

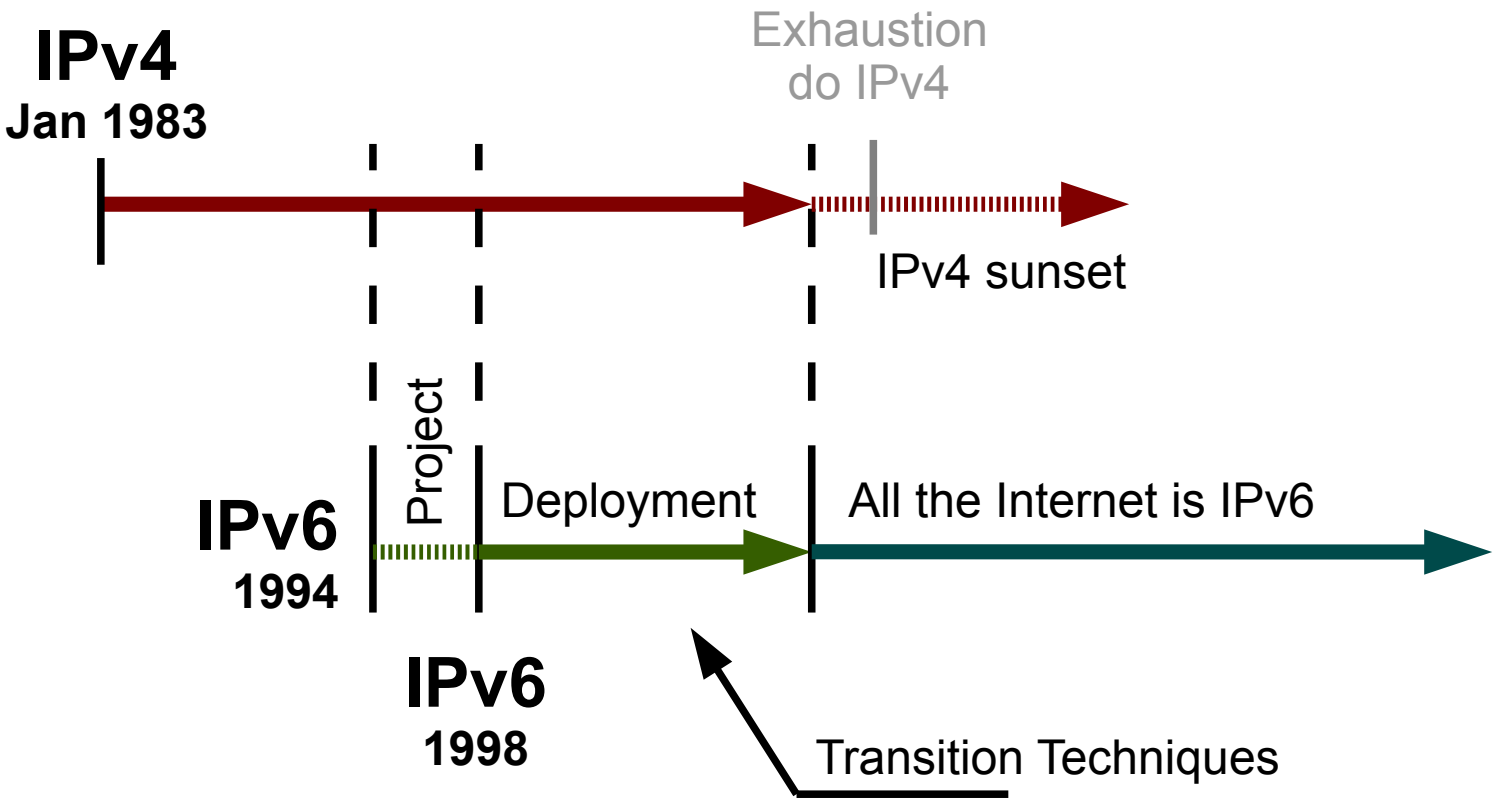
http://ipv6.br/basico





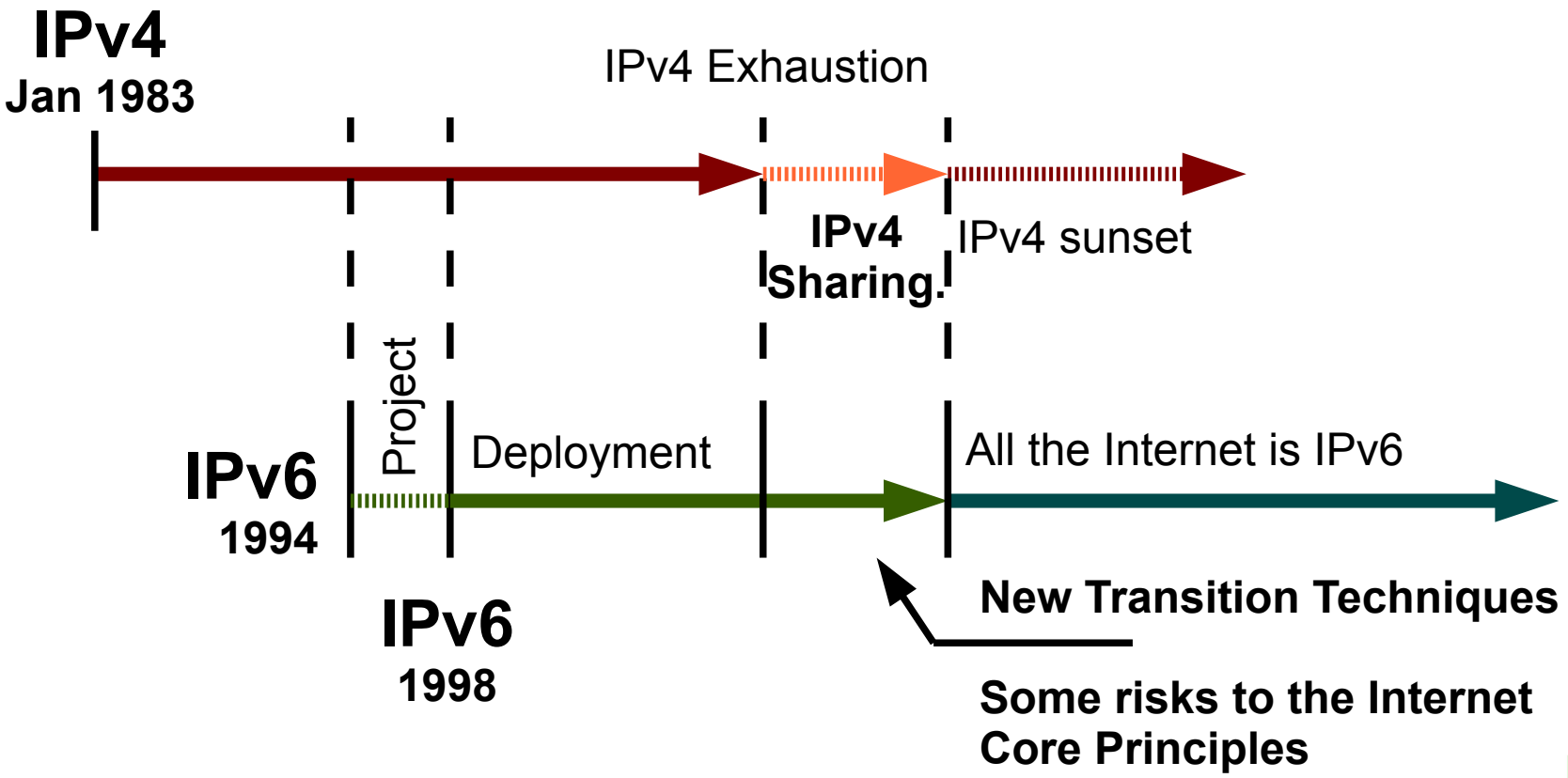


The transition



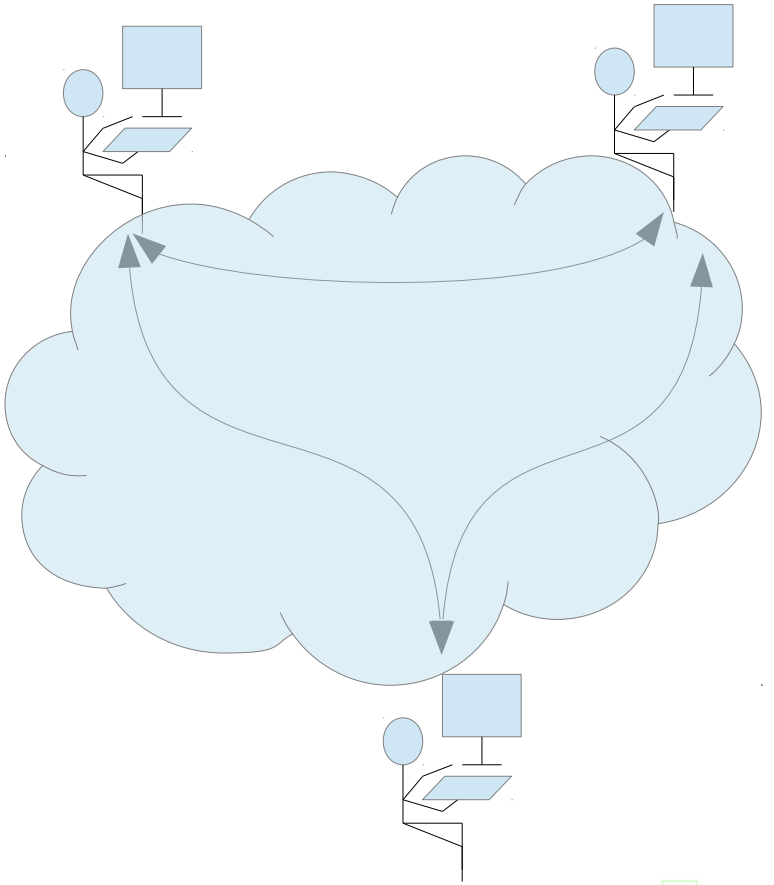
IPv6 and IPv4 are not compatible

Transition

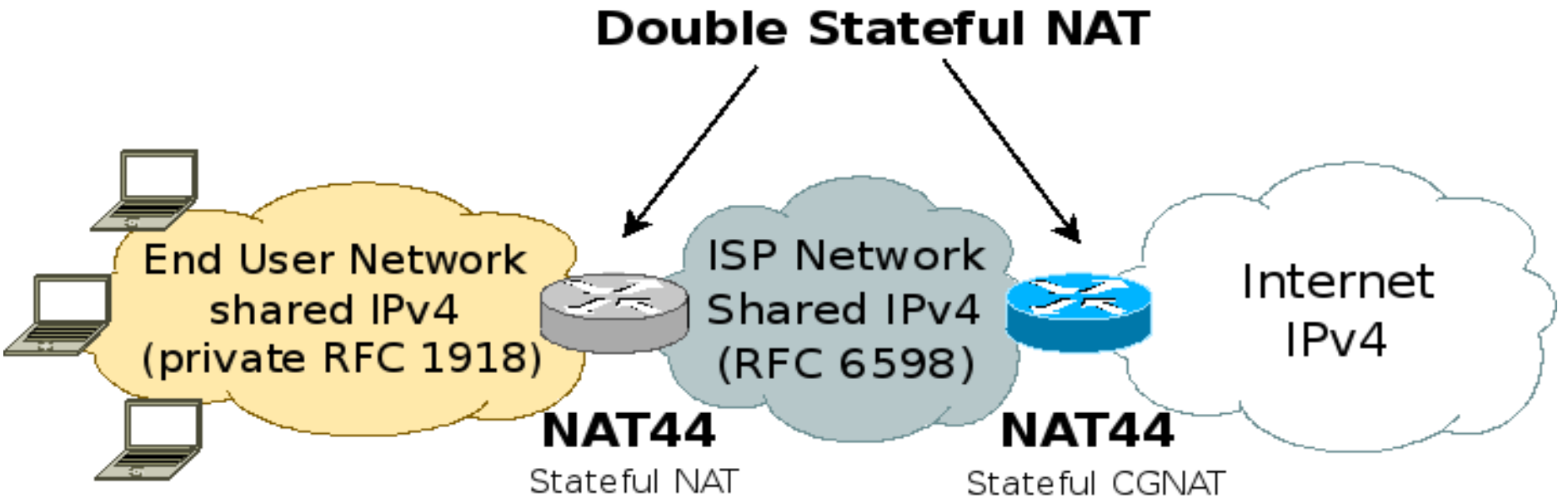


Some Internet Principles

- Any device can communicate with any other device: **end to end communication.**
- **The network core is simple.** Forward the packets to their destinations. No filters. No complex mechanisms.
- Most of the **complex protocols, new applications, etc, are implemented at the network ends.** Anyone can create a new functionality or a new protocol to the Internet, without having to ask permission to anyone else.
- **These are the keys for inovation!**



NAT444



RFC 1918
Private space
10.0.0.0/8
172.16.0.0/12
192.168.0.0/16

RFC 6598
Shared address space
100.64.0.0/10

Double NAT or NAT444

- **Doesn't foster IPv6** deployment
- **Brokes** the **end to end** model
- **Brokes** the **“simple core”** principle
- **Worst user experience** (games, video streaming, etc)
- **High investment**, tends to perpetuate itself
- Can bring more control over the Internet to the big telecom operators

What can we do?

- **Foster the fast IPv6 deployment**
  - 1st: Transit operators and vendors
  - 2nd: Content (web, e-mail, etc)
    - IPv6 content decreases the need of IPv4 sharing.
  - 3rd: Access providers
    - Other transition techniques: NAT64, MAP, DS-Lite.
  - After that: others...

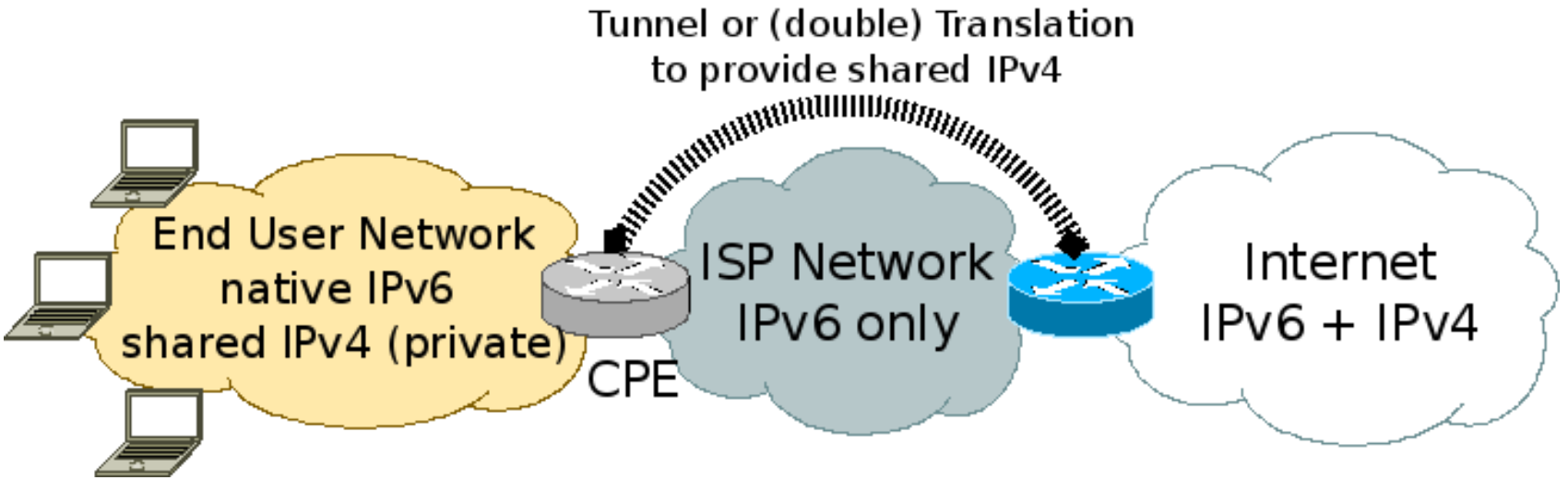
Transition Techniques

- There are so many...

LISP
DS-Liite
Teredo
GRE
4rd
6to4
MAP-T
BGP Tunneling
6a44
6rd
L2TP
NAT64
lw-dslite
ISATAP
4over6
464XLAT
A+P
6VPE
MAP-E
IVI
6PE
Tunnel Broker

Transition Techniques

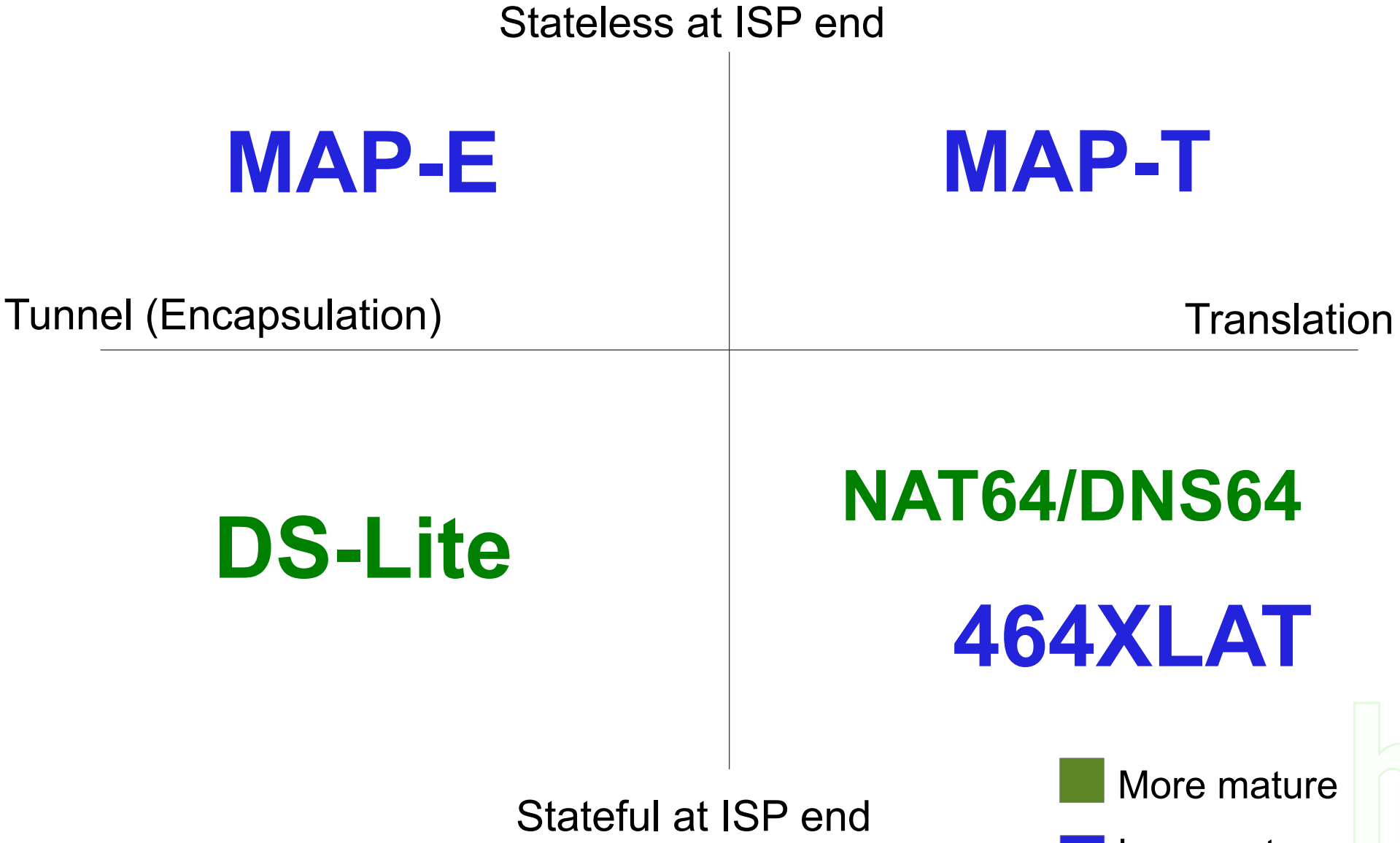
- **Between ISPs and end users**.
- **No more IPv4** addresses → need for sharing.
  - **single** stateful NAT
- End users do have **native IPv6**.



Transition Techniques

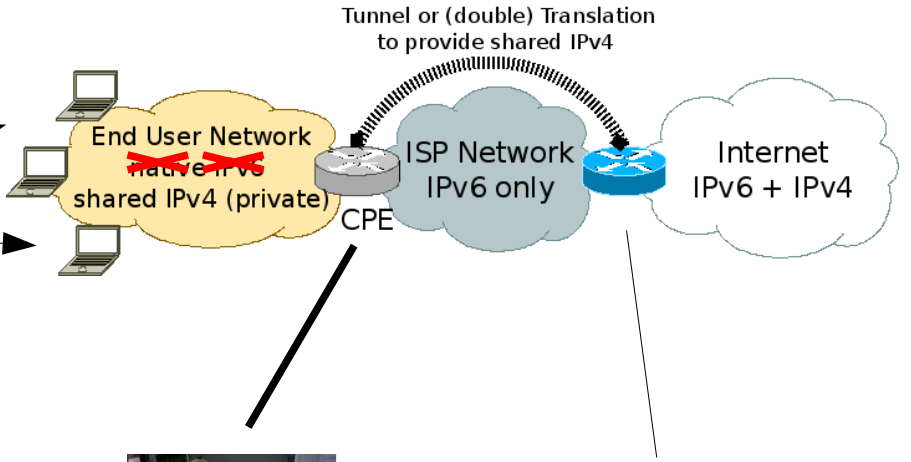
- How can we choose?
  - **Native IPv6** for the users
  - **Stateless (at ISP end) is better** than stateful
  - We should **avoid** techniques that **prolong IPv4 life**, without simultaneous IPv6 adoption
  - **Does it fit** to my specific network?
  - **Maturity** and **deployment options**

Transition Techniques



Tests

- It's a **work in progress**...
  - **End user point of view**
  - Linux, Ubuntu, Windows, Mac OS, IOS and Android
  - **No native IPv6 (enforced)**
  - Main Internet **applications**



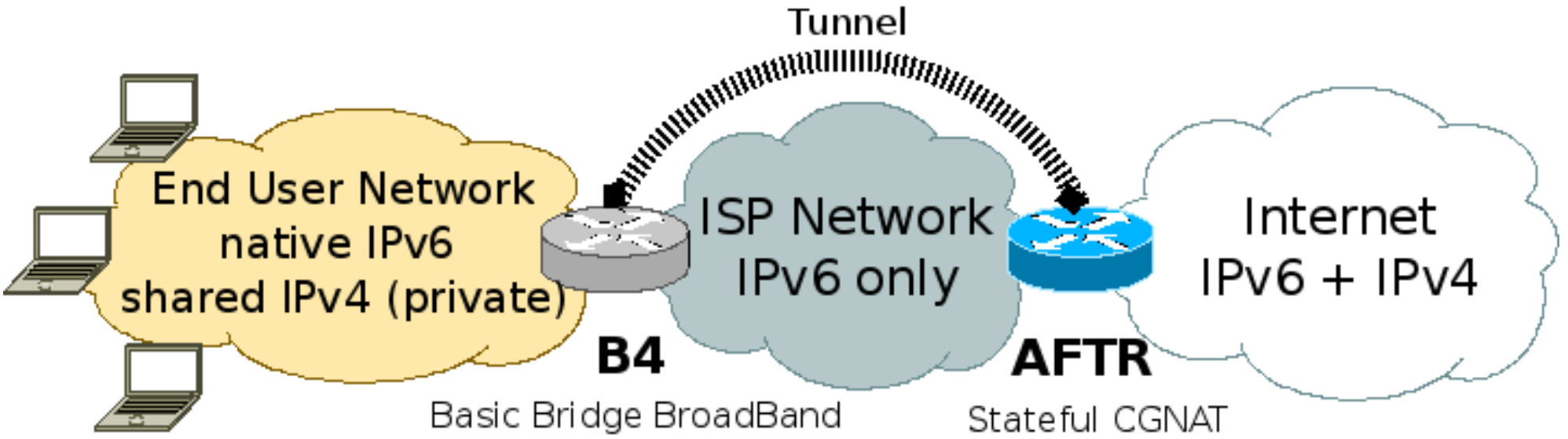
APLICATION	SOFTWARE/SERVICE USED
Internet search	www.google.com
E-mail access	mail.google.com / bl170w.blu170.mail.live.com
Email	SMTP and IMAP in Mail Software
Social networks	www.facebook.com
Vídeo on-line	www.youtube.com
Download peer-to-peer	Torrent Client
News site	www.uol.com.br / www.msn.com
Net-banking	www.itau.com.br
Vídeo call	Skype
Games via Internet	League of Legends

OpenWRT
WR1043-ND TP-Link

Linux

DS-Lite

- RFC 6333
- AFTR: http://www.isc.org/software/aftr



DS-Lite

DS-Lite	Symbols:		
		yes	It works behind DS-Lite in all OSs.
		no	It doesn't work behind DS-Lite in at least one OS.
		VVV	The user experience was better than in the direct connection with Internet.
		VV	The user experience was the same as in the direct connection with Internet.
		V	The user experience was worse than in the direct connection with Internet.
		X	It was tested and didn't work in the appointed OS.
		-	Software not available in the appointed OS.
			It wasn't tested in the appointed OS.

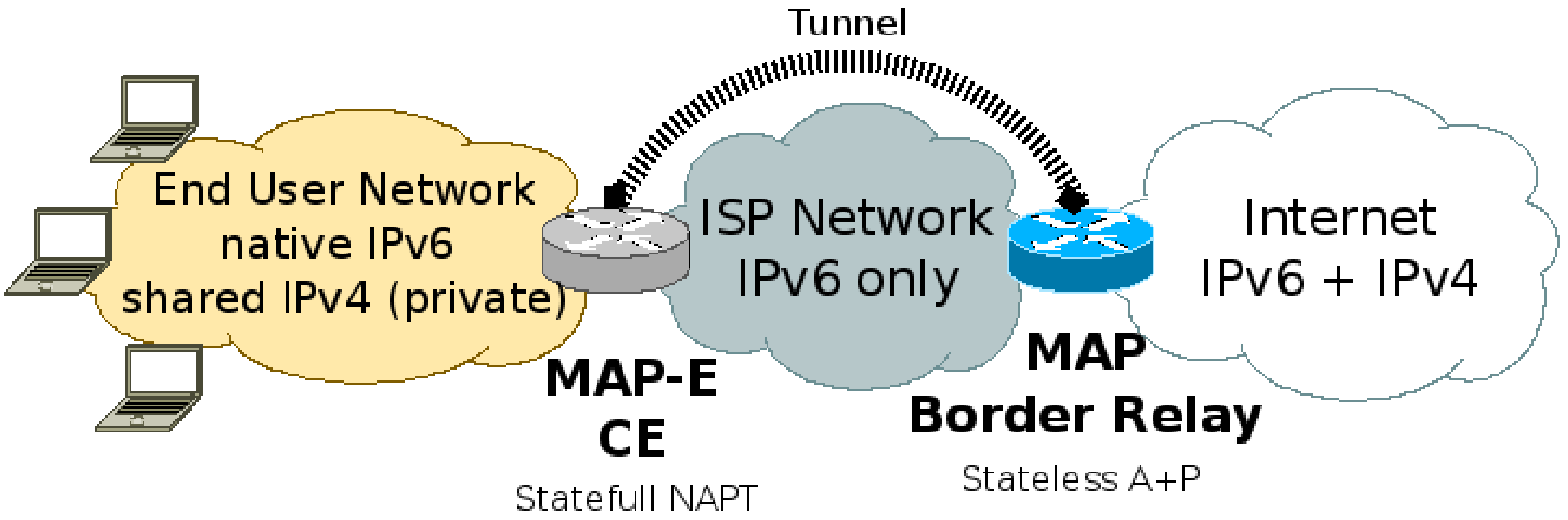
			O.S. USED FOR TEST				
APLICATION	**SOFTWARE/SERVICE USED**	**OK**	LINUX 64bits Ubuntu 12.04	WIN 7 64bits	Mac OS	IOS	Android
Internet search	www.google.com		VV	VV	VV	VV	VV
E-mail access	mail.google.com / bl170w.blu170.mail.live.com		VV	VV	VV	VV	VV
Email	SMTP and IMAP in Mail Software		VV	VV	VV	VV	VV
Social networks	www.facebook.com		VV	VV	VV	VV	VV
Vídeo on-line	www.youtube.com		VV	VV	VV	VV	VV
Download peer-to-peer	Torrent Client		V	V	V	-	-
News site	www.uol.com.br / www.msn.com		VV	VV	VV	VV	VV
Net-banking	www.itau.com.br		VV	VV	VV	VV	VV
Vídeo call	Skype		V	V	V	V	V
Games via Internet	League of Legends		-	VV	VV	-	-

MAP

- MAP-T (Double Translation)
- MAP-E (Tunnel / Encapsulation)
- IETF drafts
  - Last call / softwires WG
- Uses A+P
  - Stateless IPv4 address sharing
  - Port range restriction
- Previous tests: http://tools.ietf.org/id/draft-cordeiro-softwire-experience-mapt-01.txt

MAP-E

- http://tools.ietf.org/html/draft-ietf-softwire-map-01
- CERNET (Linux) / Cisco



MAP-E

MAP-E	Symbols:		
		yes	It works behind MAP-E in all OSs.
		no	It doesn't work behind MAP-E in at least one OS.
		VVV	The user experience was better than in the direct connection with Internet.
		VV	The user experience was the same as in the direct connection with Internet.
		V	The user experience was worse than in the direct connection with Internet.
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			O.S. USED FOR TEST				
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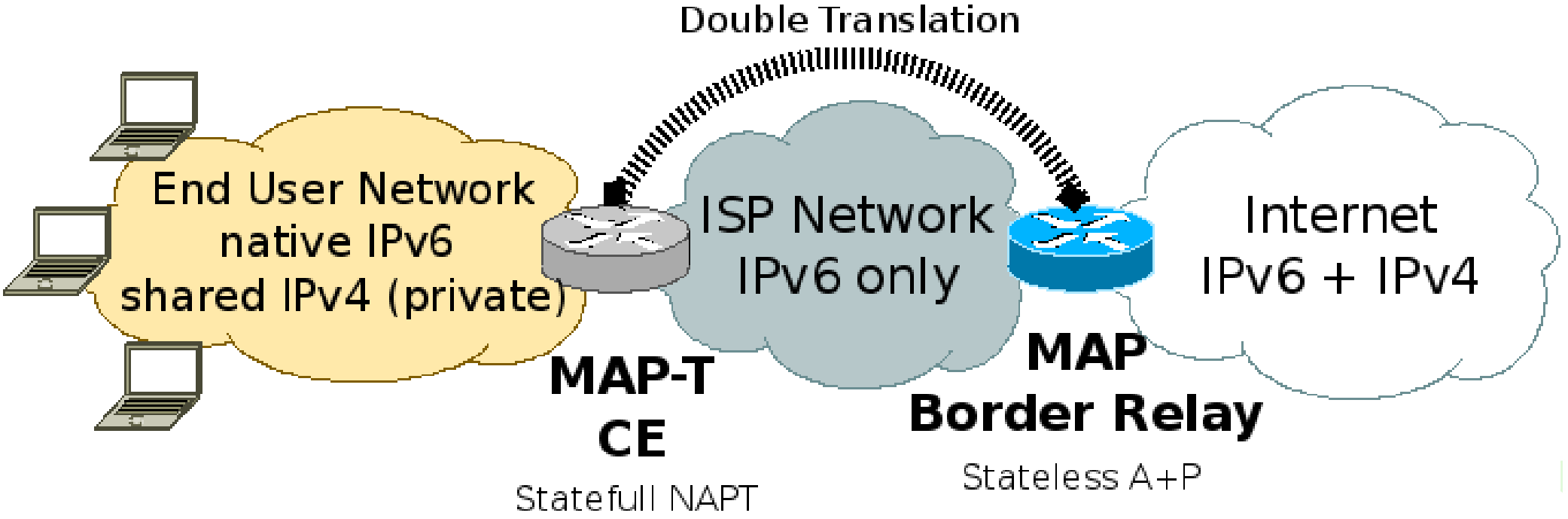
Internet search	www.google.com		VV	VV	VV	VV	VV
E-mail access	mail.google.com / bl170w.blu170.mail.live.com		VV	VV	VV	VV	VV
Email	SMTP and IMAP in Mail Software		VV	VV	VV	VV	VV
Social networks	www.facebook.com		VV	VV	VV	VV	VV
Vídeo on-line	www.youtube.com		VV	VV	VV	VV	VV
Download peer-to-peer	Torrent Client		V	V	V	-	-
News site	www.uol.com.br / www.msn.com		VV	V	V	VV	VV
Net-banking	www.itau.com.br		VV	VV	VV	VV	VV
Vídeo call	Skype		VV	VV	V	V	V
Games via Internet	League of Legends		-	V	VV	-	-

MAP-T

- http://tools.ietf.org/html/draft-ietf-softwire-map-01
- http://tools.ietf.org/html/draft-ietf-softwire-map-t-01
- CERNET (Linux) / Cisco



MAP-T

MAP-T	Symbols:		
		yes	It works behind MAP-T in all OSs.
		no	It doesn't work behind MAP-T in at least one OS.
		VVV	The user experience was better than in the direct connection with Internet.
		VV	The user experience was the same as in the direct connection with Internet.
		V	The user experience was worse than in the direct connection with Internet.
		X	It was tested and didn't work in the appointed OS.
		-	Software not available in the appointed OS.
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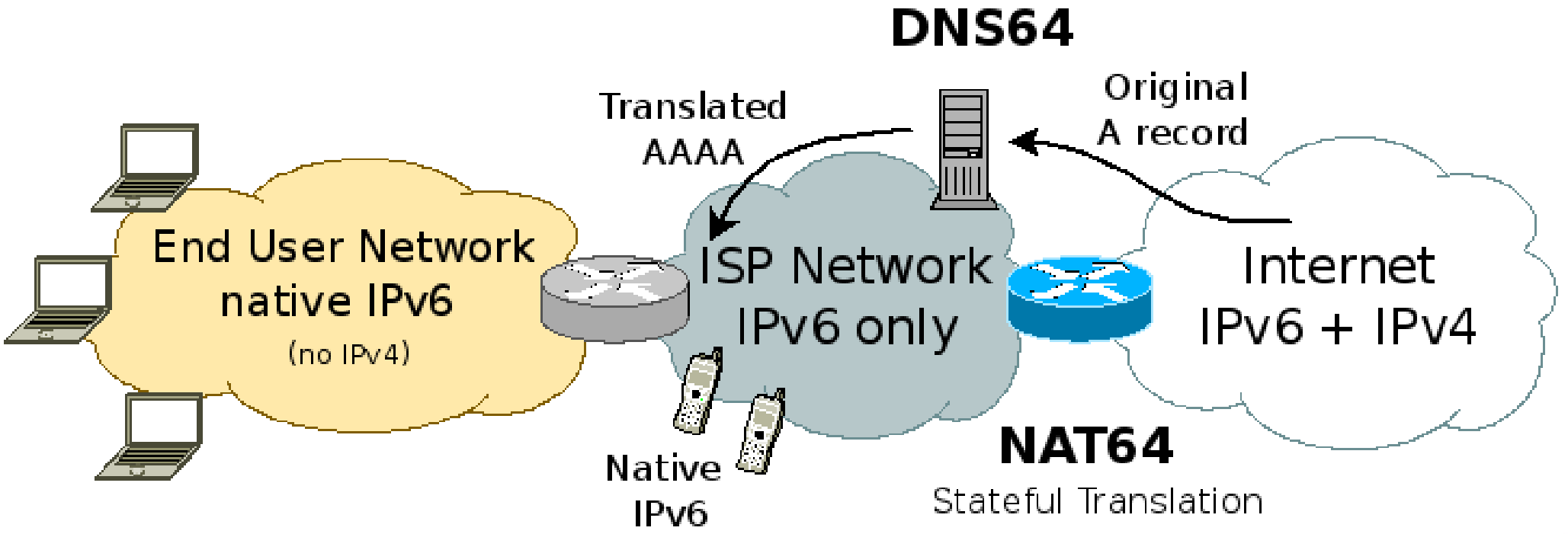
			O.S. USED FOR TEST				
APLICATION	SOFTWARE/SERVICE USED	OK	LINUX 64bits Ubuntu 12.04	WIN 7 64bits	Mac OS	IOS	Android
Internet search	www.google.com		VV	VV	VV	VV	VV
E-mail access	mail.google.com / bl170w.blu170.mail.live.com		VV	VV	VV	VV	VV
Email	SMTP and IMAP in Mail Software		VV	VV	VV	VV	VV
Social networks	www.facebook.com		VV	VV	VV	VV	VV
Vídeo on-line	www.youtube.com		VV	VV	VV	VV	VV
Download peer-to-peer	Torrent Client		V	V	V	-	-
News site	www.uol.com.br / www.msn.com		VV	VV	VV	VV	VV
Net-banking	www.itau.com.br		VV	VV	VV	VV	VV
Vídeo call	Skype		V	V	V	V	V
Games via Internet	League of Legends		-	V	VV	-	-

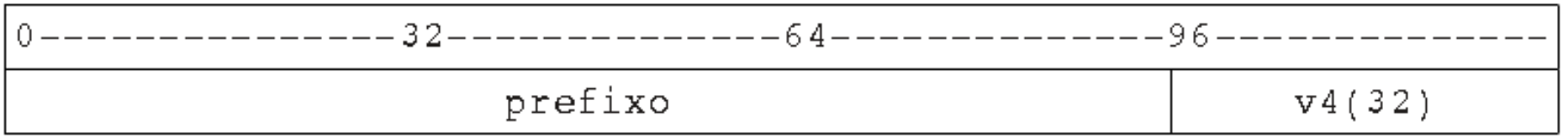
NAT64 and DNS64

- NAT64 and DNS64 are independent techniques that are used together



NAT64

- **RFC 6146**
- Stateful translation IPv6 to IPv4
- Well known prefix: **64:ff9b::/96**
- Linux, Windows, Cisco, Juniper, A10, F5, etc.



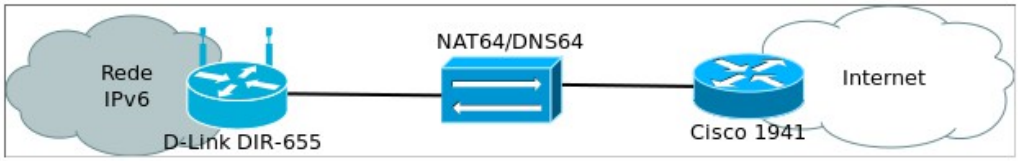

```
ex.: IPv4 = 203.0.113.1
     translated IPv6 = 64:ff9b::203.0.113.1
```

DNS64

- Auxiliary technique for NAT64
- **RFC 6147**
- Work as a recursive DNS, but:
  - If there is no AAAA response, translates the A in a AAAA. Uses the same IPv6 prefix that NAT64.
- BIND, Totd, etc

NAT64 and DNS64

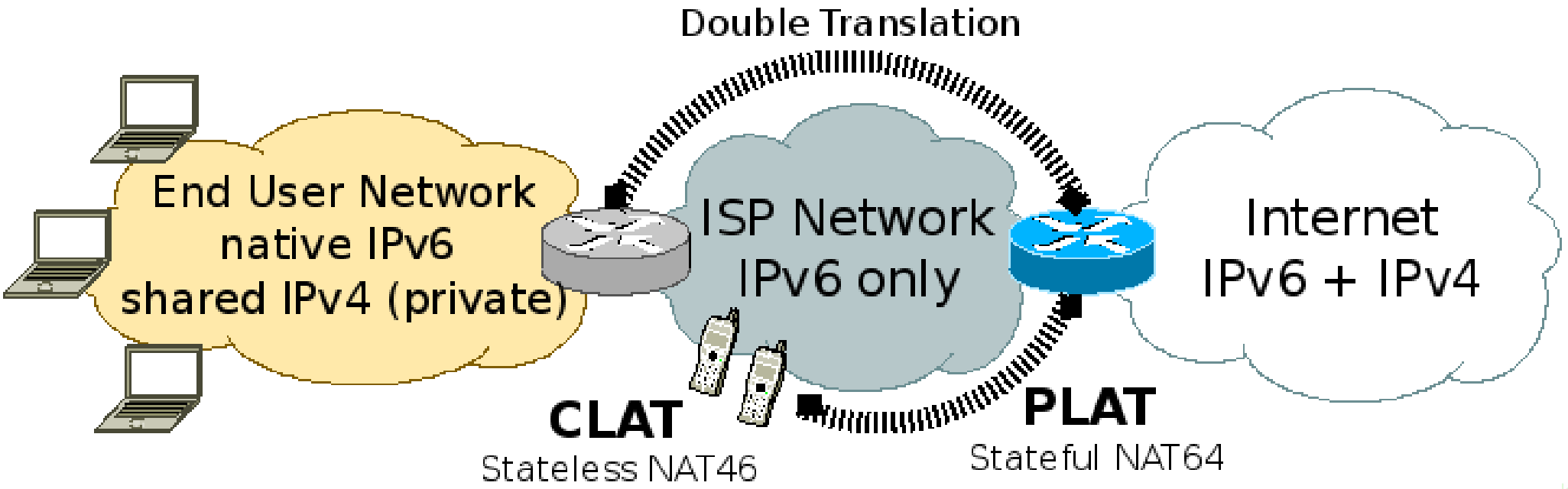
- In progress...
- See RFC6586 (2010)
- Previous tests at NIC.br (2012):



NAT64	Ecdsys						
DNS64	Bind						
		Win. Vista	Windows 7	Windows XP	Ubuntu 10.04	Mac OS 10.6	Mac OS 10.7
	IPv6 only	ok	ok	need v4	need v4	need v4	need v4
	Web	ok	ok	-	ok	ok	ok
	Email (IMAP+SMTP)	ok	ok	-	ok	ok	ok
	Skype	x	x	-	x	x	x
	Google Talk	x (nat. v6 ok)	x (nat. v6 ok)	-	x (nat. v6 ok)	x (nat. v6 ok)	x (nat. v6 ok)
	MSN	x	x	-	x	x	x
	Torrents (Miro, uTorrent, Transmission)	x (nat. v6 ok)	x (nat. v6 ok)	-	x (nat. v6 ok)	x (nat. v6 ok)	x (nat. v6 ok)
	Dropbox	x	x	-	x	x	x
	Video Streaming (VLC)	ok	ok	-	ok	ok	ok
	FTP	ok	ok	-	ok	ok	ok
	SSH	ok	ok	-	ok	ok	ok
	NTP	ok	ok	-	ok	ok	ok
	Windows Update	ok	ok	-	-	-	-

464XLAT

- RFC 6877
- Included in Android code recently



464XLAT

- No tests from NIC.br yet, sorry...
- But, see please:
  - https://docs.google.com/spreadsheet/ccc?key=0AnVbRg3DotzFdGVwZWlWeG5wXzVMcG5qczZEZloxWGc#gid=0
- Tests from Cameron Byrne (T-Mobile)
- 200+ apps
  - 25 fails with NAT64/DNS64
  - All worked with 464XLAT

App Name	Functionality	Version	464XLAT Fixed
connection tracker	Broken	NA	NA
DoubleTwist	Broken	1.6.3	YES
Go SMS Pro	Broken	NA	YES
Google Talk	Broken	4.1.2	YES
Google+	Broken	3.3.1	YES
IP Track	Broken	NA	NA
Last.fm	Broken	NA	YES
Netflix	Broken	NA	YES
ooVoo	Broken	NA	YES
Pirates of the Caribean	Broken	NA	YES
Scrabble Free	Broken	1.12.57	YES
Skype	Broken	3.2.0.6673	YES
Spotify	Broken	NA	YES
Tango	Broken	NA	YES
Texas Poker	Broken	NA	YES
TiKL	Broken	2.7	YES
Tiny Towers	Broken	NA	YES
Trillian	Broken	NA	YES
TurboxTax Taxcaster	Broken	NA	
Voxer Walkie Talkie	Broken	NA	YES
Watch ESPN	Broken	1.3.1	
Zynga Poker	Broken	NA	YES
Xabber XMPP	Broken	NA	NA

Final Remarks

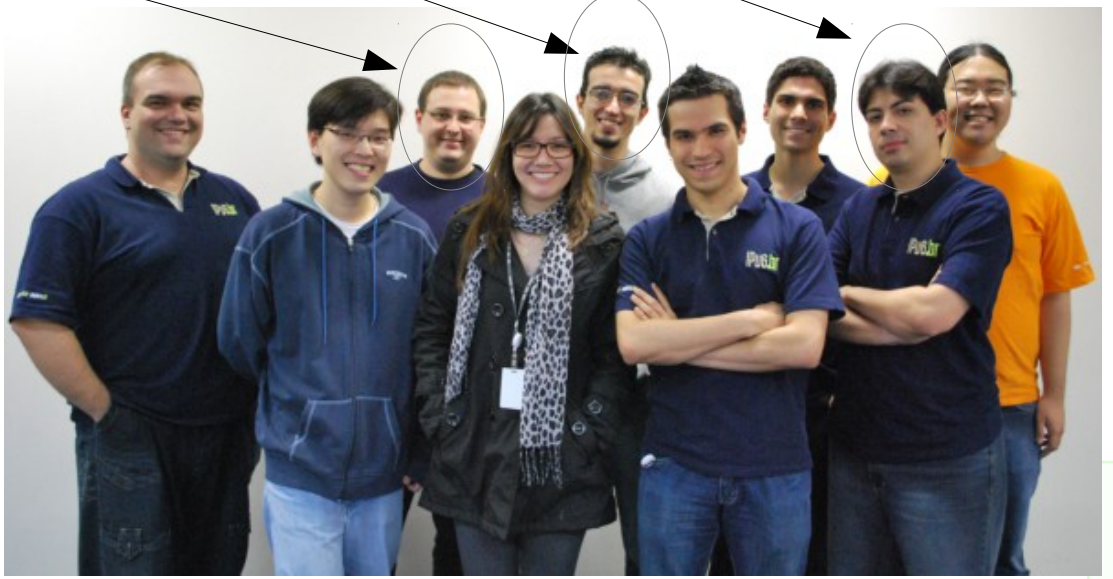
- **NAT444** can lead us to a **worst Internet for business** (worst user experience, less inovation, no IoT, etc). Please try, really try, not to do it. **If you must, do it together with IPv6**.
- **NAT64/DNS64 is not viable for now**. Can be if Skype, Dropbox, and other couple off applications are fixed. **464XLAT is a very good option for mobile operators**, but it is avaliable just on Androids for now. We should ask other vendors to implement it.
- **MAP-T and MAP-E are good options**. They work really well. Maturing very fast. Running code for Linux (from CERNET). Cisco (IOS-XR / ASR 1K and 9K). And others: Vyatta, Furukawa, IIJ, Yamaha, IP Infusion.
- **DS-Lite can be an option**, but it is stateful on ISP side. MAP would be preferable.

Acknowledgements

- Thanks to:
  - **Rodrigo Regis**
  - **Rodrigo Carnier**
  - **Edwin Cordeiro**

  (they conducted the tests)

  and to the other members of IPv6.br team.



Contacts

- IPv6.br team
  - ipv6@nic.br
  - Antonio M. Moreiras
    moreiras@nic.br
    inoc-dba: 22548*amm