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North American IPv6 Summit April 17-19, 2013 Denver CO



Transition Techniques – 19/Apr/2013



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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

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- 464XLAT
- Final remarks

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Basic workings Tests





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Internet Governance in Brazil

V O B O G





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

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http://ipv6.br

Ceptro br Centro	de Estudos e Pesquisas em Tecnologia de Redes e Operaç	ões	egibr nichr
IPU6.br Ar	nova geração do otocolo Internet	0:2::3 2001:dc0:2001:0:4606:820 2001:12ff:0:2:: 2001:dc0:2001:0:4608:20:: 2001:12ff:0:2:: 2001 1:2::3 2001:dc0:2001:0:4606:820 2001:12ff:0:2:: 2001 2:0:1:dc0:2001:0:4608:20:: 2001:12ff:0:2:: 2001 2001:12ff:0:2:: 2:0:1:dc0:2001:0:4608:20:: 2001:12ff:0:2:: 2001 2001:12ff:0:2:: 2:0:1:dc0:2001:0:4608:20:: 2001:12ff:0:2:: 2001 2001:12ff:0:2::	3 2001:dc0:2001:0:4606:820 :dc0:2001:0:4608:20:: 2001:1 3 2001:dc0:2001:0:4606;820 :dc0:2001:0:4608:20:: 2001:1 3 2001:dc0:2001:0:4606;820
BlogCalendário	Você está em: IPv6.br Em Destaque	Novidades do Blog	Realize cadastro ou login para comentar e realizar downloads!
 Curso e-learning Curso Básico 	O pai da Internet fala sobre IPv6 e seu lançamento mundial.	Você sabe qual é a hora certa para ganhar um tablet?	Este sítio utiliza IPv6
 Questões Frequentes O IPv6 Introdução Ative e use o IPv6 Cabeçalho Endereçamento Funcionalidades Básicas Transição Cronograma de implantação 	Vídeo publicado em 04/06 onde Vinton Cerf, um dos criadores do TCP/IP e considerado pai da Internet, fala sobre o IPv6 e sobre o World IPv6 Launch. Legendas em português estão disponíveis:	O pai da Internet fala sobre IPv6 e seu lançamento mundial. Testando o NAT64/DNS64 – visão do usuário final O novo www.ipv6.br Qual é o tamanho de bioco apropriado? Endereçamento IPv6 Efeitos colaterais do dia mundial do IPv6	Se o globo girar, você também já usa o IPv6! Sua Conectividade IPv6 IPv4 - OK! Nao foi possivel detectar seu ipv6
 Estatísticas 	Teste o seu sítio	E-learning e apostilas	Conectado via ipv4
 Fórum IPv6 Videos Fotos Downloads Links Quem Somos 	Seu Sítio Web está pronto para usuários IPv Validar www.ipv6.br Validar	6? Acesse nosso e-learning de introdução ao protocolo IPv6. Apostilas do Curso IPv6 Básico.	Para um teste mais detalhado, visite www.test-lpv6.com.br
Contato Pesquise por:	Notícias sobre IPv6 World IPv6 Day is here Who cares? - ZDNet		LeTrafficManiac Life After World IPv6 Launch: On the first day

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IPv6 validator



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E-learning

http://ipv6.br/curso

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A Nova Geração do Protocolo Internet	Curso de Introdução ao IPv6	8	6 / 14	
	Cabeçalho IPv6			
Introdução				
O Protocolo IP				-
Implantação do IPv6		Classe de Tráfego (Traffic Class)	Identificador de (Flow Labe	Fluxo J
Cabeçalho IPv6	Versilo (Version)	Tamanho dos Dados (Payload Length)	Proxima Cabecalho (Next Header)	Limite de Encamishamento (Hop Limit)
Endereçamento do IPv6				
Serviços Básicos do IPv6				
Segurança	Endereço de Origem(Source Address)			
Roteamento e Gerenciamento	Endereço de Destino(Destination Address)			
Coexistência e Transição				
Mais Informações	O campo Identificador de Fluxo foi acrescentado, adio suporte a QoS ao IP.	ionando um mecanism	o extra de	\Rightarrow
uma iniciativa CGIJI NICJI	anterior		- C	róximo
(cc)) BY- SA	Transition Techniques – 19/Apr/20	13		

are care 200 are dad Capacity Building (trainings)

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CORE (43681 on ubuntu) lab-dslite3.imn

http://ipv6.br/basico

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The transition



IPv6 and IPv4 are not compatible



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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!

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NAT444



Private space 10.0.0.0/8 172.16.0.0/12 192.168.0.0/16

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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...

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Transition Techniques

• There are so many...





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Transition Techniques

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





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- 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

Stateless at ISP end



MAP-T

Tunnel (Encapsulation)

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Translation

DS-Lite

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NAT64/DNS64

464XLAT









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- 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	
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DS-Lite

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



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DS-Lite

	-		/es It works behind DS-Lite in all OSs.							
			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.							
DS Lite	Symbols:		The user experience was the same as in the direct connection with Internet.							
D3-Lite			The user experier	nce was worse that	an in the direct c	onnection with l	nternet.			
			It was tested and	didn't work in the	appointed OS.					
		-	Software not avai	lable in the appoi	nted OS.					
			It wasn't tested in	the appointed OS	5.					
				O.S.	USED FOR TES	т				
APLICATION	SOFTWARE/SERVICE USED	ок	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.cor		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-T (Double Translation)
- MAP-E (Tunnel / Encapsulation)
- IETF drafts
 - Last call / softwires WG
- Uses A+P

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- Stateless IPv4 address sharing
- Port range restriction

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• Previous tests: http://tools.ietf.org/id/draft-cordeiro-softwire-experience-mapt-01.txt



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MAP-E

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





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MAP-E

			It works behind	MAP-E in all OS	Ss.			
			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.					
	Symbols		The user experience was the same as in the direct connection with Internet.					
	Symbols.	V	The user exper	The user experience was worse than in the direct connection with Internet.				
		X	It was tested an	nd didn't work in	the appointed C	DS.		
		-	Software not av	vailable in the ap	pointed OS.			
			It wasn't tested	in the appointed	OS.			
				0.S	. USED FOR T	EST		
APLICATION	SOFTWARE/SERVICE USED	ок	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	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	-	-	





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- http://tools.ietf.org/html/draft-ietf-softwire-map-01
- http://tools.ietf.org/html/draft-ietf-softwire-map-t-01



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MAP-T

			yes It works behind MAP-T in all OSs.						
			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.						
	Symbols		The user experience was the same as in the direct connection with Internet.						
	oymbols.	V	/ The user experience was worse than in the direct connection with /		ith Internet.				
			It was tested an	nd didn't work in f	the appointed O	S.			
		-	Software not av	ailable in the ap	pointed OS.				
			It wasn't tested	in the appointed	OS.				
			O.S. USED FOR TEST						
		-							
APLICATION	SOFTWARE/SERVICE USED	ок	LINUX 64bits Ubuntu 12.04	WIN 7 64bits	Mac OS	IOS	Android		
APLICATION Internet search	SOFTWARE/SERVICE USED	ок	LINUX 64bits Ubuntu 12.04 VV	WIN 7 64bits VV	Mac OS VV	IOS VV	Android VV		
APLICATION Internet search E-mail access	SOFTWARE/SERVICE USED www.google.com mail.google.com / bl170w.blu170.mail.live.com	ок	LINUX 64bits Ubuntu 12.04 VV VV	WIN 7 64bits VV VV	Mac OS VV VV	IOS VV VV	Android VV VV		
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APLICATION Internet search E-mail access Email Social networks	SOFTWARE/SERVICE USED www.google.com mail.google.com / bl170w.blu170.mail.live.com SMTP and IMAP in Mail Software www.facebook.com	ОК	LINUX 64bits Ubuntu 12.04 VV VV VV VV VV	WIN 7 64bits VV VV VV VV VV	Mac OS VV VV VV VV VV	IOS VV VV VV VV	Android VV VV VV VV VV		
APLICATION Internet search E-mail access Email Social networks Vídeo on-line	SOFTWARE/SERVICE USED www.google.com mail.google.com / bl170w.blu170.mail.live.com SMTP and IMAP in Mail Software www.facebook.com www.youtube.com	ОК	LINUX 64bits Ubuntu 12.04 VV VV VV VV VV VV	WIN 7 64bits VV VV VV VV VV VV	Mac OS VV VV VV VV VV VV	IOS VV VV VV VV VV	Android VV VV VV VV VV VV		
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APLICATION Internet search E-mail access Email Social networks Vídeo on-line Download peer-to-peer News site Net-banking	SOFTWARE/SERVICE USED www.google.com mail.google.com / bl170w.blu170.mail.live.com SMTP and IMAP in Mail Software www.facebook.com www.youtube.com Torrent Client www.uol.com.br / www.msn.com www.itau.com.br	<u>ок</u>	LINUX 64bits Ubuntu 12.04 VV VV VV VV VV VV VV VV VV	WIN 7 64bits VV	Mac OS VV	IOS VV VV VV VV VV - VV VV VV	Android VV VV VV VV VV - VV VV VV		
APLICATION Internet search E-mail access Email Social networks Vídeo on-line Download peer-to-peer News site Net-banking Vídeo call	SOFTWARE/SERVICE USED www.google.com mail.google.com / bl170w.blu170.mail.live.com SMTP and IMAP in Mail Software www.facebook.com www.youtube.com Torrent Client www.uol.com.br / www.msn.com www.itau.com.br Skype	<u>ок</u>	LINUX 64bits Ubuntu 12.04 VV VV VV VV VV VV VV VV VV VV	WIN 7 64bits VV V V V V V V V V V V	Mac OS VV	IOS VV VV VV VV VV - VV VV VV VV	Android VV VV VV VV VV - VV VV VV VV		



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NAT64 and DNS64

• NAT64 and DNS64 are independent techniques that are used together



NAT64

• RFC 6146

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- 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

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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=0AnVbRg3DotzFdGVwZWIWeG5wXzVMcG5qczZEZloxWGc#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

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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:

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CQI

- Rodrigo Regis
- Rodrigo Carnier
- Edwin Cordeiro

(they conducted the tests)

and to the other members of IPv6.br team.

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