IPv6 deployment in Latin America and the Caribbean

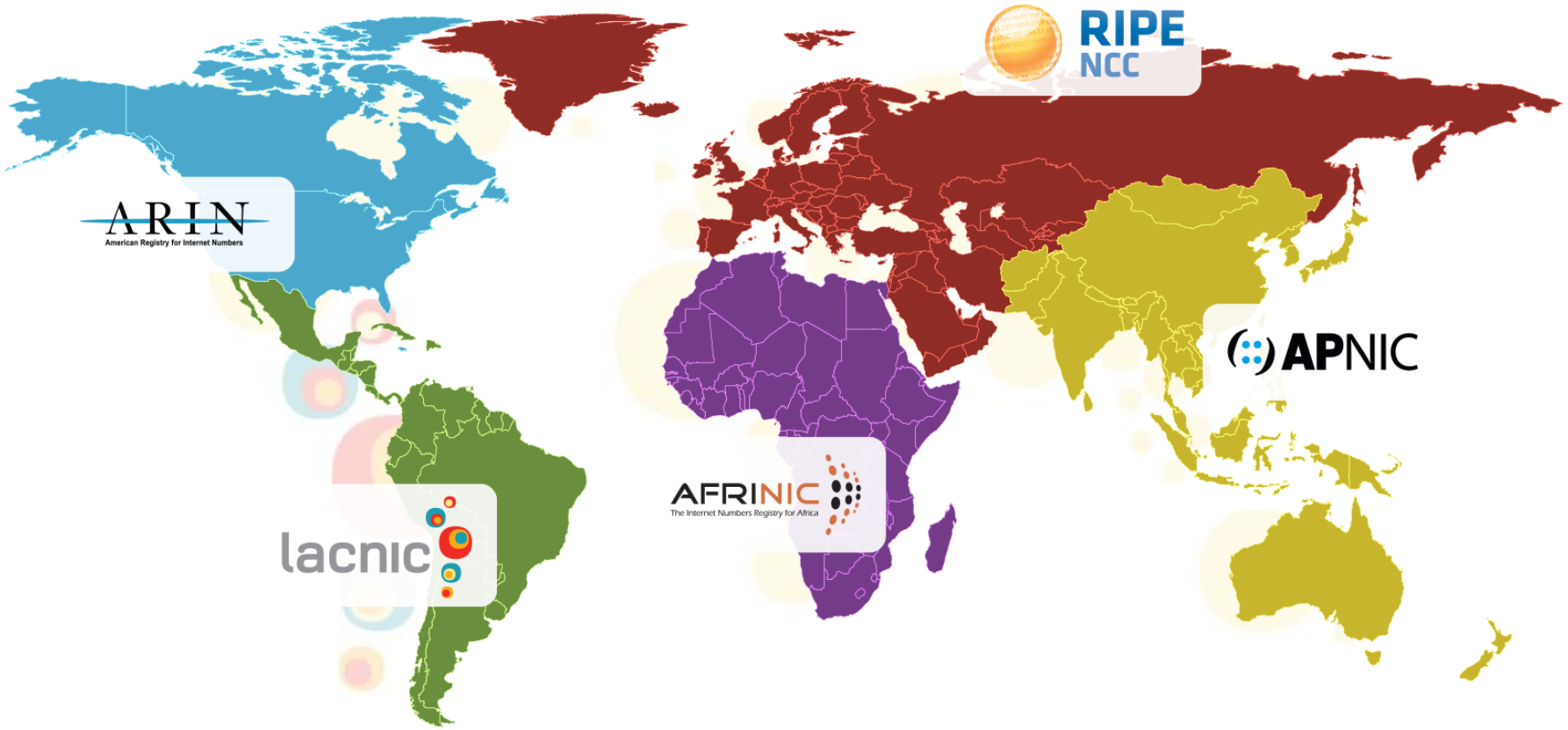
CaribNOG 13 – Warrens, Barbados

Kevon Swift
kevon@lacnic.net

Agenda

- **LACNIC –** *Caribbean snapshot*
- **IPv6 End User Readiness**
- **IPv6 in Latin America**
  - LACNIC/CAF IPv6 KPI – ***ICAv6***
  - Results across LACNIC economies
  - Case Studies
  - Economic Model
- **Lessons Learnt**
  - Recommendations

The Regional Internet Registries (RIRs)



LACNIC's Caribbean Service Area (pop/Internet users)

•Aruba (110,663 / 88.6%)

•Belize (340,844 / 41.59%)

•BES [Bonaire (17,408) , St Eustatius (3,543), Saba(1,991)]

•Cuba (11,047,251 / 37.31%)

•**Curacao (146,836 / *43%)**

•Dominica Republic (10,349,741 / 54.22%)

•Guyana (735,554 / 38.20%)

•**French Guiana (250,109 / *72%)**

•Haiti (9,996,731 / 12.20%)

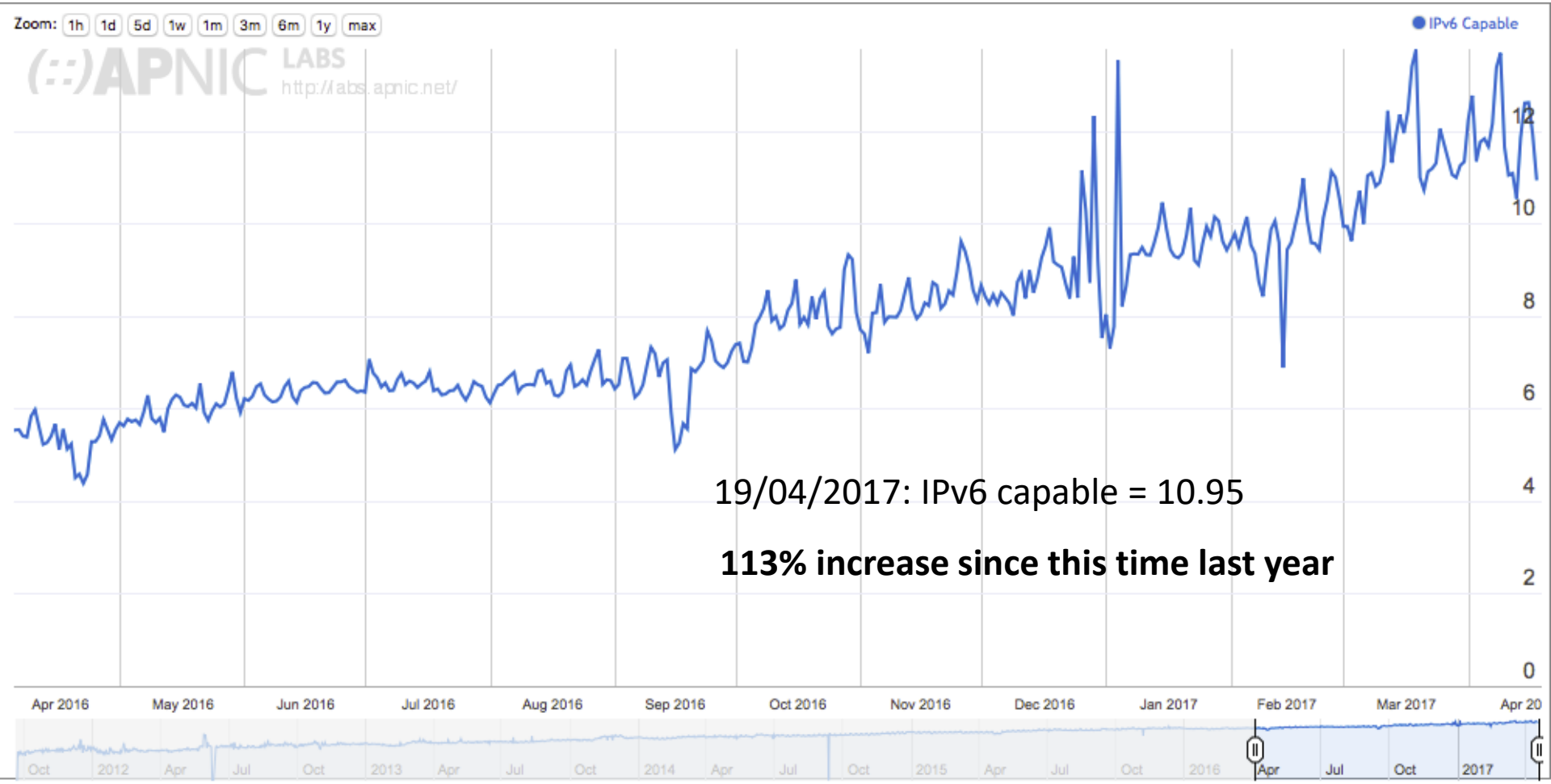
•**St Maarten (40,850 / *26.84%)**

•Suriname (576,311 / 42.7%)

•Trinidad and Tobago (1,341,151 / 69.2%)

Source: ITU Statistics (2015)

IPv6 measurement
End user readiness: World



http://stats.labs.apnic.net/ipv6/XA as of 19/04/2017

The IPv6 economy league table (top 20)

http://stats.labs.apnic.net/ipv6/ as of 17/04/2017

CC	Country	IPv6 capable (%)
BE	Belgium	53.97
DE	Germany	43.66
CH	Switzerland	34.89
US	United States of America	33.64
GR	Greece	32.89
LU	Luxembourg	29.86
IN	India	25.50
GB	Great Britain	25.00
PT	Portugal	24.95
JP	Japan	22.18
IE	Ireland	21.31
FR	France	18.82
CA	Canada	18.53
EC	Ecuador	18.02
EE	Estonia	17.35
PE	Peru	17.15
MY	Malaysia	15.67
NO	Norway	15.54
TT	Trinidad and Tobago	15.01
AU	Australia	14.96

Various ways to measure IPv6 adoption

Opendata Project by LACNIC: http://stats.labs.lacnic.net/CAF-LACNIC ICAv6 Index and Partial Indicators: http://portalipv6.lacnic.net/caf-lacnic/

Google IPv6 Statistics: global and by country

APNIC Capability Measurements by country and estimated population using IPv6 per ASN

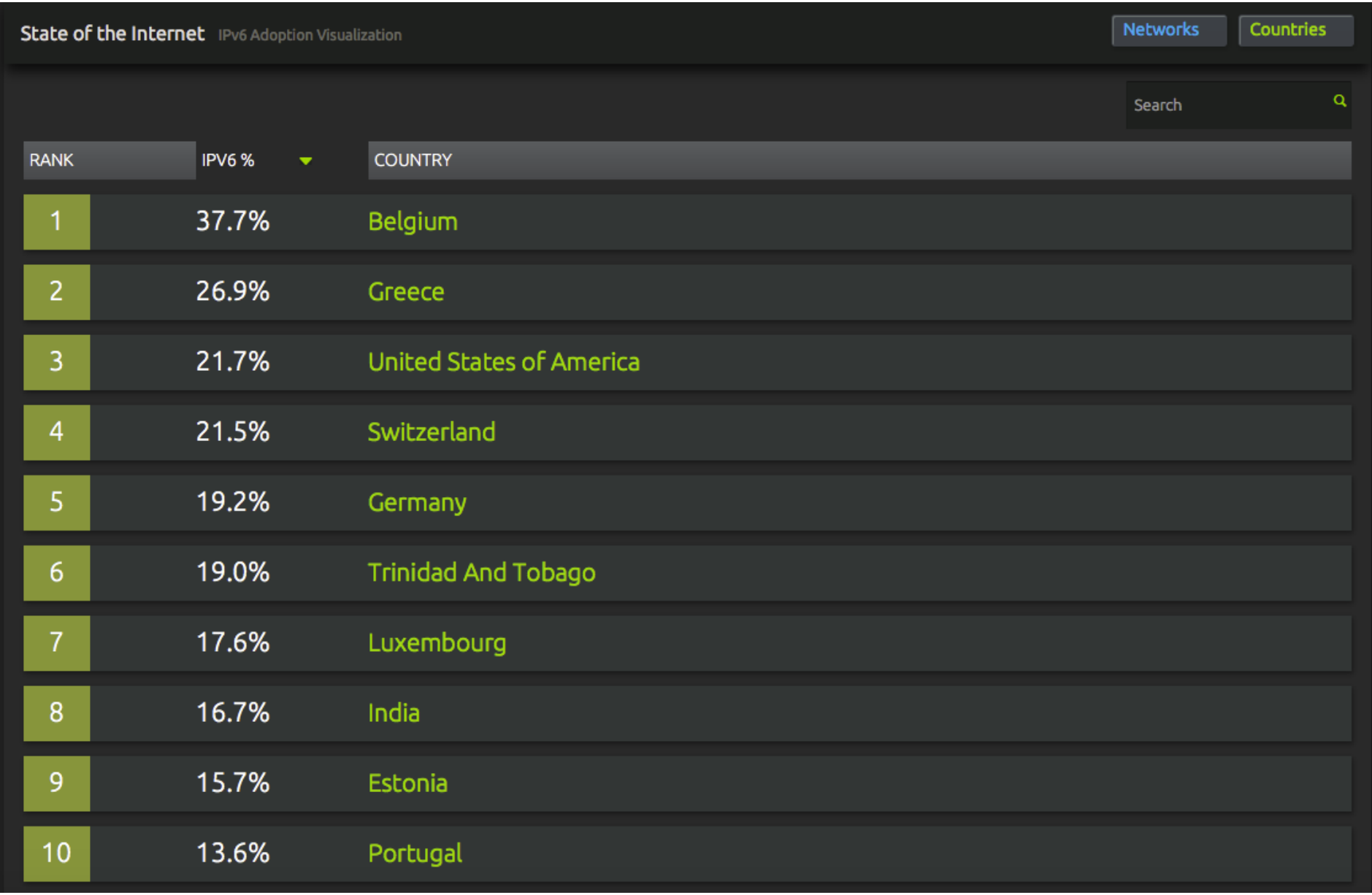
Akamai IPv6 Adoption Visualization: https://www.akamai.com/es/es/our-thinking/state-of-the-internet-report/state-of-the-internet-ipv6-adoption-visualization.jsp

Various Measurements on the World IPv6 Launch Website: http://www.worldipv6launch.org/measurements/

Cisco 6lab Project (very comprehensive information): http://6lab.cisco.com/index.php

RIPE Statistics: http://v6asns.ripe.net/v/6?s=_ALL

lacnic



Source: Akamai

lacnic

IPv6 in Latin America

Special Report: IPv6 Deployment for Social and Economic Development in Latin America and the Caribbean

- LACNIC teamed up with CAF – Development Bank of Latin America to examine IPv6 deployment in Latin America and the Caribbean

- Results aim to clarify:
  - Why IPv6 adoption is still low in Latin America and the Caribbean compared to other regions
  - What can be done to improve deployment

- Conducted over 10-month period in 2015

- Results published at http://portalipv6.lacnic.net

Research included

- Surveys among LACNIC Members addressing deployment (or not) of IPv6
- LACNIC IPv6 KPI (ICAv6) based on Cisco's methodology for evaluating various stages of the Internet value chain
- 10-country sample comprising face-to-face interviews with ISPs, public entities and academic institutions
- Dynamic model to assist ISPs with the financial implications of various deployment strategies
- Successful cases, guidelines, recommendations

LACNIC ICAv6

1. PACTO (Planning): % of IPv6 allocated prefixes with observed traffic wrt total allocations.

2. ASTRAN (AS with IPv6 transit): AS transit with observed IPv6 traffic. Average of AS's providing IPv6 transit and IPv4 transit AS's that have an IPv6 assignment.

3. CONT (Content): Sum of the weighted % of IPv6 accessible sites plus the weighted % of IPv6 proof/test domains ("IPv6" embryos according to LACNIC).

4. USUARIOS (Users): percentage of IPv6-capable end-users

$$LACNIC\ ICAv6\ \% = 0{,}3 * (0{,}1 * PACTO + 0{,}9 * ASTRAN) + 0{,}7 * \sqrt{CONT * USUARIOS}$$

lacnic

Results

Country	ICAv6	PACTO	ASTRAN	CONT	USUARIOS
Argentina	26.33	6.55	75.75	32.64	2.02
Aruba	15	50	50	46.77	0
Belize	12.61	4.35	46.22	52.9	0
Bolivia	20.04	6.45	33.02	47.88	5.09
Brazil	38.4	11.53	67.88	51.21	15.5
Chile	20.15	11.35	71.61	45.63	0.01
Colombia	26.13	14.29	93.28	53.96	0.01
Costa Rica	19.85	10.84	70.69	39.53	0.01
Cuba	27.5	16.67	100	50.64	0
Curacao	15.01	5.88	54.95	50.37	0
Dom Rep	27.28	19.44	80.53	48.11	1.04
Ecuador	48.82	59.38	97.77	48.73	17.85
El Salvador	7.39	4.17	24.34	49.17	0.02
F Guiana	27	0	100	46.99	0
Guatemala	33.22	14.81	74.75	48.97	6.61
Guyana	28.2	40	100	49.26	0
Haiti	0	0	0	55.18	0
Honduras	19.51	3.08	71.92	51.7	0
Mexico	21.77	19.85	63.33	54.62	0.62
Nicaragua	2.63	5.56	9.11	49.03	0
Panama	20.25	1.49	74.85	51.28	0
Paraguay	19.83	2.78	70.68	45.03	0.02
Peru	35.52	28.85	54.78	50.16	16.05
Suriname	2.72	75	0	45.51	0.01
T&T	38.24	16.67	68.26	50.9	14.95
Uruguay	24.88	11.11	80.58	51.16	0.31
Venezuela	19.92	13.56	72.28	48.82	0

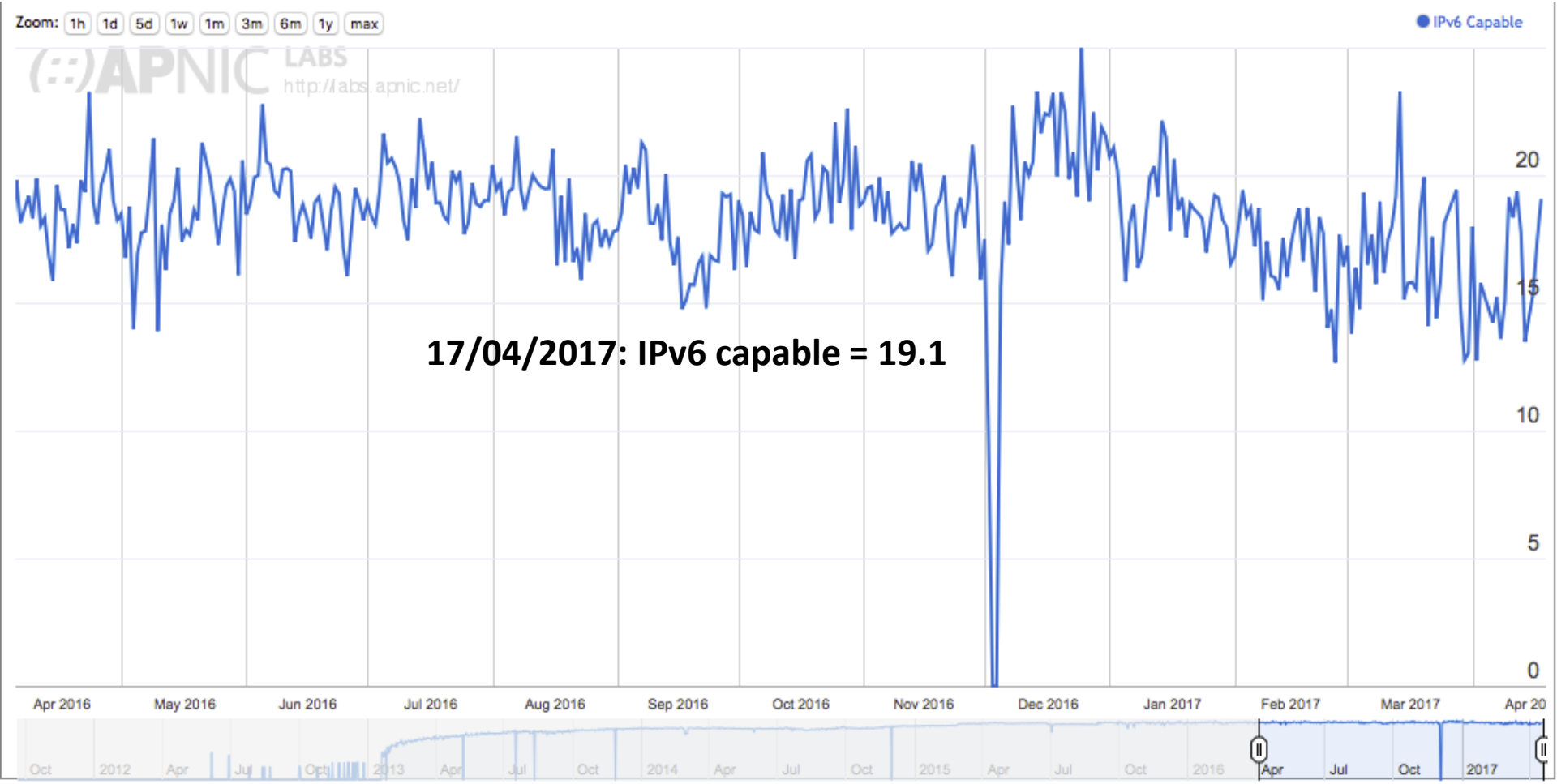
Field Work: Summary of findings

- Roughly only four (4) countries have more than 1% of users ready for IPv6 (Bolivia, Brazil, Ecuador and Peru). Most ISPs are still not offering IPv6 to end users (residential, mobile) but most have IPv6 deployed in their network core;
- 30% of organisations in the region are thinking about deploying IPv6 in 2016;
- Most commonly, the transition strategy adopted is Dual Stack with native IPv6 & private IPv4 + CGN44;
- Countries with large Internet penetration are the most delayed in IPv6 uptake (lower growth rate, IPv4 stock still enough for their *needs*)

Field Work: Summary of Findings con't

- ISPs:
  - So called "IPv6-ready" CPEs not so IPv6-ready
  - Provisioning systems & internal BSS software
  - Operations / help-desk training (but not a big issue)
- NRENs / Universities: IPv6 deployed in CPEs but some campus problems: Wi-Fi & firewalls generally not supporting IPv6 (or not configured)
- Governments: e-Gov systems, Government portals, community Wi-Fi networks not supporting IPv6

Perú


Zoom: 1h 1d 5d 1w 1m 3m 6m 1y max
IPv6 Capable
APNIC LABS
http://labs.apnic.net/
17/04/2017: IPv6 capable = 19.1
20
15
10
5
0
Apr 2016
May 2016
Jun 2016
Jul 2016
Aug 2016
Sep 2016
Oct 2016
Nov 2016
Dec 2016
Jan 2017
Feb 2017
Mar 2017
Apr 20
Oct
2012
Apr
Jul
Oct
2013
Apr
Jul
Oct
2014
Apr
Jul
Oct
2015
Apr
Jul
Oct
2016
Apr
Jul
Oct
2017

Peru IPv6 leaderboard

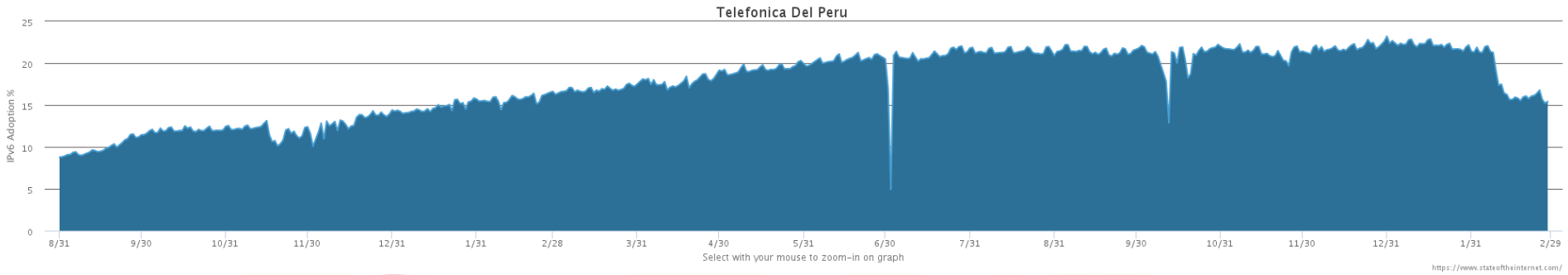
ASN	Organization	IPv6 capable (%)
6147	Telefonica del Peru	22.50
12252	America Movil Peru	0.02
262253	Econocable Media	0.07
262210	Viettel PER	0.16
21575	Entel Peru	0.03
277843	Optical Technologies	0.32
19180	Americatel Peru	0.08
52400	Olo del Peru	0.00

http://stats.labs.apnic.net/ipv6/PE 12/06/2016

Telefónica – Perú

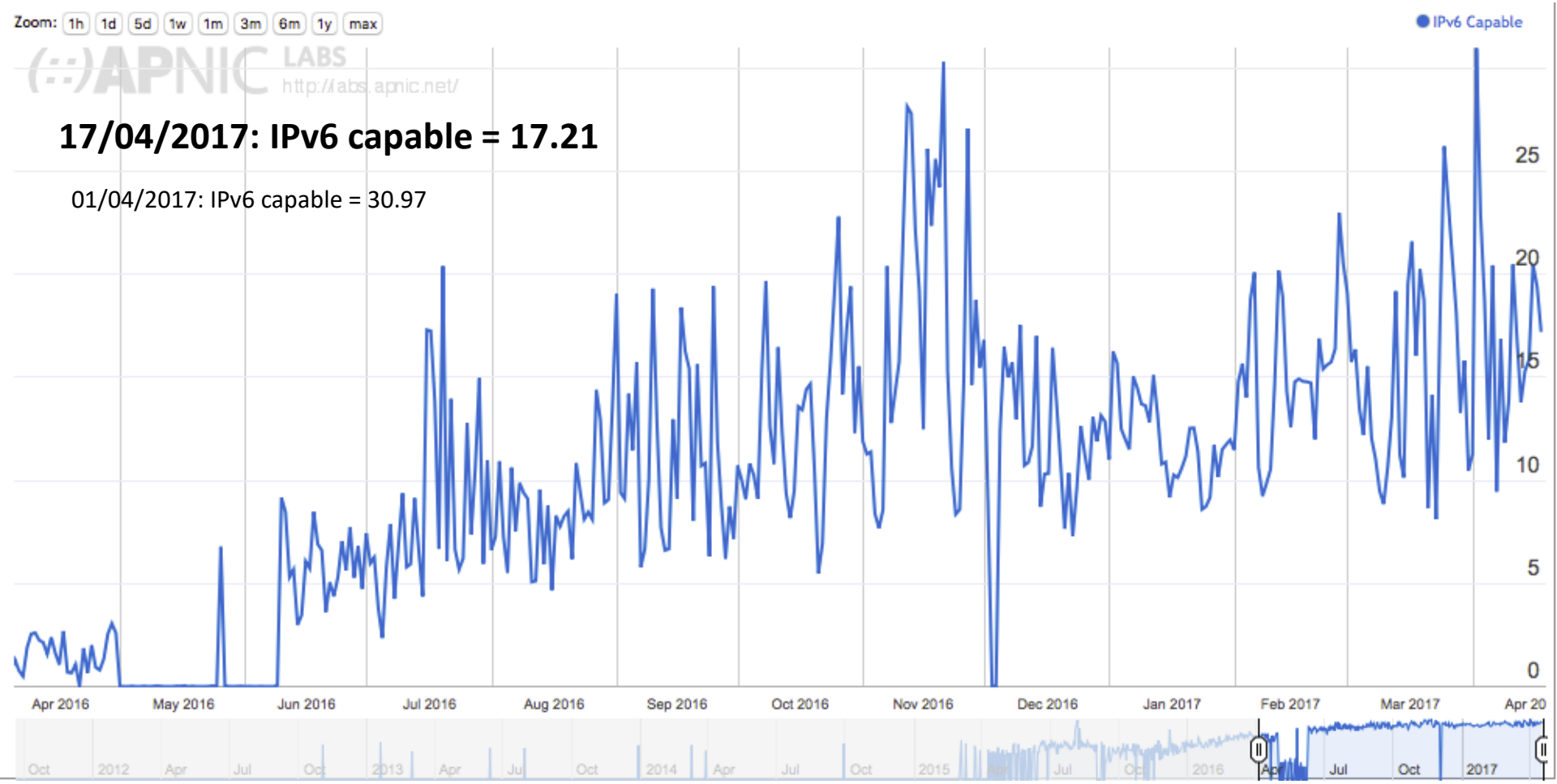
- **2008:** address shortage identified due to high growth rate of DSL customers
  - Internal planning involving all areas of the company
- **2010:** equipment and software testing
- **2012:** started ADSL IPv6 service
- IPv6 in HFC network is expected by 2016 and mobile in 2017

Telefónica – Perú



- CGN deployed due to IPv4 shortage (2012)
  - Corporate users and some DSL users get public IPs
  - Mobile uses CGN
  - IPv6: dual stack, CGN for IPv4 address sharing
- No problems identified in BSS
- Provisioning systems were part of the initial plan
- Help Desk: IP technology is irrelevant

Trinidad and Tobago



T&T IPv6 leaderboard

ASN	Organization	IPv6 capable (%)
27665	Columbus Communications Trinidad	0.00
5639	TSTT	0.00
33576	DIG001 – Digicel Jamaica	78.30
27924	Massy Communications	0.00
27789	Greendot	0.02
61478	Air Link Communications	0.00
263222	RVR International	0.02
46764	UWI Open Campus	0.04
27800	Digicel Trinidad and Tobago	0.00

http://stats.labs.apnic.net/ipv6/PE 19/04/2017

Economic Model

Control Panel

I.1 NLV of the Costs of Each Alternative

	Net Present Value
Alternative 1, transition with dual-stack and CGNAT with CPE	$4.910.952,82
Alternative 1, transition with dual-stack and CGNAT without CPE	$2.312.338,22
Alternative 2, using CGNAT without implementing IPv6	$6.192.207,28
Alternative 3, purchasing IPv4 addresses without NAT or IPv6	$4.077.689,49

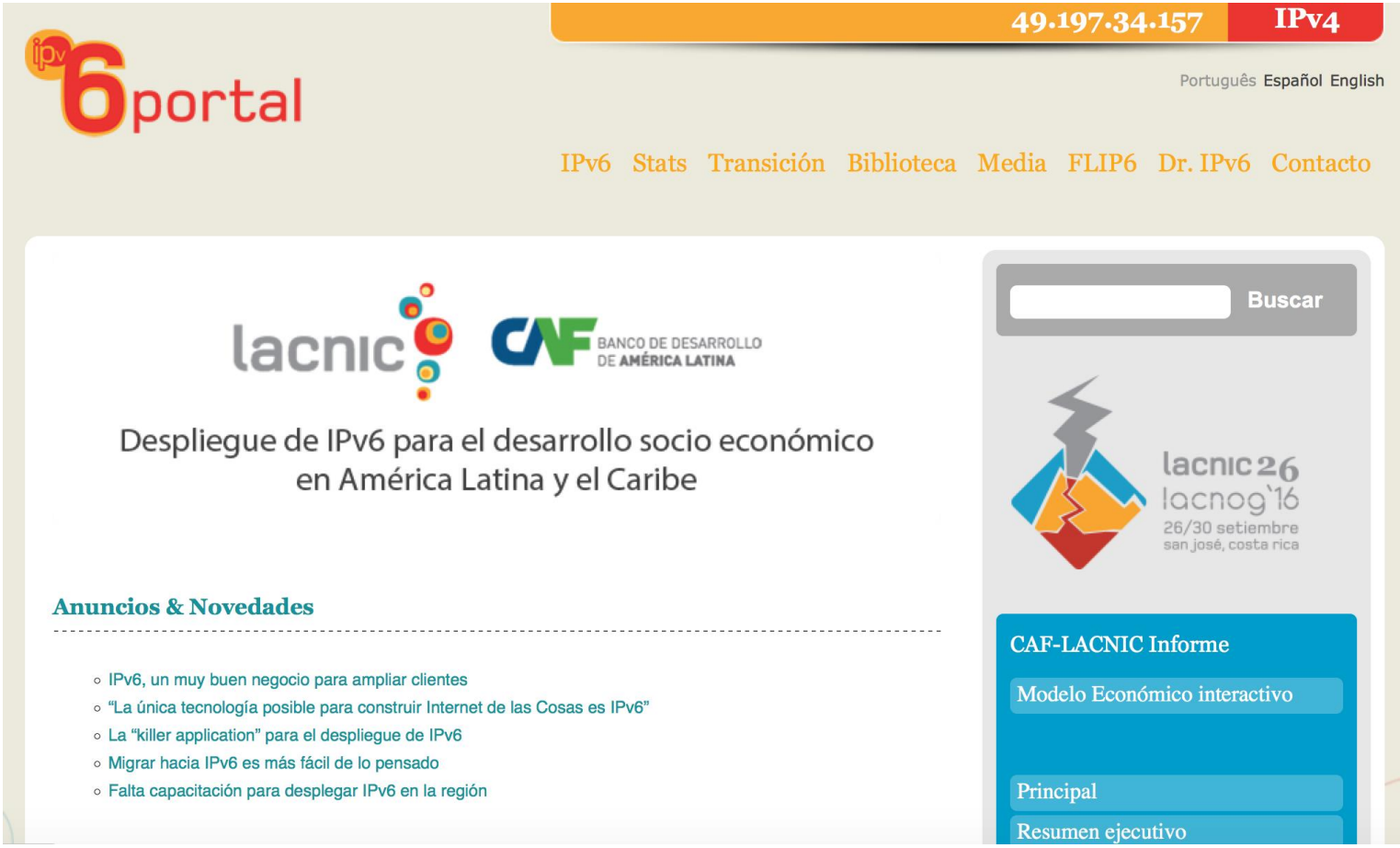
I.2 Main Parameters

Rate of opportunity cost of capital.	12%
Service life of dual-stack CPEs or timeframe for replacement of IPv4-only CPEs with dual-stack CPEs	5,0
Service life of IPv4-only CPEs. Alternative 2.	5,0
Total number of current residential customers	100.000
Idem but already served with IPv4 addresses (CGNAT or individual IPv4 addresses)	50.000
Annual customer base growth rate	15%
CGNAT operational capacity – simultaneous sessions – calculation module	10.000.000
Maximum average number of sessions per user without dual-stack	1.000
Minimum design number of sessions with CGNAT per user without dual-stack, by quality	1.000
% of IPv4 sessions per user with dual-stack (CONT indicator)	4,92%
Minimum design number of sessions with CGNAT per use with dual-stack, by quality	492
% of users connected simultaneously	30%
Average number of users per client	3
Annual drop in IPv4-only CPE prices	10%
Reduction of the price difference between dual-stack vs. IPv4-only CPEs = 0 in 5 years	20%
Annual ARPU per customer assumed to be constant	$240,00

Lessons Learnt

General recommendations

- Adjustments to regulatory frameworks and policies so that they will facilitate IPv6 deployment (telecoms, ICT, public procurement).
- Intervention at the regulatory level does not compromise technological neutrality
- Support for academic networks and universities (agents for innovation)
- Develop road map to encourage a timely transition to IPv6, including training plans



portalipv6.lacnic.net/

Upcoming research

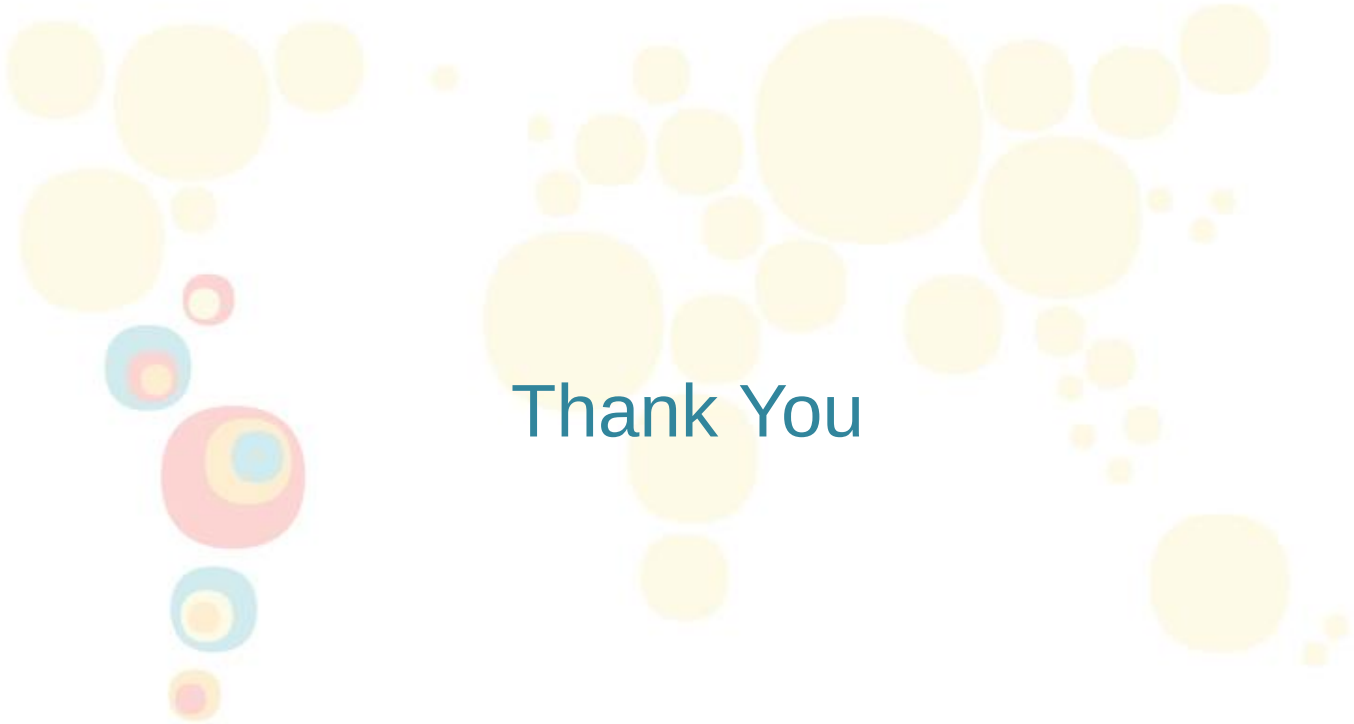
Governments as promoters of the Internet of Things: Recommendations for Latin America and the Caribbean

To promote leadership among regional governments as promoters of IoT

3 phases:

- Research on socioeconomic impacts of IoT and identify technical and regulatory requirements
- Best practices guide on based on experiences in 5 countries: CO, PA, BR, CR, PE
- Sensitisation campaign in international spaces

Questions?



Thank You