



IPv6 Deployment as a Strategic Decision

Answers to some of your questions

What is the LACNIC Role in the Internet Numbers System?



- Non-for-profit, non-government, membership-based organization established in Uruguay since 2002.
 - +11,000 members in 33 territories/economies in the region.
- Telecom Operators, Internet Service Providers, Business, Academia, Government Offices, End Users.



What is IPv6?

- Every single device connected to Internet, whether it is a supercomputer, a smartphone or a sensor of temperature in and agricultural field, **requires an Internet address (IP address)**.



- IPv4 was the original standard for the experimental Internet
 - The Internet ran out of the old addresses (IPv4).
-
- The new addresses protocol (IPv6) offers the chance to connect every Internet device.
 - Our region is doing a reasonable deployment... on average.

How is the region deploying IPv6 to end users

- Global IPv6 Deployment (Oct 2020): **~ 33%**
 - LatinAmerica: **~24%**
 - MX: 39% UY: 30% BR: 36% EC: 28% PE: 20%
 - BO: 18% AR: 10% GT: 10% CO: 9%
 - PY: 5% **CL: 1.1** **VE: 0.4%**
 - Caribbean: ~ 5%
 - **GF: 43%** TT: 23% SX: 13% BZ: 2.5% DO: 1.8%
 - **SR: 5%** **AW, CU, CW, GY, HT: 0%**
 - Central America: ~ 2%
 - GT: 9% **NI: 0.1%** **PA: 0.4%** **CR: 0.2%**
 - **HN: 0%** **SV: 0%**
- Sources:
 - <https://www.google.com/intl/en/ipv6/statistics.html>
 - <https://stats.labs.apnic.net/ipv6/XA>
 - <http://stats.labs.lacnic.net/IPv6/graph-access.html>

Why IPv6 deployment is strategic for Governments, Business and End-users?

Reason no. 1

- April 21st., 2012:
 - Trinidad and Tobago Parliament Internet Web page was hacked...
 - <https://www.guardian.co.tt/article-6.2.420843.aa3e8cc2e5>
- Today:
 - So far, **the perpetrators of this crime have not been found**, due to the impossibility to trace them.
 - Other cases
 - <https://www.databreachtoday.com/norways-parliament-investigates-email-hacks-a-14936>
 - <https://www.bankinfosecurity.com/compromised-website-led-to-aussie-parliament-hack-a-13412>
- Transaction traceability is a fundamental criteria for Internet Security and Internet Users Trust.
- **IPv6 allows traceability of transactions** allows the Operator to map every IP address to single subscriber.
 - Something very unlikely in IPv4.
- Traceability reduces the “need” for massive surveillance.

Why IPv6 deployment is strategic for Governments, Business and End-users?

Reason no. 2

- Latin American and Caribbean (LAC) Internet Users: ~ 400 million
- Space (IPv4) allocated to LAC region: ~ 190 million IP addresses.
 - ~ Two users have to share one Internet address (avg).
- Internet Penetration in LAC region: ~ 50%-60%
- No more IPv4 addresses left for ~ 300 million unconnected people (and growing!).

Internet users in Guyana

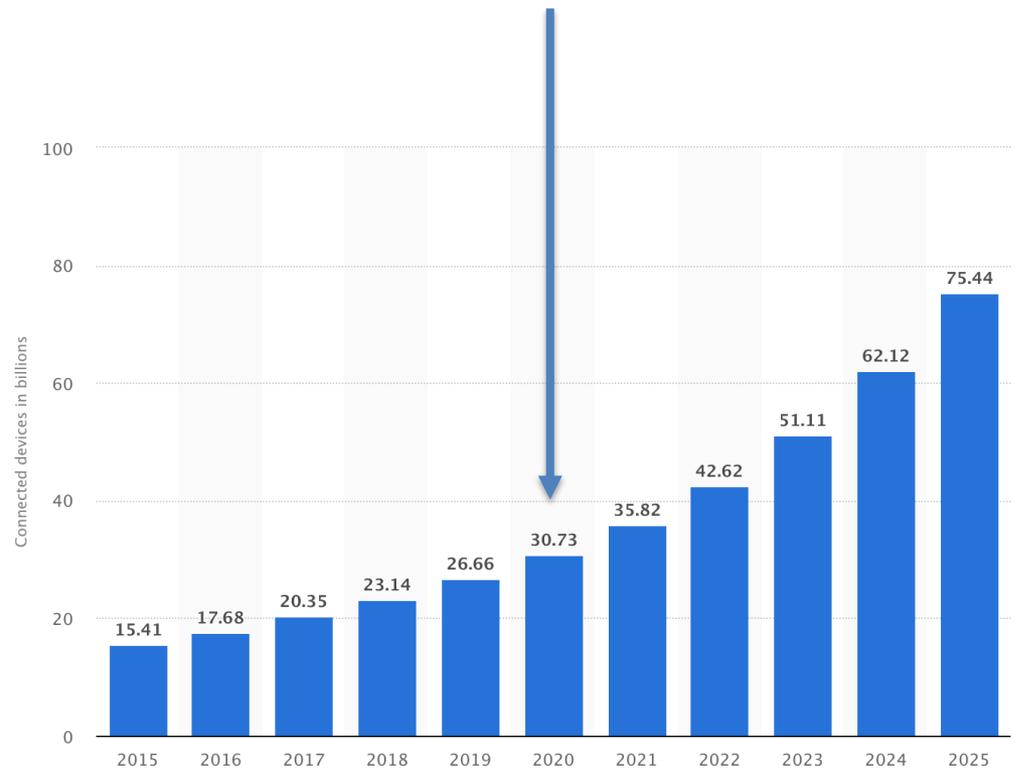
- There were **430.0 thousand** internet users in Guyana in January 2020.
- The number of internet users in Guyana **increased** by **10 thousand** (+2.4%) between 2019 and 2020.
- Internet penetration in Guyana stood at **55%** in January 2020.

- <https://www.lacnic.net/1039/2/lacnic/phases-of-ipv4-exhaustion>

Why IPv6 deployment is strategic for Governments, Business and End-users?

Reason no. 3

- Growth of interconnected devices **IS exponential** and different magnitude order than Internet users.
- **Internet of things, SmartCities, Industry 4.0, Industrial Internet** will require massive Internet Addresses for every devices/sensor interconnected.



Data visualized by  + a b l e a u

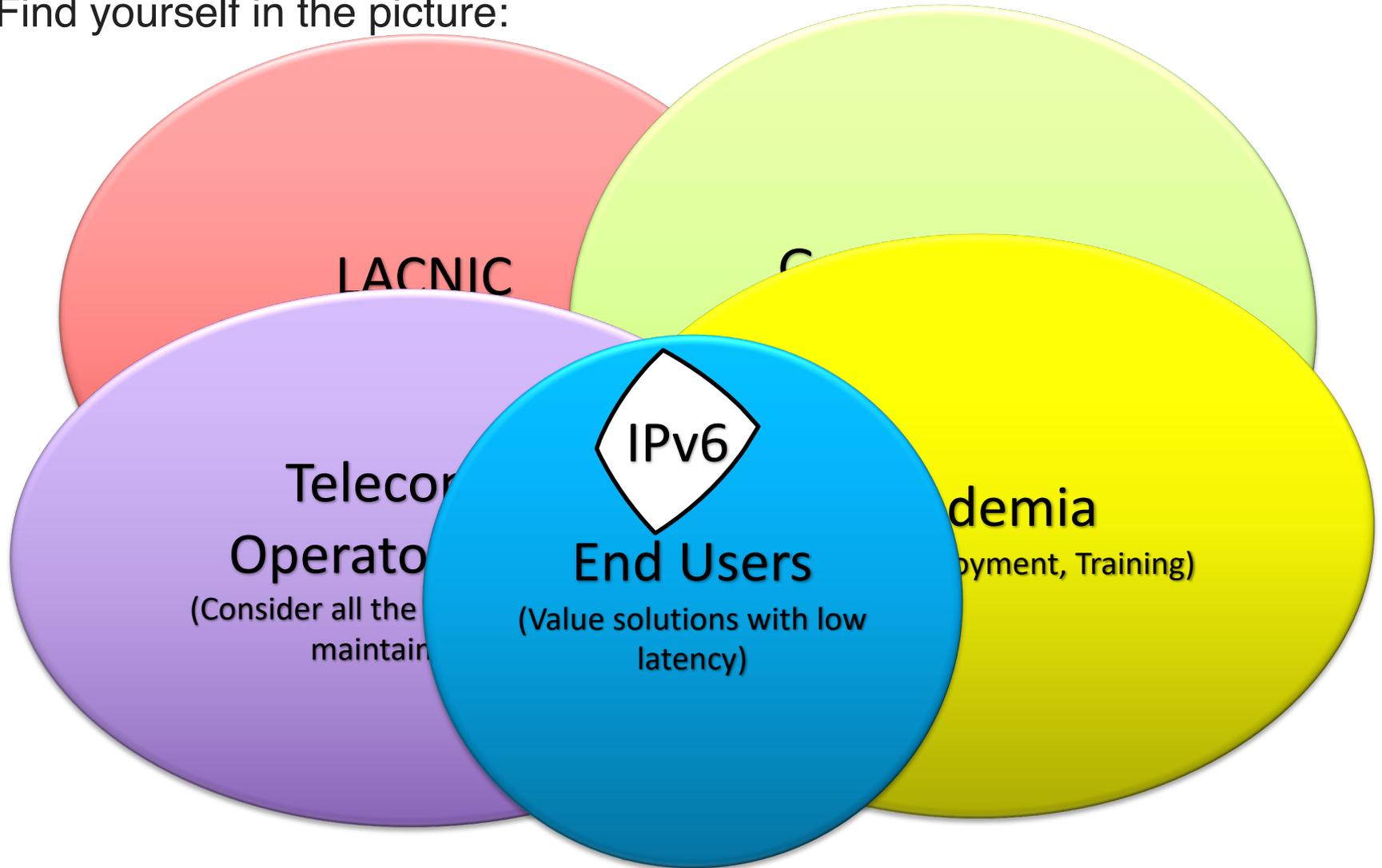
© Statista 2018

Why our countries are behind in IPv6 deployment?

- Recommended reading
 - <https://www.lacnic.net/2943/1/lacnic/>
 - IPv6 Deployment for Social and Economic Development in Latin America and the Caribbean (2016): <http://www.lacnic.net/3024/1/lacnic/caf-lacnic>
- In short (2020):
 - Telecom Operators and Internet Service Providers are not considering all the relevant aspects of IPv6 deployment for their business.
- There is something different key players in the industry can do.

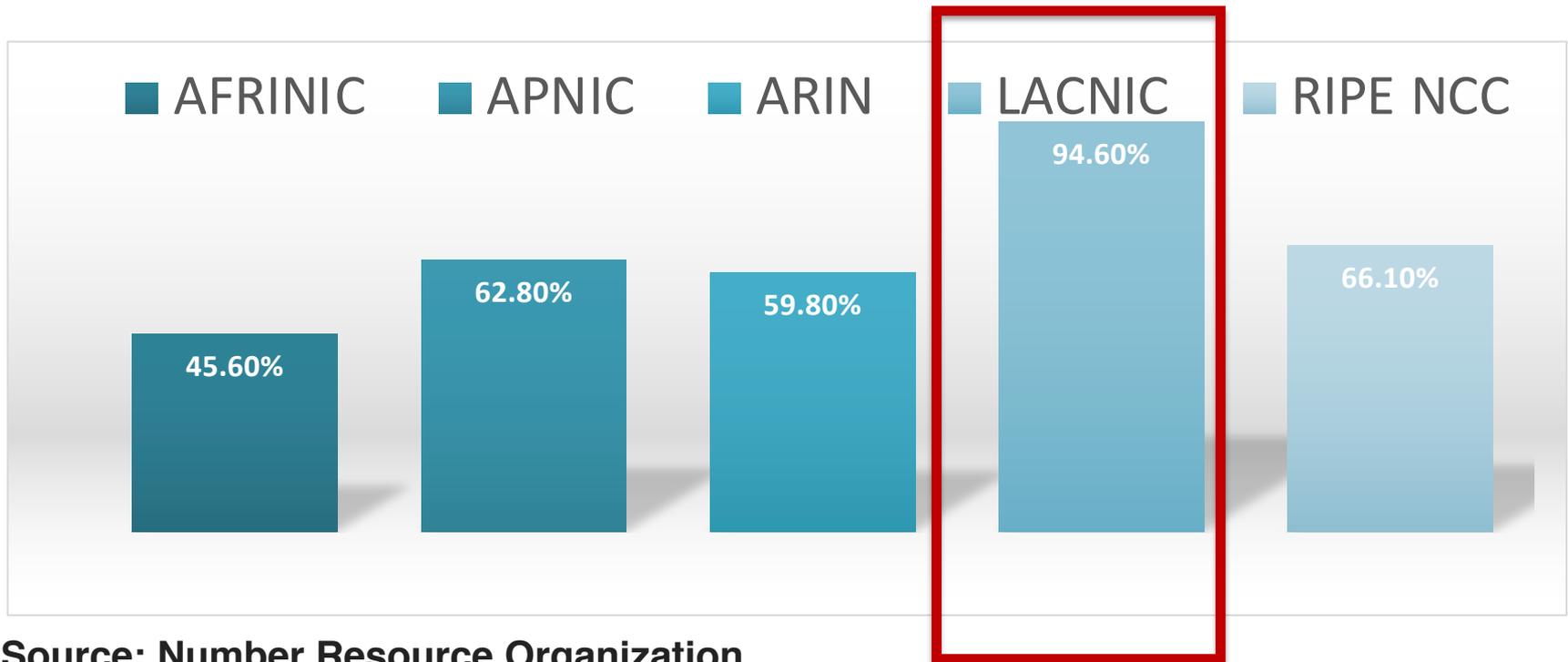
What can I do to foster IPv6 deployment in my country?

Find yourself in the picture:



LACNIC's role on IPv6 deployment in the region

- LACNIC has been working with Operators to create awareness, capacity building and training **since 2005**
- Today, **9 out of 10** operators in the region has requested and received IPv6 space.



Source: Number Resource Organization

<https://www.nro.net/statistics/>

WHAT'S IN IT FOR

GOVERNMENTS

Regulation vs. Cooperation

Strict deadlines to deploy IPv6 to **Telecomm Operators and ISP.**

- Friction among Government/regulator and Industry players.
- Telecomm Operators will allocate valuable resources (sometimes legal injunctions) to avoid regulation application rather than actual IPv6 deployment.
- Unable to include other relevant stakeholders.
- **Ineffective!**

Voluntary commitments to deploy IPv6, multiple stakeholders

- Collaboration -based efforts among multi-stakeholders.
- No legal excuses.
- Multiple parties looking for solutions (instead of excuses)
- **More Effective and Inclusive!**

Summary of Recommendations to Improve IPv6 deployment

| Action | Internally (Gov. Offices) | Concessionaires | Nationwide | When? |
|---|---------------------------|-----------------|------------|---------------------------------------|
| 1a) Request operators retain the capacity to map every used IP to a single identifiable subscriber | NA | ✓ | NA | Now |
| 1b) To limit the use of CGN while IPv6 hasn't been widely deployed | NA | ✓ | NA | once 2a or 2b requirement is in place |
| 2a) To request every IT purchase to be IPv6 compatible. | ✓ | * | * | Now |
| 2b) To limit(reject) IT equipment imports IPv4 only compatible. | ✓ | ✓ | ✓ | once 2a requirement is in place |
| 3a) To require (at least one) service to be IPv6 compatible. | ✓ | * | * | Now |
| 3b) To require static content on Web site available on IPv6 | ✓ | ✓ | NA | Now |
| * Desired but would require economical impact analysis beforehand and a proper implementation schedule. | | | | |

Why IPv6 deployment is strategic for Governments?

- **Reason no. 4**
- Our Countries face the challenge to properly dispose tons of technological waste every year.
- Lack of IPv6 deployment may attract old IT equipment with a very limited expectative of use.
- Being a late technology adopter, our countries are exposed to acquire cheap and old technology.
- **Effective IPv6 deployment may prevent the introduction of limited life expectancy equipment, thus reducing waste.**



What can Governments do to foster its deployment? (1a + 1b)

Traceability of connections is fundamental to the Internet Security.

- Request operators to **retain** the capacity to map every used IP to a reduced number of identifiable subscribers
 - In many jurisdictions Service Providers (ISPs) have a legal requirement to map a subscriber with the address used on the public Internet (e.g., for abuse response).
 - Unfortunately, **Carrier-Grade NATs (CGNs) make this requirement an expensive and sometimes impossible task.**
- **To limit the use of CGN while IPv6 hasn't been widely deployed**
 - CGN may create the perception that IPv6 is not needed, thus delaying its effective deployment.



What can Governments do to foster its deployment? (2a)

Demand of IPv6 services, solutions and equipment is fundamental to start its offer.

- **To request every IT Government purchase to be IPv6 compatible.**
 - In most Countries, the State is the major IT buyer.
 - Requiring IPv6 compatibility in every IT purchase or services acquisition could represent the demand required to make a business case for:
 - **Telecomm Operators** > IPv6 native connections
 - **Infrastructure Providers** > Collocation and hosting providers
 - **Equipment Vendors** > Firmware in Routers, Switches and CPEs.
 - **Network Solutions Providers** > Network configuration
 - **Including Connectivity Projects (all of them to include IPv6 support)**

What can Governments do to foster its deployment? (2b)

Avoiding large obsolete equipment stocks.

- To limit(reject) IT equipment imports IPv4 only compatible.
 - Our region may face the challenge to receive **many cheap (and obsolete) IT equipment/solutions and become a dump.**
 - Establishing a plan to limit or reject IT equipment/solutions IPv4 only compatible, may help to reduce that risk.
 - Nationwide or at least for Government purchases.



What can Governments do to foster its deployment? (3a +3b)

Readiness of government IT infrastructure to deploy IPv6 services.

- **To require (at least one) service to be IPv6 compatible.**
 - Considering the Government has many online services (e-gov), it would be appropriate to make sure at least a few (one?) services are offered completely through IPv6.
 - Further economical impact analysis may allow to request the same to Telecom Operators.
- **Publish Government Web site content on IPv6.**
 - Besides online services (e-gov), it would be wise to have the Government static content fully available on IPv6.

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* Desired but would require economical impact analysis beforehand and a proper implementation schedule.

- Telecom Regulator
- Equipment Certification (NOM, FCC, etc)
- Department of Economy/Commerce

- Cybersecurity Strategy/LEA's
- Government Acquisitions Regulator
- Innovation Government Agency

Which entities may be interested in coordinate inside the Government?

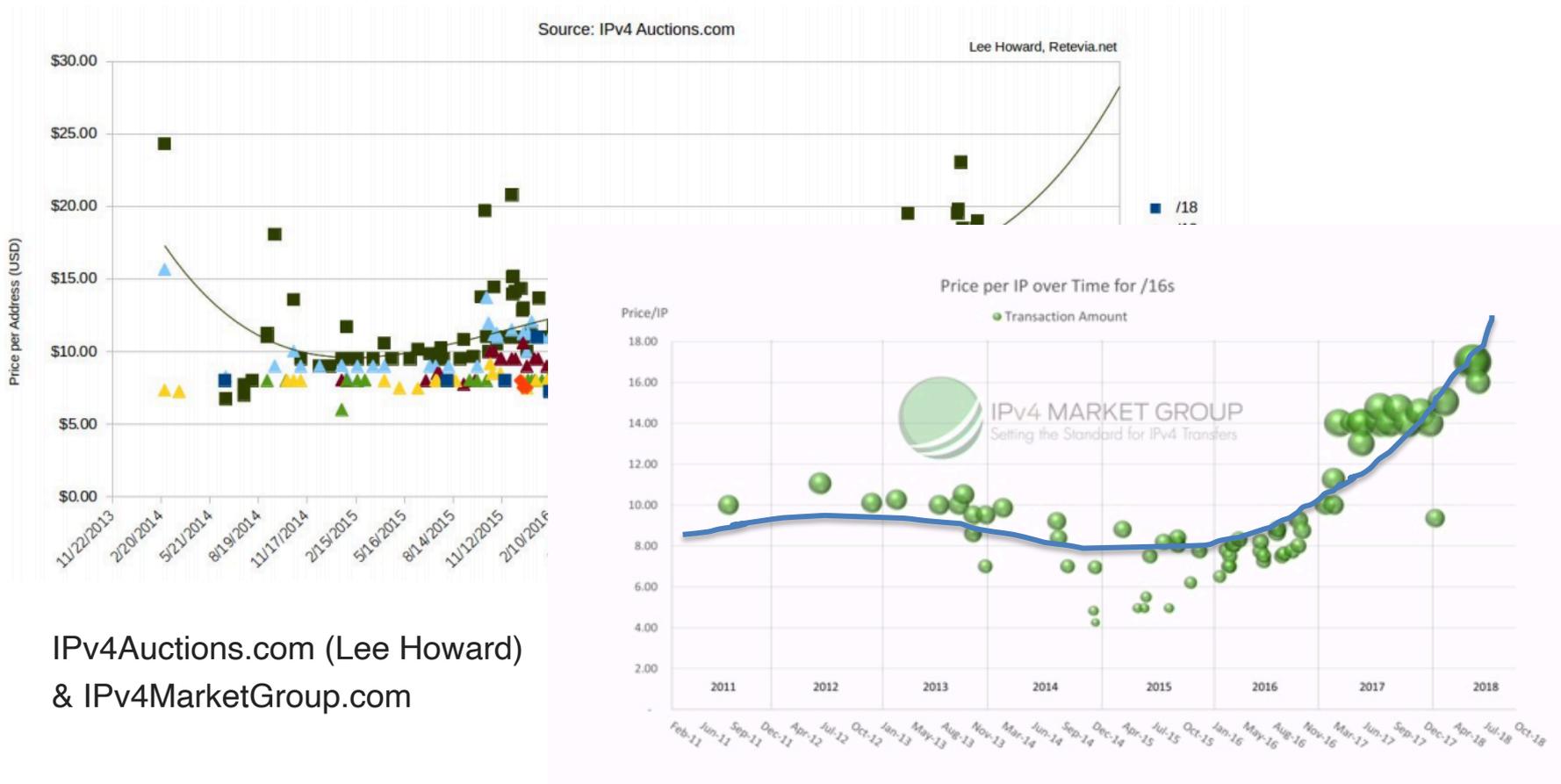
- Innovation/Entrepreneurship/Economy
Responsibilities:
 - To keep a quality Internet to ensure innovation.
- Social Development:
 - To reduce Digital Gap
 - Sustainable Development Goals
- Cybersecurity Strategies Law enforcement
Agencies:
 - Transaction traceability

WHAT'S IN IT FOR

OPERATORS + ISP

What's in it for Operators?

- Cost of customer base growth (IPv4 addresses cost in secondary market over the last **five years + CGN**).

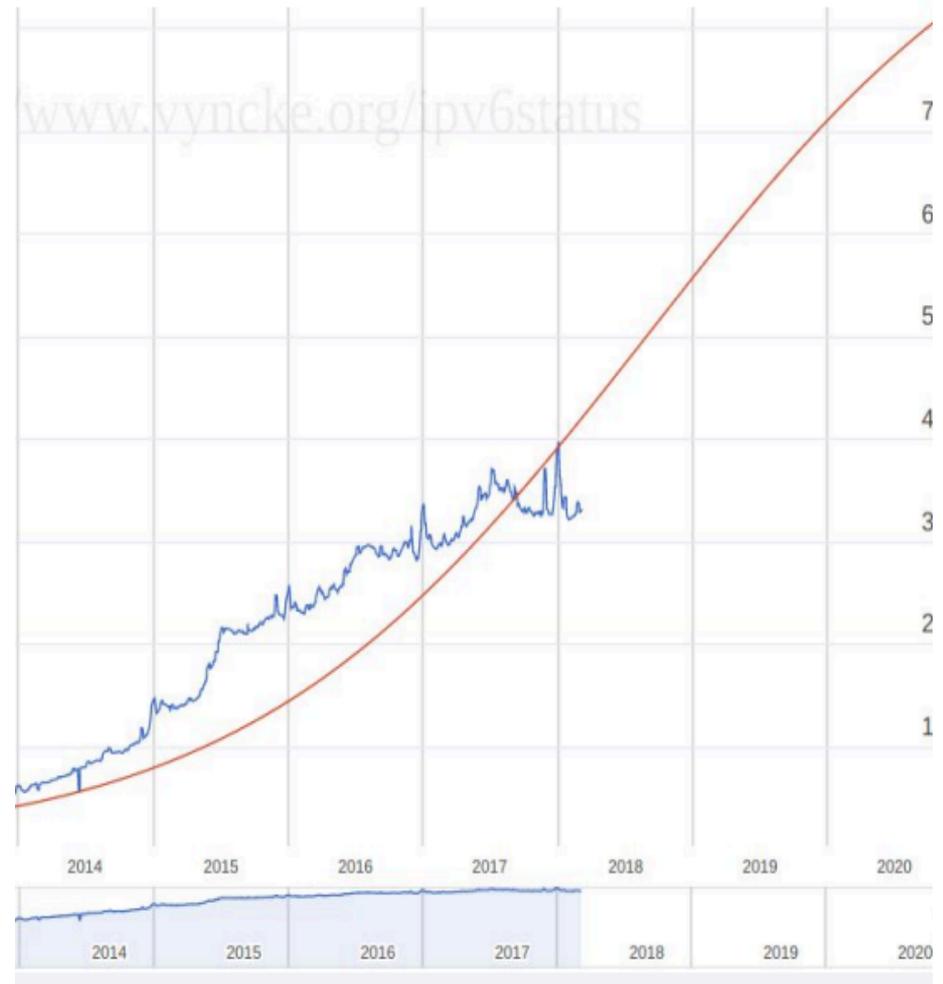


IPv4Auctions.com (Lee Howard)
& IPv4MarketGroup.com

What's in it for Operators?

Cost of IPv4 (operative cost of IPv4 only solution)

- At the current growth rate, 80% of the world will have IPv6 in four years.
- Most of them will use translation (IPv4aaS), so IPv4 performance will suffer.
https://docs.google.com/spreadsheets/d/1ksOoWOaRdRyjZnjLSiKHf4O5L1OUTNOO_7NK9vcVApc/edit#gid=0
- ¿How much money is in the CDNs?



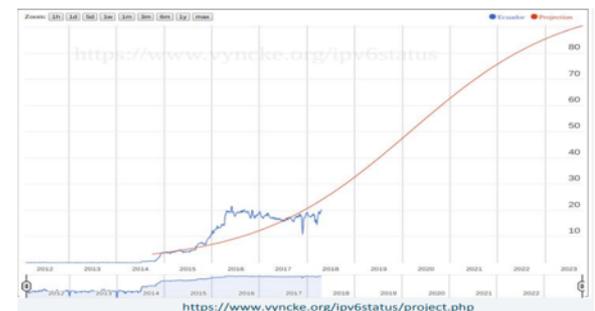
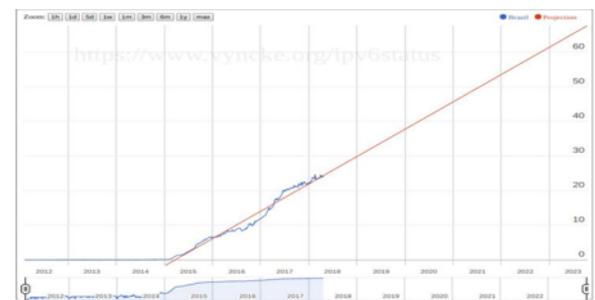
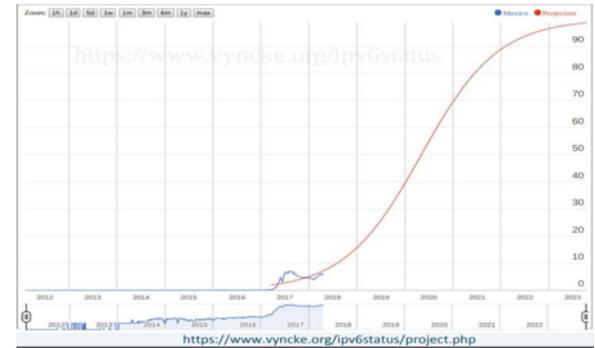
Fuentes: Lee Howard

What's in it for Operators?

Cost of IPv4 (competitive)

- Current trends allow to estimate most of the networks will ver IPv6 by 2023.
- Even more, some of them will differentiate with services around IPv6.
- An effective deployment takes no less than four years.
- **If they have not started, they will be out of market in 4 years.**

Fuentes: Lee Howard



What's in it for Operators?

Cost of IPv4 (Risk to become invisible for the Internet)

- Only ¼ of total networks are transporting IPv6 traffic.
- Out of those 15 thousand networks, **250 networks doesn't care any more about IPv4 networks 45 thousand networks worldwide.**
- https://bgp.he.net/ipv6-progress-report.cgi?section=ases_v6_only
- **If they have not started yet, they will be INVISIBLE in 4 years.**



Fuentes: Lee Howard

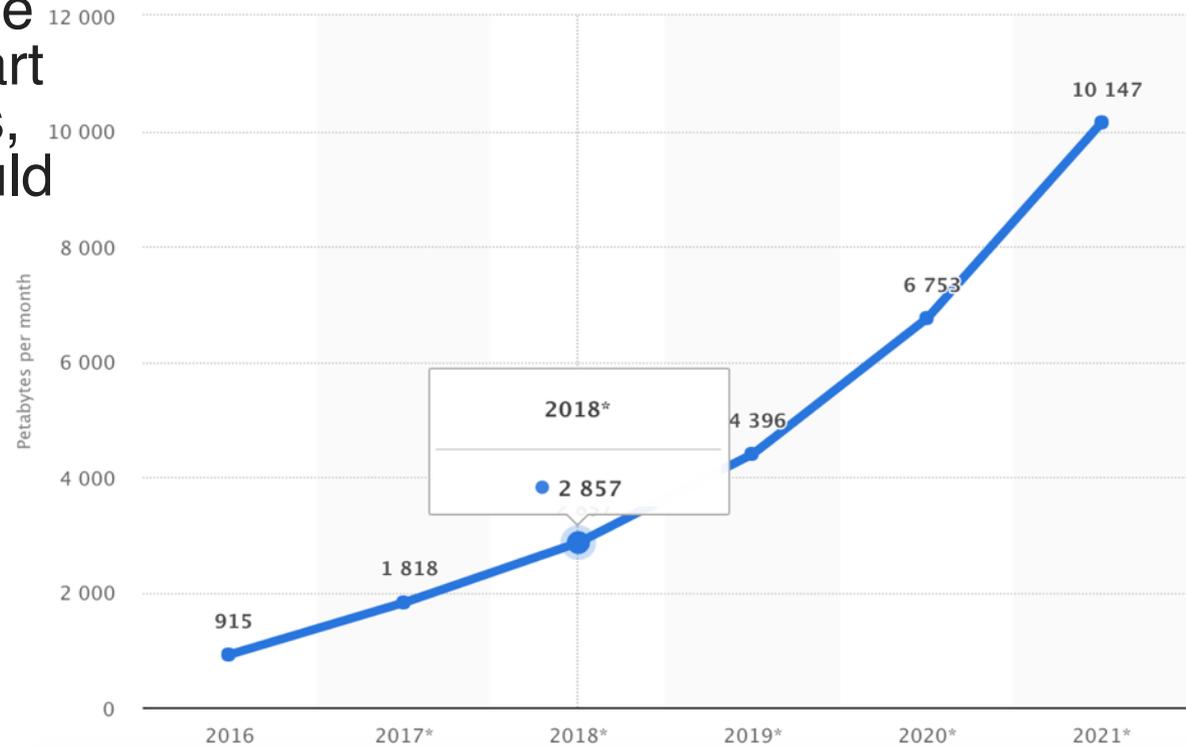
What's in it for Operators?

Low Latency, “the unintended killing feature of IPv6”

- Why Content providers invest such amount of money to get content closer to end users and reduce latency from 200ms a 20ms?
 - Because “Latency Matters”!
- Why Content Providers should care to deploy a CDN inside an ISP network which still makes one to four translation transactions rising latency?
 - Mobile providers are 5-30% faster with IPv6.
- Selected sites load 5% faster in median and 15% faster for the 95% percentile on IPv6 compared to IPv4.
 - <https://blogs.akamai.com/2016/06/preparing-for-ipv6-only-mobile-networks-why-and-how.html>
- IPv6 now faster than IPv4 when visiting 20% of top websites (and just as fast for the rest)
 - https://www.theregister.co.uk/2016/07/28/ipv6_now_faster_a_fifth_of_the_time
 - <http://dl.acm.org/citation.cfm?doid=2959424.2959429>
- IPv6 is performing better than IPv4 for mobile networks. TCP timeout on IPv4 over mobile carrier networks is high as 4.6% and IPv6 timeouts are on a much lower side of 1.6%.
 - <https://www.linkedin.com/pulse/ipv6-measurements-zaid-ali-kahn/>

Low Latency “users”: Gaming Community

- **Data volume of global online gaming traffic from 2016 to 2021 (in petabytes per month)**
- If you think online gaming is not part of your business, maybe you should be part of that business.
- Online Gaming revenue 2016:
– **20 Bn USD.**



Source: Statista.com

What's in it for Operators?

- Commercial Opportunities
 - Chance of New Services or Niche Services (ie., Gaming Community)
 - **Domestic Monitoric Services (fixed IP)**
 - Segment routing for IPv6 Dataplane
 - New Capabilities: Process Ids
 - **A Chance to rise ARPU.**
 - To keep network (and customer base) growing.
- Regulatory Opportunities
 - To address requirement to map a transaction to a single subscriber..

WHAT'S IN IT FOR

ACADEMIA

What's in it for Academia

- Innovation, Research and Capacity Building
 - Most of our countries Academia plays a fundamental role in Innovation.
 - IPv6, Internet of Things, Smart Cities, etc.
 - Once Academia plays that role, it start building its own IPv6 infrastructure.
 - And is ready to **Build local technological Capacity**.
 - Most of the Industry players in our region is not ready, not only because of the business case for the financial investment but due to lack of professionals up to date in this technologies.
 - Academia has the chance to **seize this opportunities and fulfil its social role**.

WHAT'S IN IT FOR
USERS

What's in it for End Users

- End Users (Individuals or Companies)
 - Domestic Monitoring Security Solutions
 - Gaming Community.
 - Full promise of Internet of Things:
 - Individuals: Smart Homes, Wearables.
 - Industry: Smart Cities, Industry 4.0

So, finally

IN SUMMARY

Summary of benefits for the Multiple Interested parties on an effective IPv6 deployment.

| Benefit | ISP's | Academia | End Users* | State |
|--|-------|----------|------------|-------|
| Customer Base Growth (Digital Gap Reduction) | ✓ | | ✓ | ✓ |
| Full Promise of Internet of Things (IoT) | ✓ | ✓ | ✓ | ✓ |
| Full Promise of Smart Cities | ✓ | | | ✓ |
| Transaction Traceability | ✓ | | ✓ | ✓ |
| Customer Base growth cost reduction (currently IPv4 2nd MKT + CGN) | ✓ | | | |
| Latency reduction (transactional cost with IPv4) | ✓ | | ✓ | |
| Competitiveness with IPv6 services | ✓ | | ✓ | |
| Reduction of the Risk to become invisible | ✓ | | ✓ | |
| Capacity Building in IPv6 | ✓ | ✓ | ✓ | ✓ |
| Domestic Monitoring Services | ✓ | | ✓ | |
| Gaming Community Effective Solutions | ✓ | | ✓ | |

In Summary

- IPv6 is not a solely a technological decision, it is now a **strategic one, critical for the development of digital national initiatives.**
- IPv6 deployment can be supported and accelerated with participation and collaboration of **Multi stakeholders:**
 - Government, Academia, Industry/Operators, End Users, Civil Society.
- Cooperation among Multiple interested parties may result in a more effective approach as opposed to Regulation of specific actors.
- LACNIC offers cooperation through different levels.
 - Capacity Building to Operators, holders of numeric resources.
 - Awareness to a wider public through different sub regional and local events
 - Always open to collaborate in local initiatives.

Some references

- **Study:** Despliegue de IPv6 para el desarrollo socio económico en América Latina y el Caribe
 - <http://portalipv6.lacnic.net/wp-content/caf-lacnic/CAF-LACNIC-IPv6-Deployment-Social-Economic-Development-in-LAC.pdf>
- **Guide:** 12 Steps to activate IPv6 in an ISP network.
 - <http://portalipv6.lacnic.net/wp-content/uploads/2017/06/12-steps-to-enable-ipv6-in-an-isp-etwork.pdf>
- **Presentación:** Lee Howard presentation at LACNIC 29
 - <http://www.lacnic.net/innovaportal/file/2549/1/ipv6-for-your-boss-lacnic-may-2018-v3.pdf>
- **Belgium National Plan for Iv6 Deployment:** (Francés)
 - <http://www.presscenter.org/en/node/73400>
 - http://economie.fgov.be/fr/modules/publications/general/ipv6_pourquoi_pour_rester_dans_la_course_actes_du_colloque_2011_.jsp
- **Traceability.** Why it is important for security.
 - <https://cacm.acm.org/magazines/2018/8/229771-traceability/fulltext>



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