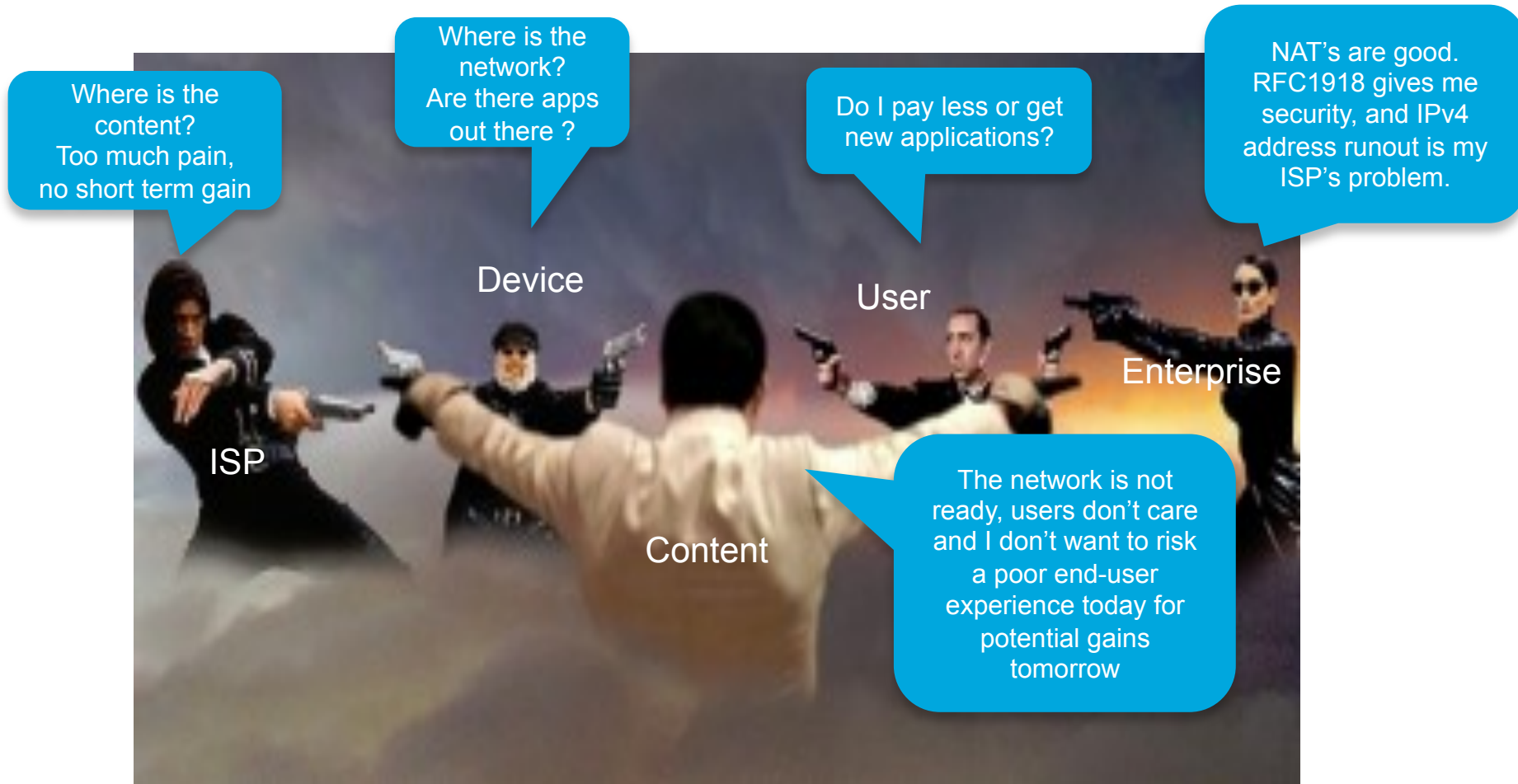




IPv6 Deployment Statistics

Alain Fiocco, Hugo Kaczmarek

IPv6 migration: A Classic Mexican Standoff



"A deadlock, stalemate, impasse; a roughly equal (frequently unsatisfactory) outcome to a conflict in which there is no clear winner or loser,"

Mean while ...IPv4 run-out is very real

IPv4 & IPv6 Statistics

RIR v4 IPs Left

AfriNIC	56,968,312
APNIC	18,775,541
ARIN	105,368,690
LACNIC	48,463,817
RIPE	29,461,416

v6 ASNs
13% (5,629/41,411)

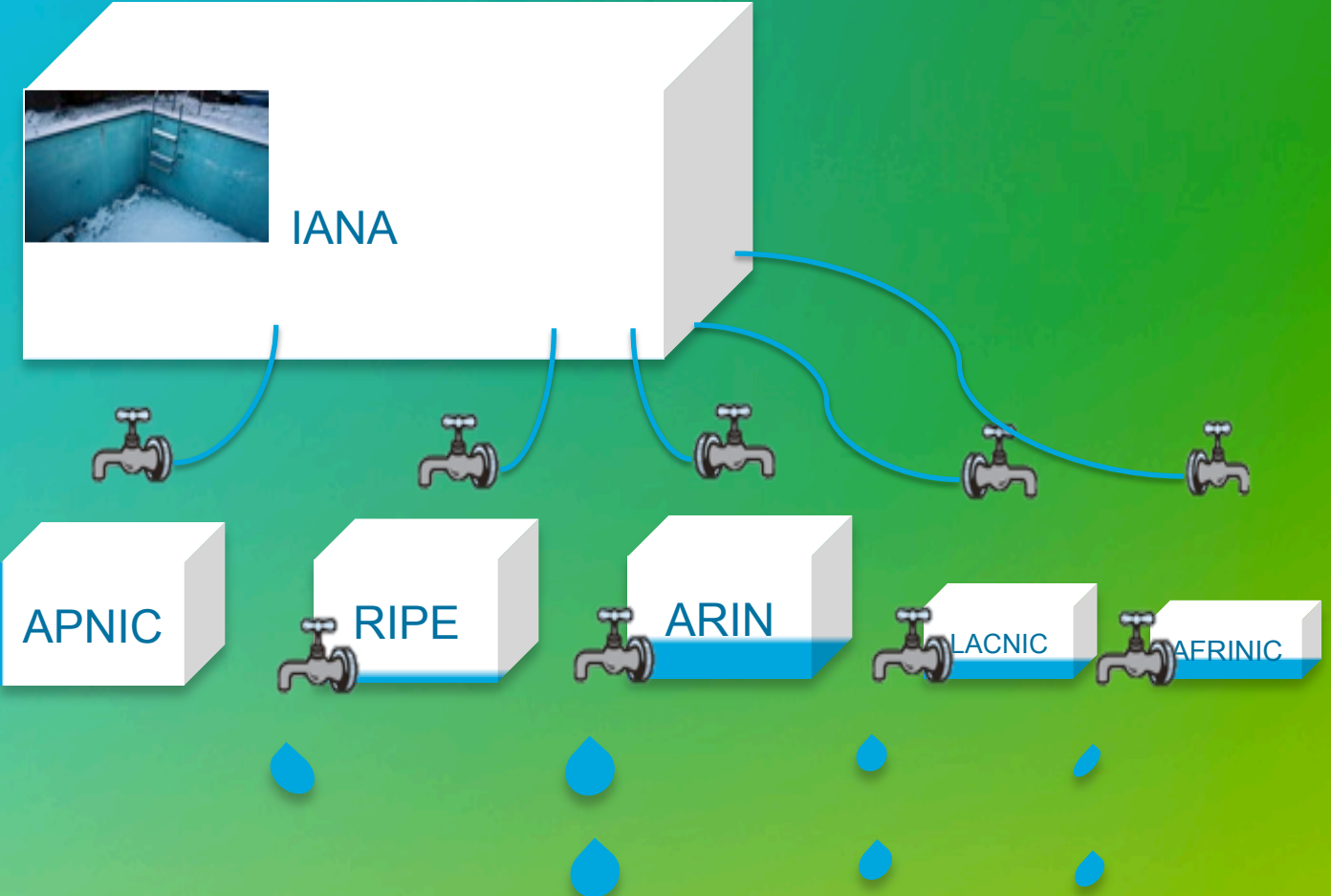
v6 Ready TLDs
84% (265/313)

v6 Glues
8,879

v6 Domains
3,230,020 ↑

0
days remaining
IANA exhausted

HURRICANE ELECTRIC
INTERNET SERVICES



- Large Enterprises
- Service Providers
- Local Registry

Mean while ...We are running empty !

IPv4 & IPv6 Statistics

RIR v4 IPs Left

AfriNIC	56,968,312
APNIC	18,775,541
ARIN	105,368,690
LACNIC	48,463,817
RIPE	29,461,416

v6 ASNs
13% (5,629/41,411)

v6 Ready TLDs
84% (265/313)

v6 Glues
8,879

v6 Domains
3,230,020 ↑

0
days remaining
IANA exhausted

HURRICANE ELECTRIC
INTERNET SERVICES



- Large Enterprises
- Service Providers
- Local Registry

Measuring IPv6 adoption lifecycle, enabling data driven business decision

- A multi-step system level transition:

IPv6 adoption requires to go through multiple steps, at Global, Regional, Country and Local level

Measuring the end stage (IPv6 traffic) is counter productive from an education standpoint.

This life cycle transition can take years before any significant IPv6 traffic can be measured

- Each of these steps must be measured in order to understand how far along in IPv6 adoption.

There are publically available data's, representing most of these steps that can be gathered and monitored over a period of time.

Some of the necessary data's needs to be collected by crawling the WEB and testing web sites.

- Global vs Local:

The Core of the Internet, aka Internet Transit is mostly global. However large economies have a local transit system as well, that interconnect all Service providers, Government, University/Education, Local content providers and Enterprises. So both Global transit as well as National transit have to be measured.

Although the WEB is truly a global system, users and content statistics have local relevance (language and locality are important aspects of the WEB) and need to be looked at and evaluated locally.

- Information/Data => Better business decision

Investment, Business Case, Timing, Government mandate/incentives, Design decision, Education

Introducing: 6lab.cisco.com/stats



[Home](#)

[World-scale data](#)

[Information](#)

Select data type :

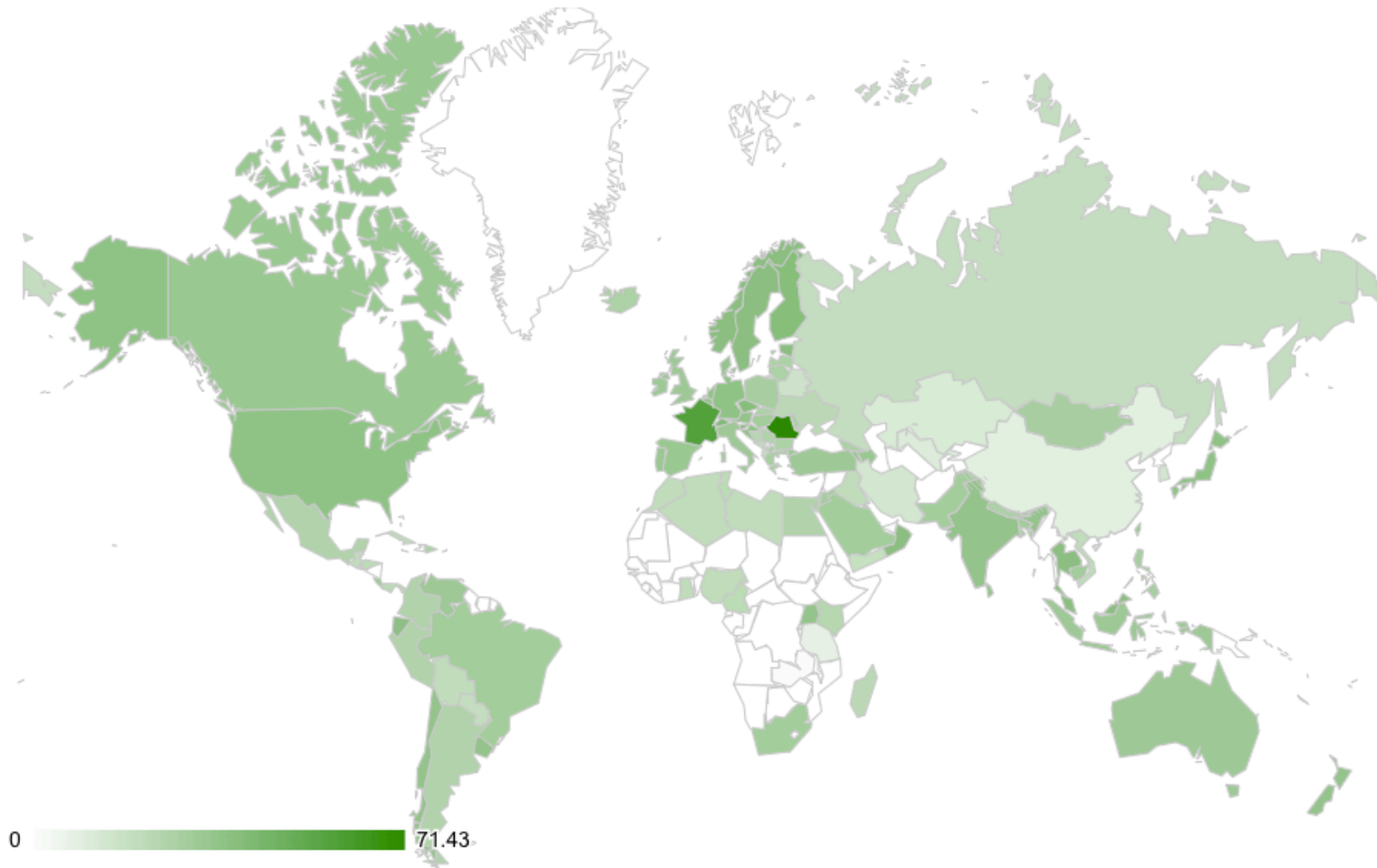
All

IPv6 Prefixes

Transit AS

Web Content

Users



[World](#) | [Africa](#) | [Asia](#) | [America](#) | [Europe](#) | [Oceania](#)

IPv6 adoption Statistics, at a glance



[Home](#)

[World-scale data](#)

[Information](#)

Select data type :

All

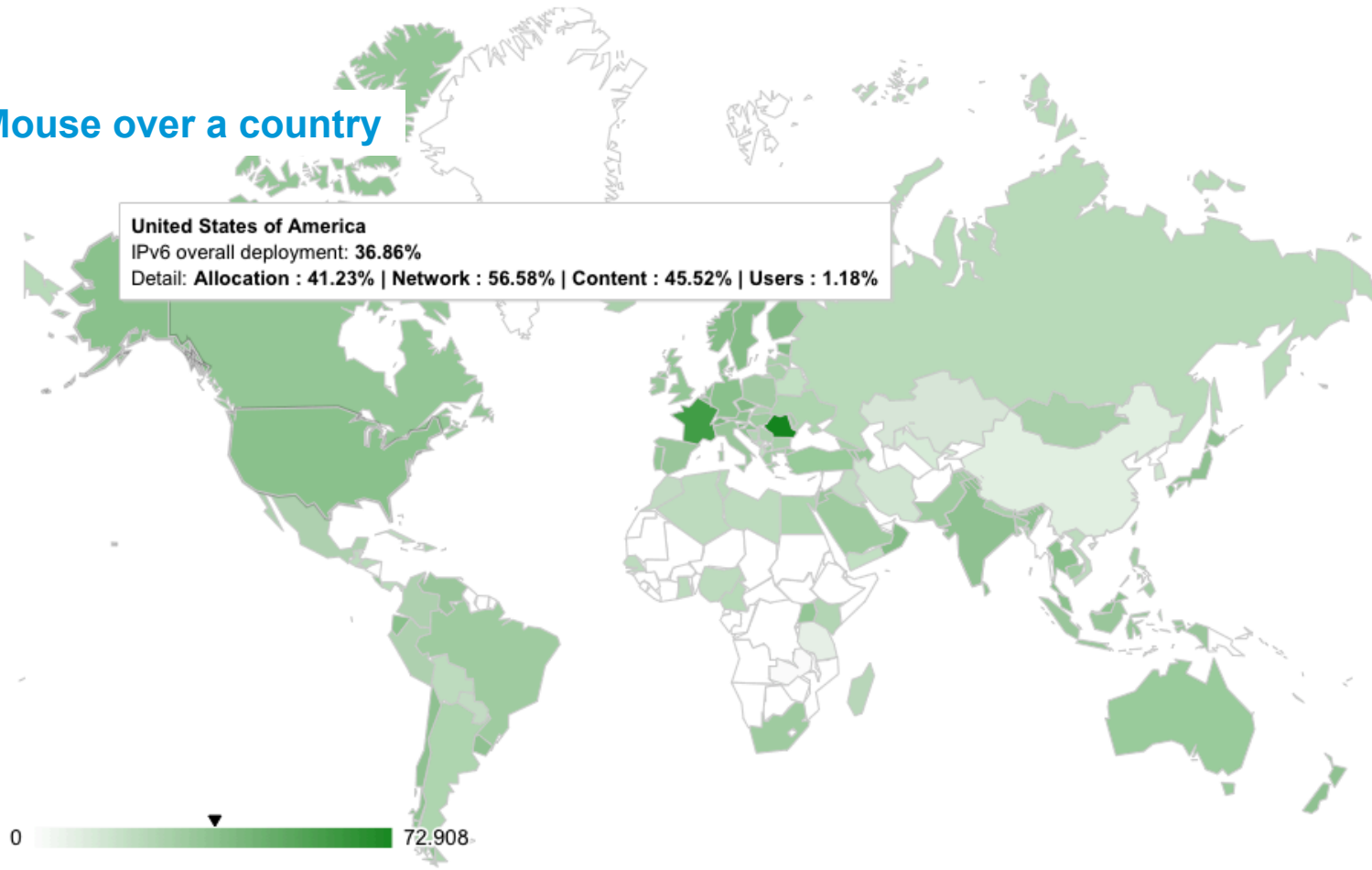
IPv6 Prefixes

Transit AS

Web Content

Users

Mouse over a country



[World](#) | [Africa](#) | [Asia](#) | [America](#) | [Europe](#) | [Oceania](#)

IPv6 adoption Statistics, at a glance



[Home](#)

[World-scale data](#)

[Information](#)

Select data type :

All

IPv6 Prefixes

Transit AS

Web Content

Users

Mouse over a country

United States of America

IPv6 overall deployment: **36.86%**

Detail: **Allocation : 41.23% | Network : 56.58% | Content : 45.52% | Users : 1.18%**

Optionally select a region

0  72.908

[World](#) | [Africa](#) | [Asia](#) | [America](#) | [Europe](#) | [Oceania](#)

IPv6 adoption Statistics, at a glance

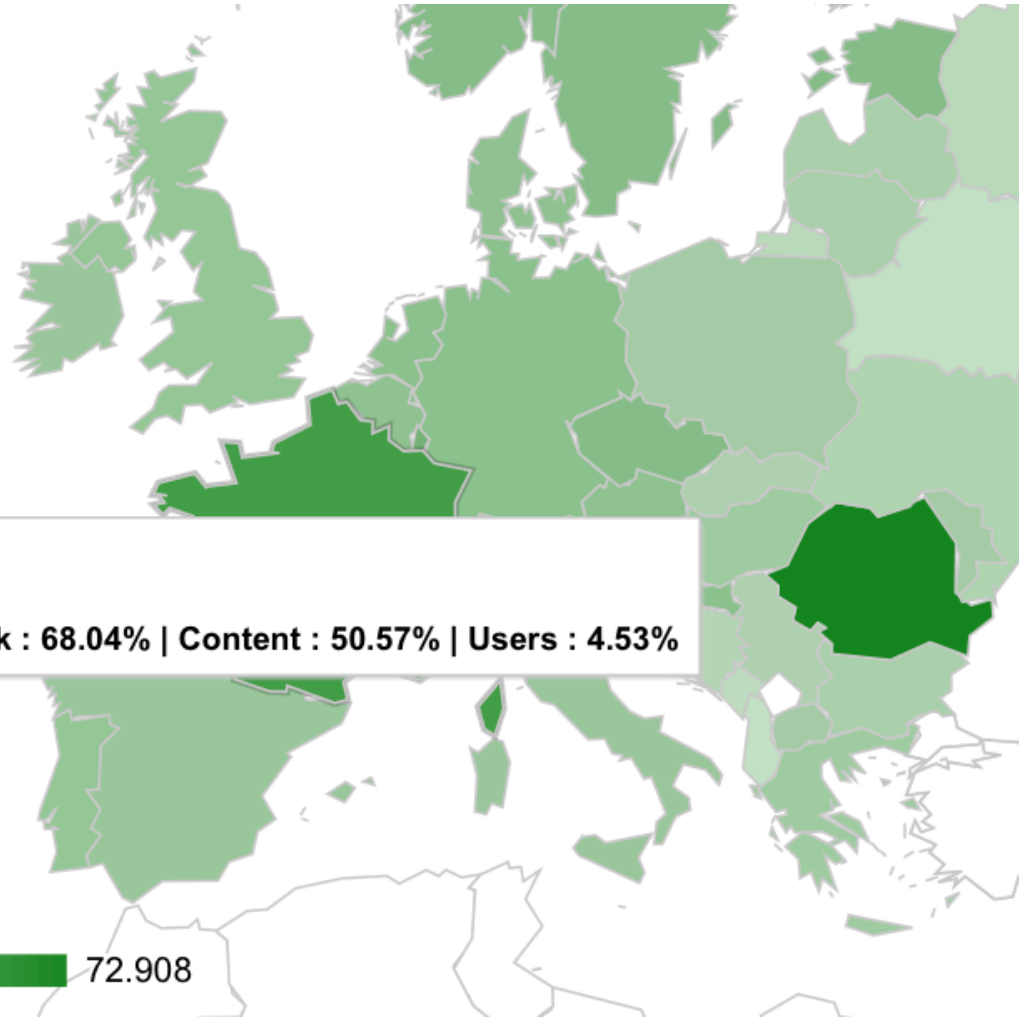


- [Home](#)
- [World-scale data](#)
- [Information](#)

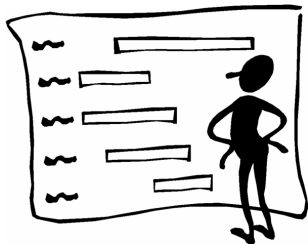
Select data type :

- All
- IPv6 Prefixes
- Transit AS
- Web Content
- Users

Mouse over a country

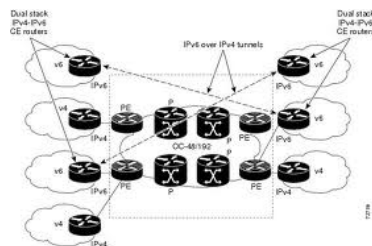


Measuring IPv6 adoption lifecycle: Network



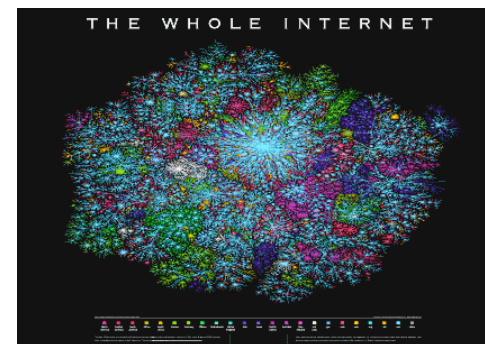
IPv6 Prefix allocation

of /32 prefix allocated
by country



Is IPv6 configured ? % of active networks?

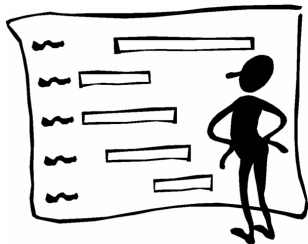
% IPv6 prefix in BGP ?
% active prefixes ?
(sending & receiving packets)



Is Internet Core ready?

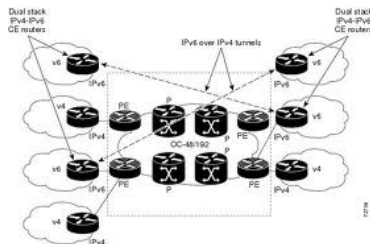
% of IPv6 enabled Transit AS
% of Transit IPv6 AS

Measuring IPv6 adoption lifecycle: Network



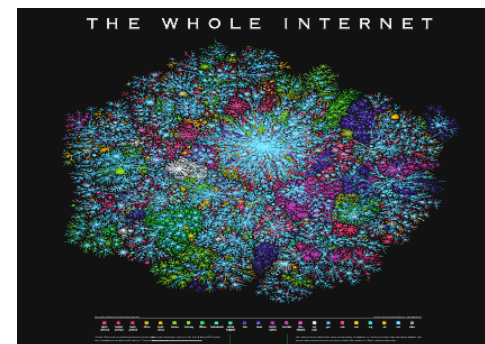
IPv6 Prefix allocation

of /32 prefix allocated
by country



Is IPv6 configured ? % of active networks?

% IPv6 prefix in BGP ?
% active prefixes ?
(sending & receiving packets)



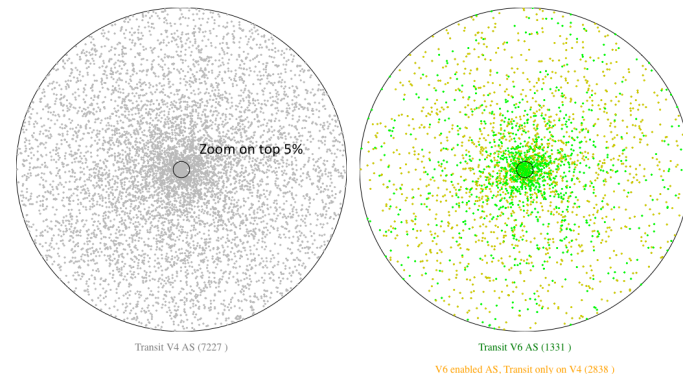
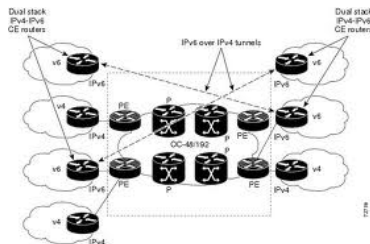
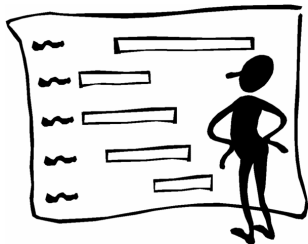
Is Internet Core ready?

% of IPv6 enabled Transit AS
% of Transit IPv6 AS

Sources :

- Whois from RIPE, ARIN, APNIC, AFRINIC, LACNIC
- <http://archive.routeviews.org/> (Internet, BGP tables)
- <http://www.team-cymru.org/Services/ip-to-asn.html> (AS# - Country)

Measuring IPv6 adoption lifecycle: Network



IPv6 Prefix allocation

of /32 prefix allocated by country

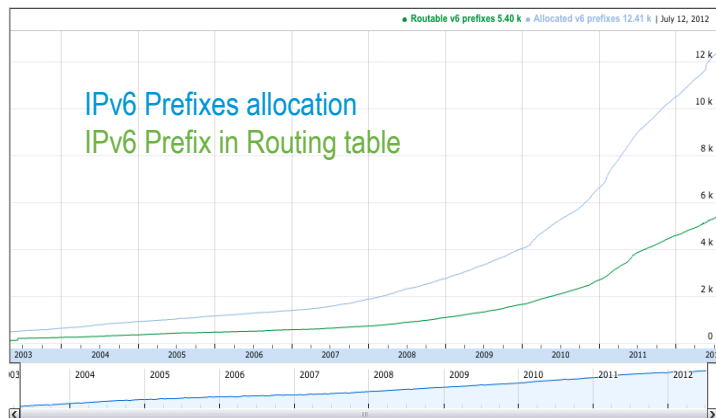
Is IPv6 configured ? % of active networks?

% IPv6 prefix in BGP ?
% active prefixes ?
(sending & receiving packets)

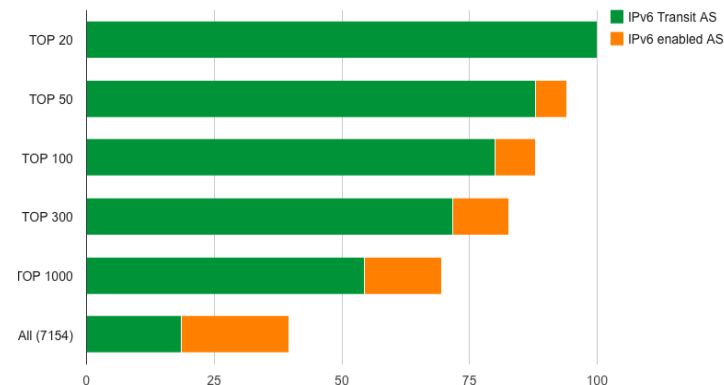
Is Internet Core ready?

% of IPv6 enabled Transit AS
% of Transit IPv6 AS

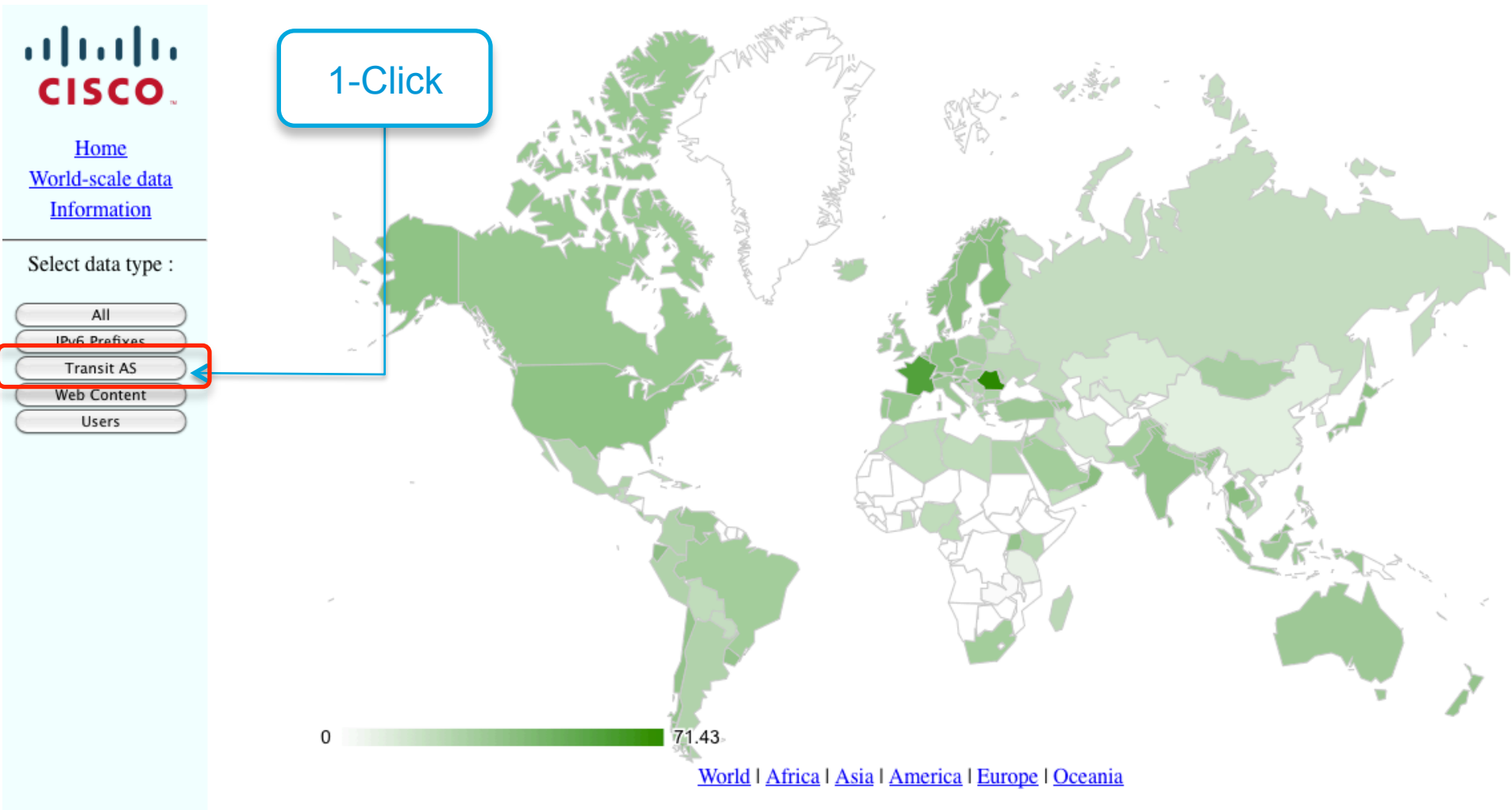
Display IPv6 Prefixes Data



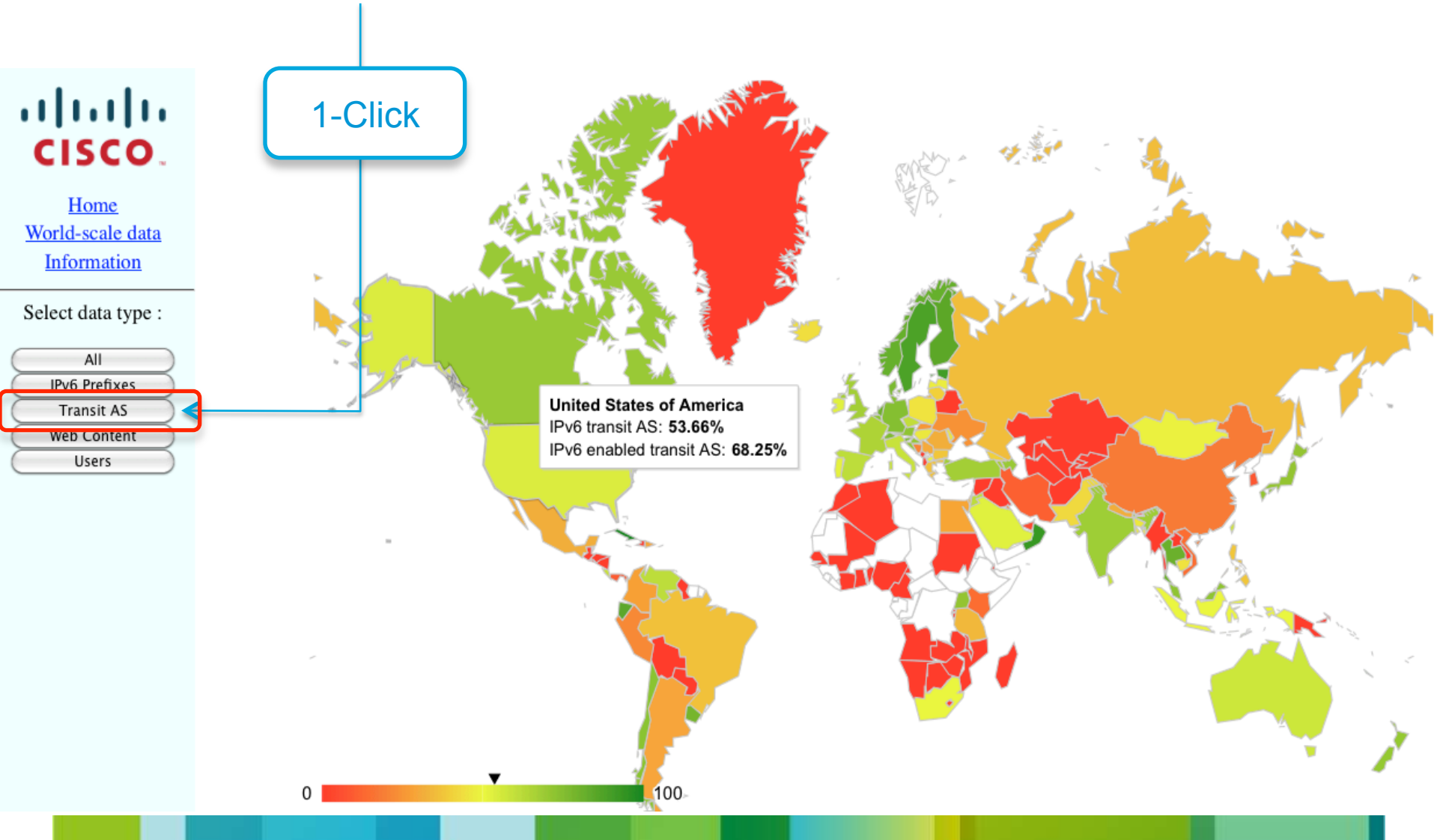
Top Transit AS overview



6lab.cisco.com/stats – home page



% of IPv6 Transit AS



% of IPv6 Transit AS

2-Mouse over countries

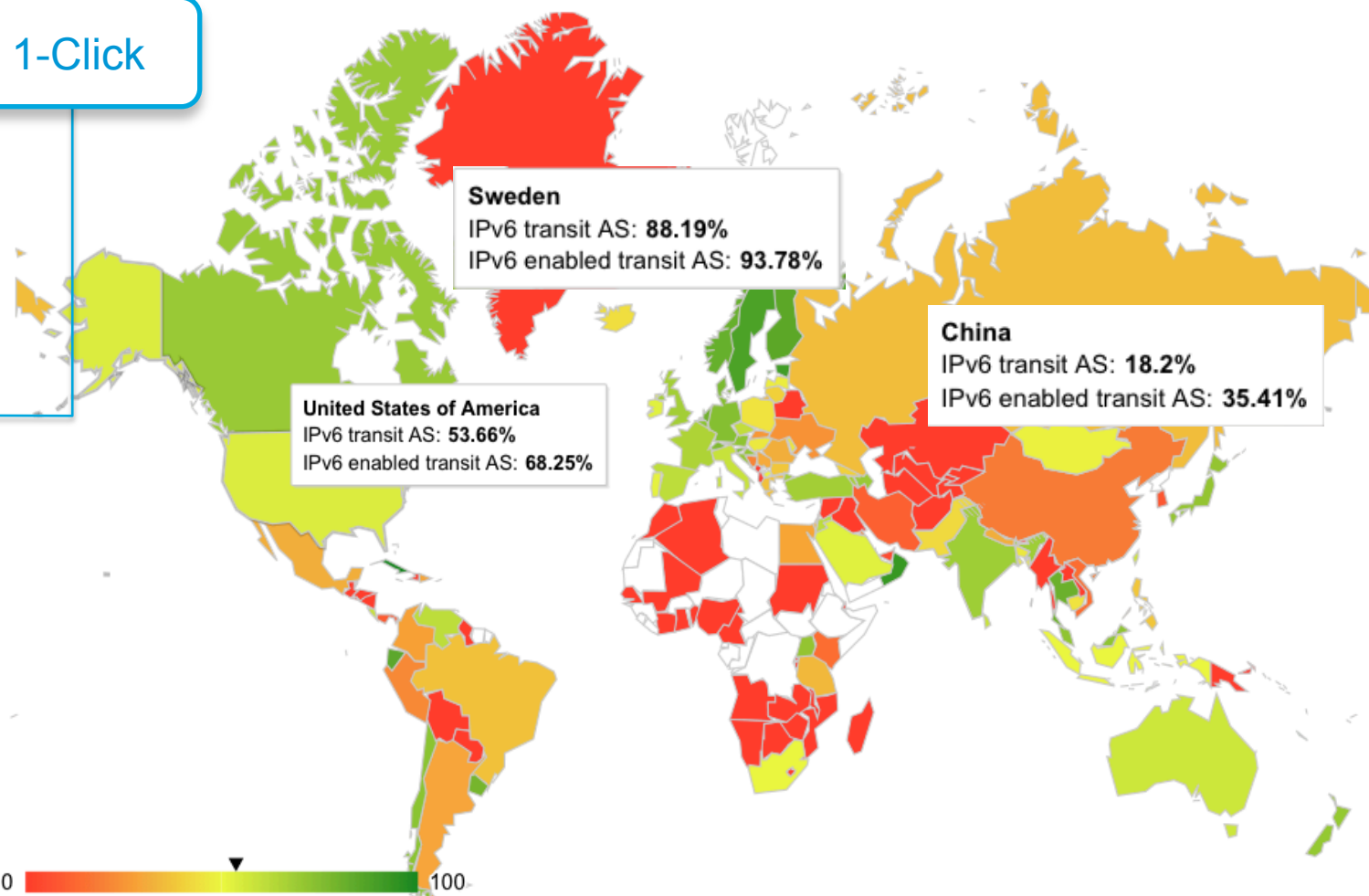
1-Click



[Home](#)
[World-scale data](#)
[Information](#)

Select data type :

- All
- IPv6 Prefixes
- Transit AS**
- Web Content
- Users



Measuring IPv6 adoption lifecycle: Content



TOP500 Sites:

Alexa's TOP500 list

Computed weight based on Alexa % of pages viewed statistics

A screenshot of a DNS configuration interface. The title is 'Type AAAA Record'. It contains several input fields: 'Name' with a sub-field '@', 'IPv6 Address' with the value '2001:05c0:1109:b900::1', and 'TTL (Time to live)' with a dropdown menu set to '30 minutes (1800)'. There are 'Save' and 'Cancel' buttons at the bottom.

DNS: Seek Production & test domain name

AAAA

Ns lookup



Production domain

HTTP get over IPv6

of success

of Failure



Testing domain?

HTTP get over IPv6

of success

of Failure

Measuring IPv6 adoption lifecycle: Content



TOP500 Sites:

Alexa's TOP500 list

Computed weight based on Alexa % of pages viewed statistics

DNS: Seek Production & test domain name

AAAA

Ns lookup

Production domain

HTTP get over IPv6

of success

of Failure

Testing domain?

HTTP get over IPv6

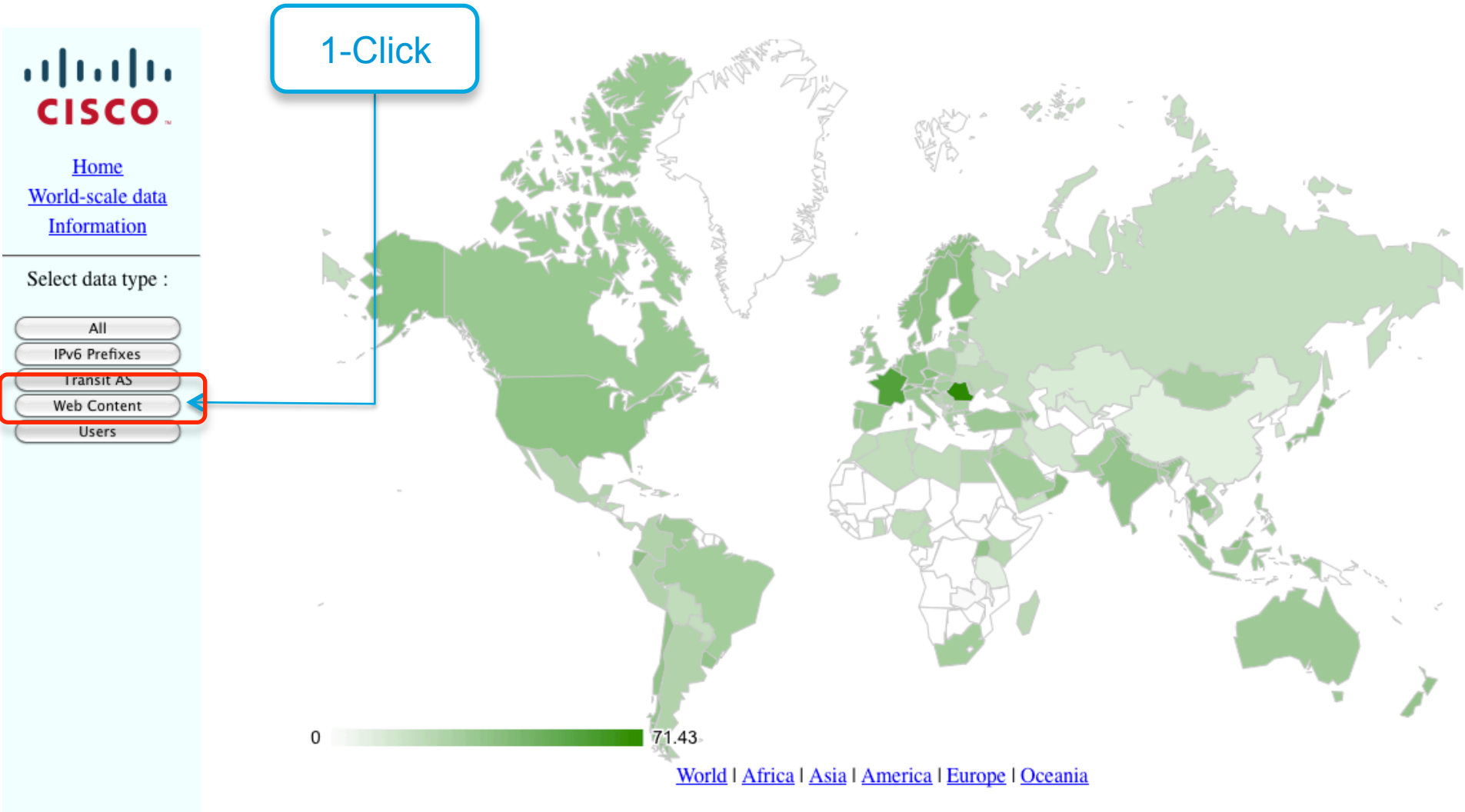
of success

of Failure

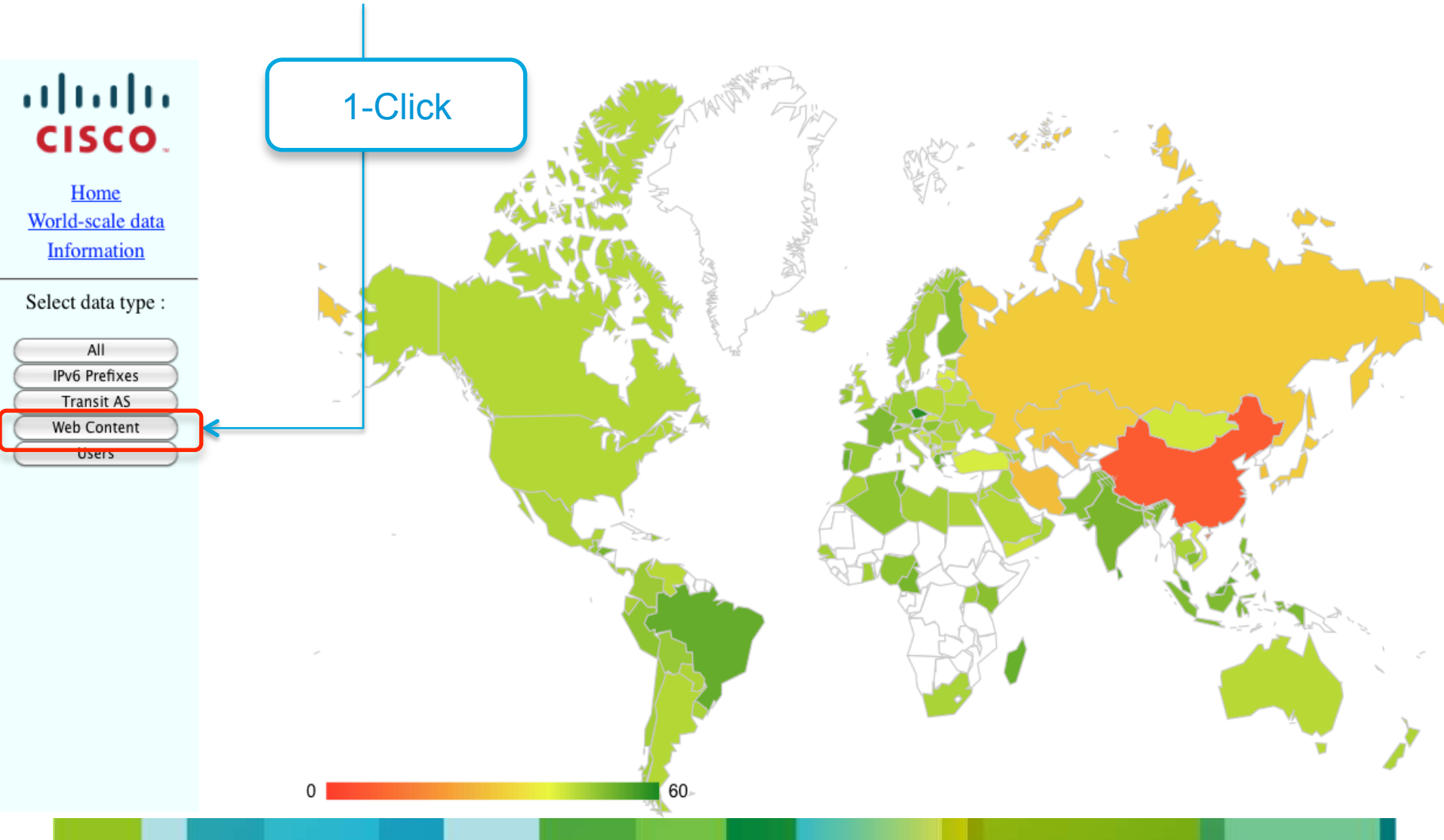
$\sum((\text{computed weight for rank}) * (\text{IPv6 enabled WEB sites})) = \% \text{ of Web pages reachable over IPv6}$

Computed by country as content is mainly locally significant

6lab.cisco.com/stats – home page



% of IPv6 Content / WEB sites



% of IPv6 Content / WEB sites

2-Mouse over countries

1-Click



[Home](#)
[World-scale data](#)
[Information](#)

Select data type :

- All
- IPv6 Prefixes
- Transit AS
- Web Content**
- Users

United States of America
ipv6 websites: **45.52% of pages available on v6 (23 / 500 websites)**
Others: **In development/test : 1.49% (6/500) | Failing : 1.64% (6/500) | Not V6 enabled : 51.4% (465/500)**

China
ipv6 websites: **7.41% of pages available on v6 (13 / 500 websites)**
Others: **In development/test : 16.97% (5/500) | Failing : 10.82% (3/500) | Not V6 enabled : 64.83% (478/500)**

Brazil
ipv6 websites: **52.94% of pages available on v6 (56 / 500 websites)**
Others: **In development/test : 0.31% (3/500) | Failing : 3.85% (12/500) | Not V6 enabled : 42.94% (429/500)**



Measuring IPv6 adoption lifecycle: Users

- Google and APNIC lab are doing an excellent job at measuring end-user IPv6 adoption

They do so by embedding java code in Google Search home page (in case of Google) or Ad's Network (in case of APNIC)

This java code, test both IPv4, IPv6 and Dual-stack on a sample of users in order to measure % of users who are successfully using IPv6.

Results can differ slightly between Google and APNIC, as the sample is different. However apart from countries where Google is not #1 search engine, numbers are very consistent. APNIC is probably more representative in these countries (ex: China)

Both are measuring additional data such as connectivity type (tunnel, native...) or Browser type

- We are *_shamelessly_* publishing both Google and APNIC results (% of IPv6 enabled users only):

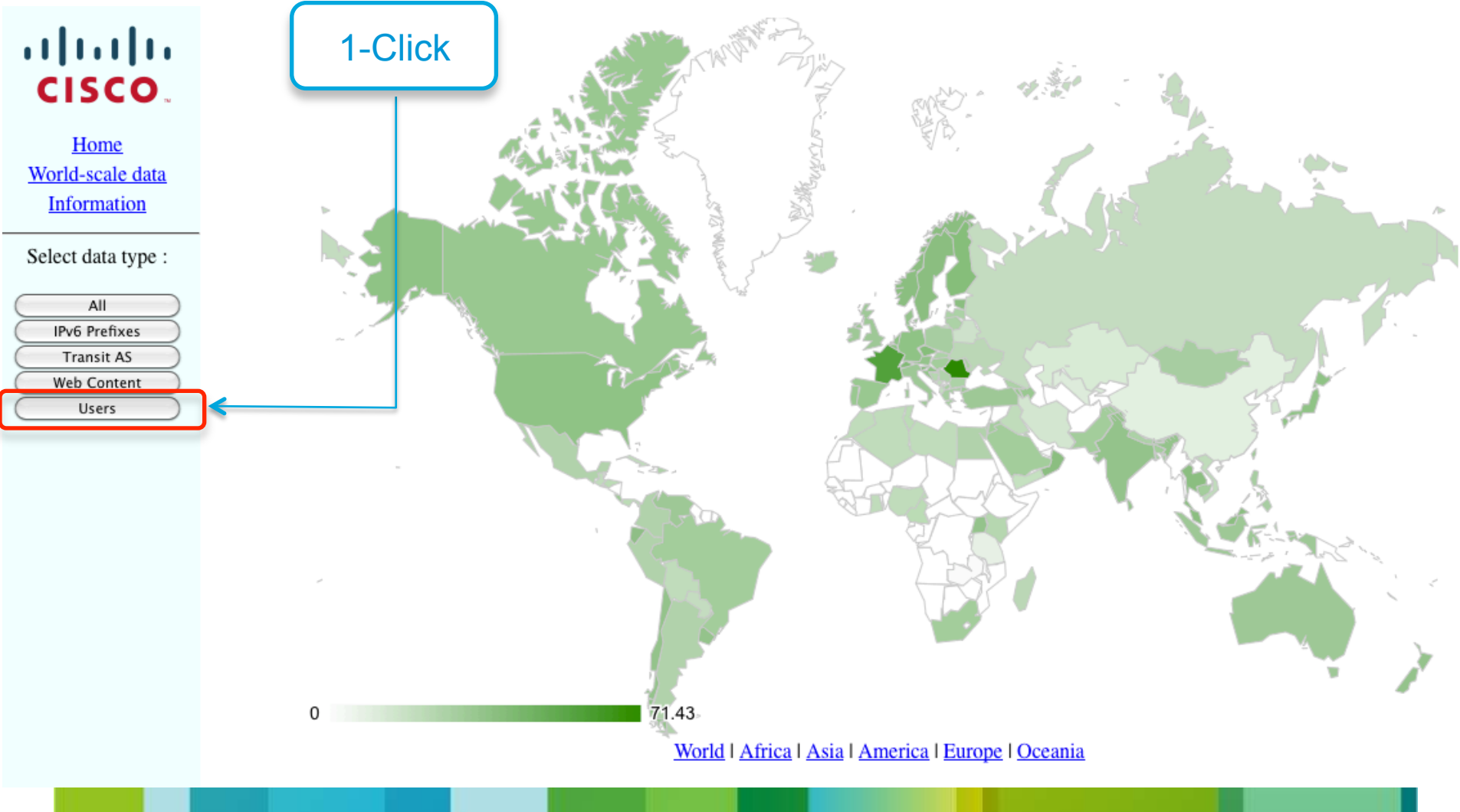
<http://6lab.cisco.com/stats> , select "Users" on the Data type TAB

Sources:

Google - <http://www.google.com/intl/en/ipv6/statistics.html>

APNIC - <http://labs.apnic.net/dists/v6dcc.html>

6lab.cisco.com/stats – home page



% of IPv6 enabled Users



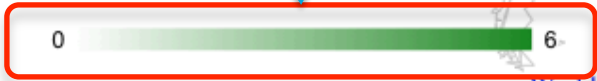
[Home](#)
[World-scale data](#)
[Information](#)

Select data type :

- All
- IPv6 Prefixes
- Transit AS
- Web Content
- Users**

MAX :

Change Scale of Green



[World](#) | [Africa](#) | [Asia](#) | [America](#) | [Europe](#) | [Oceania](#)

% of IPv6 enabled Users

2-Mouse over countries

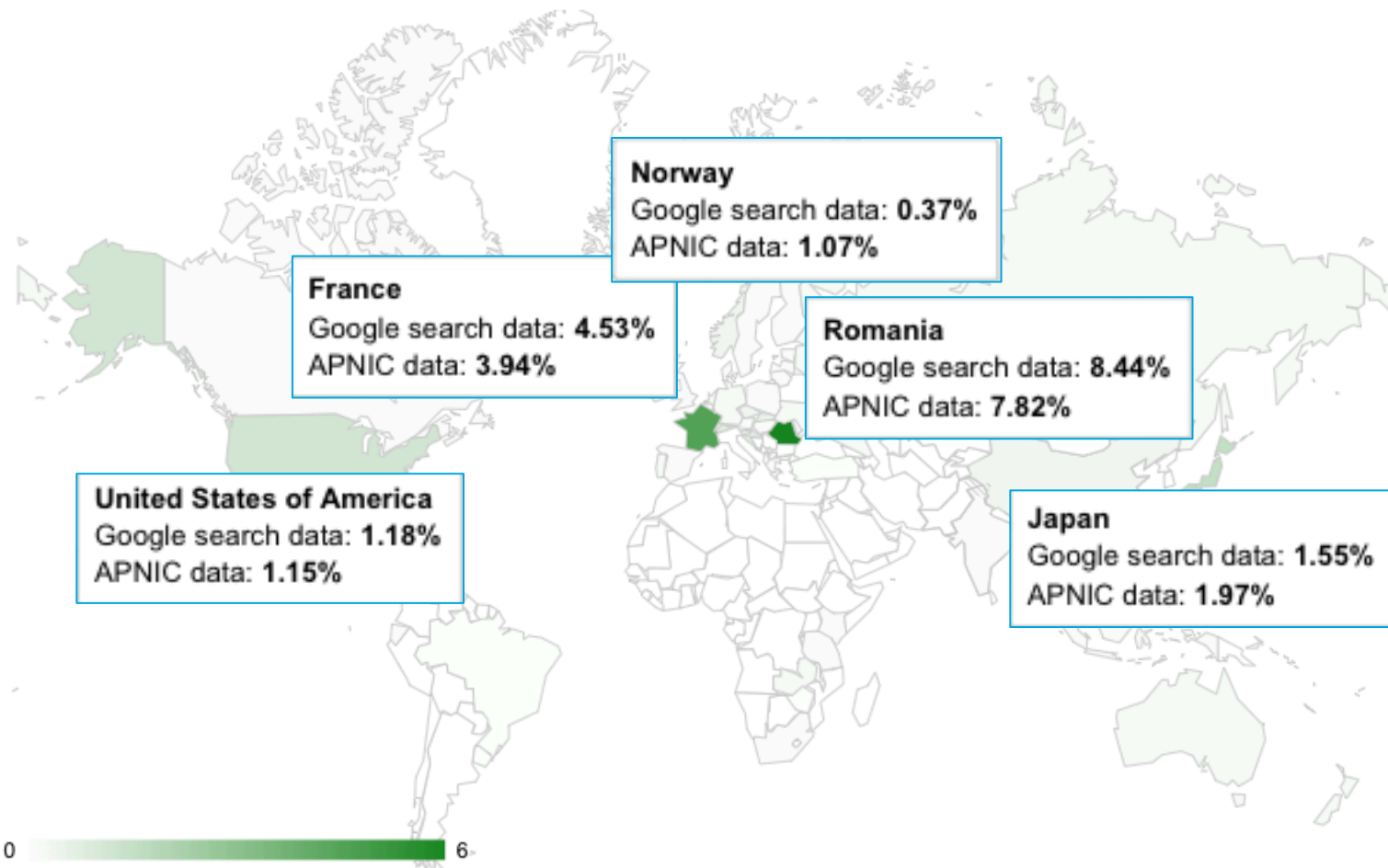


[Home](#)
[World-scale data](#)
[Information](#)

Select data type :

- All
- IPv6 Prefixes
- Transit AS
- Web Content
- Users

MAX :



[World](#) | [Africa](#) | [Asia](#) | [America](#) | [Europe](#) | [Oceania](#)

% of IPv6 enabled Users (Google Tree map)



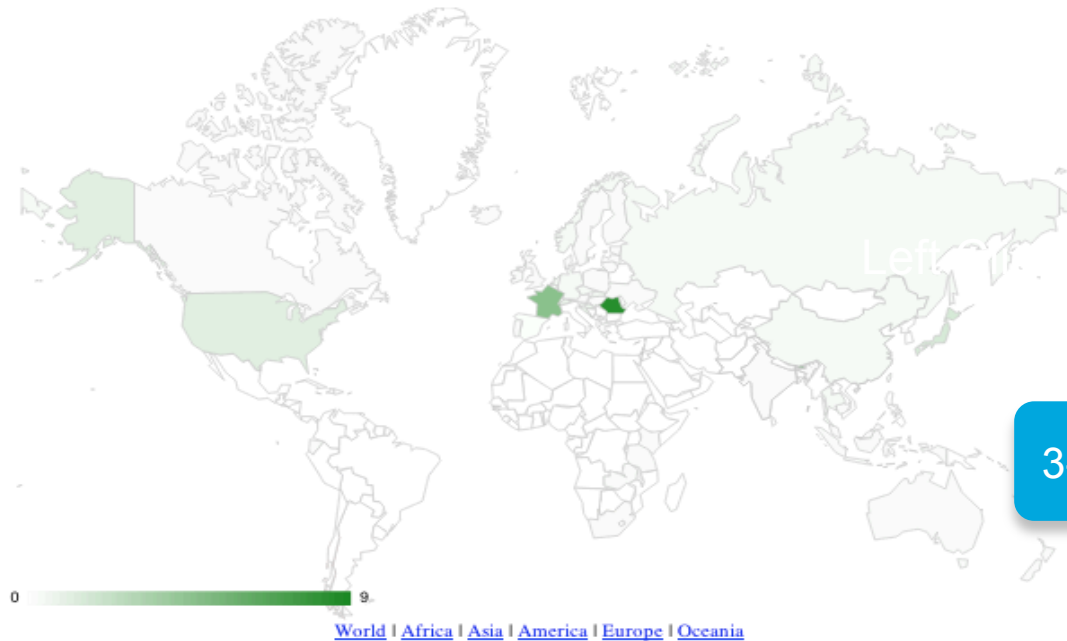
[Home](#)
[World-scale data](#)
[Information](#)

Select data type :

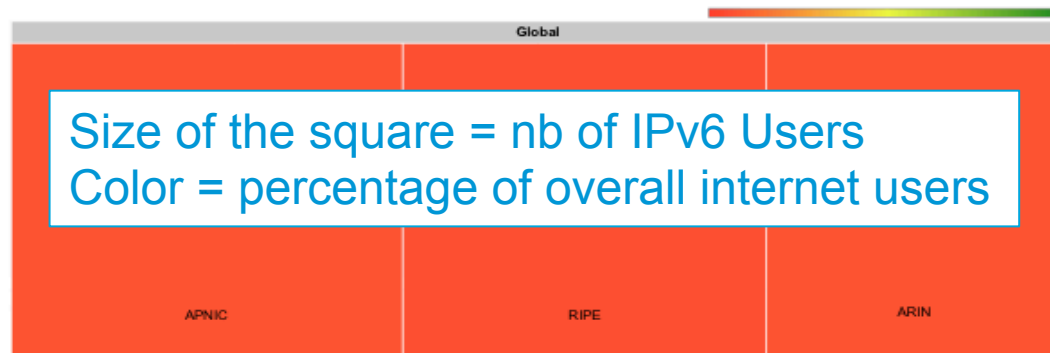
All
IPv6 Prefixes
Transit AS
Web Content
Users

MAX :

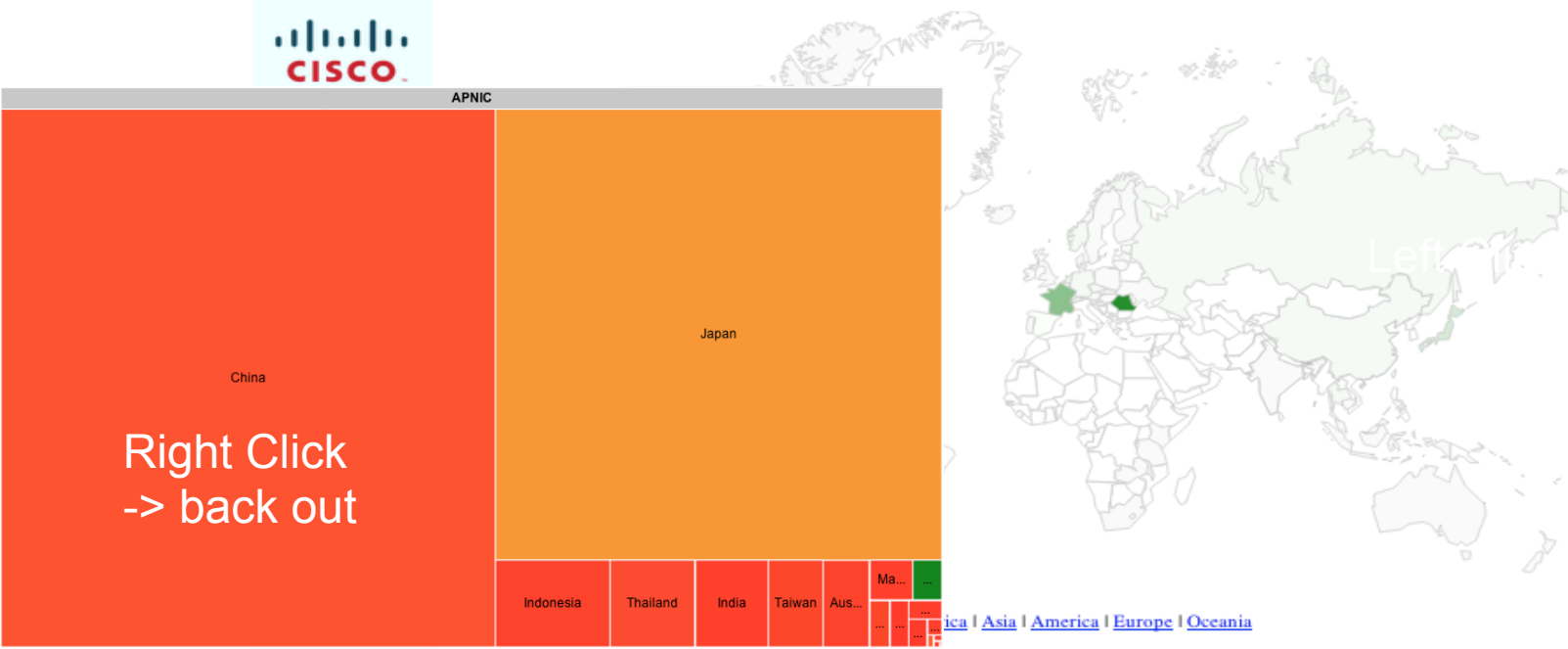
Click



3-Scroll down



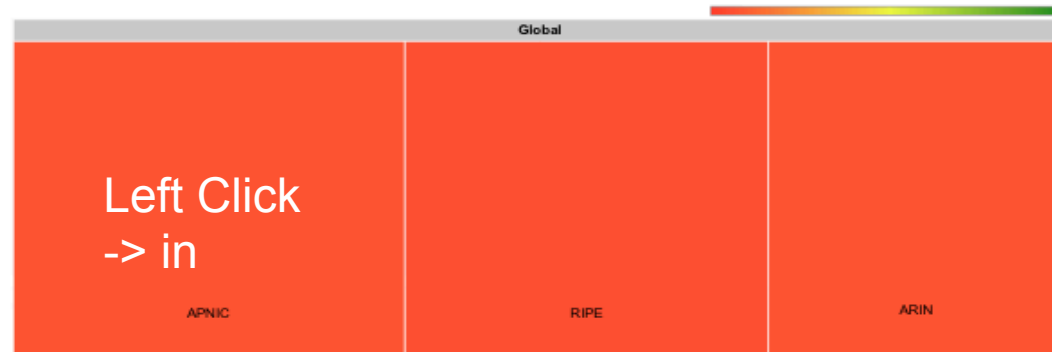
% of IPv6 enabled Users (Google Tree map)



Right Click
-> back out

Navigation in and out

- In: Left Click
- Out: Right Click



Left Click
-> in

% of IPv6 enabled Users (Google Tree map)



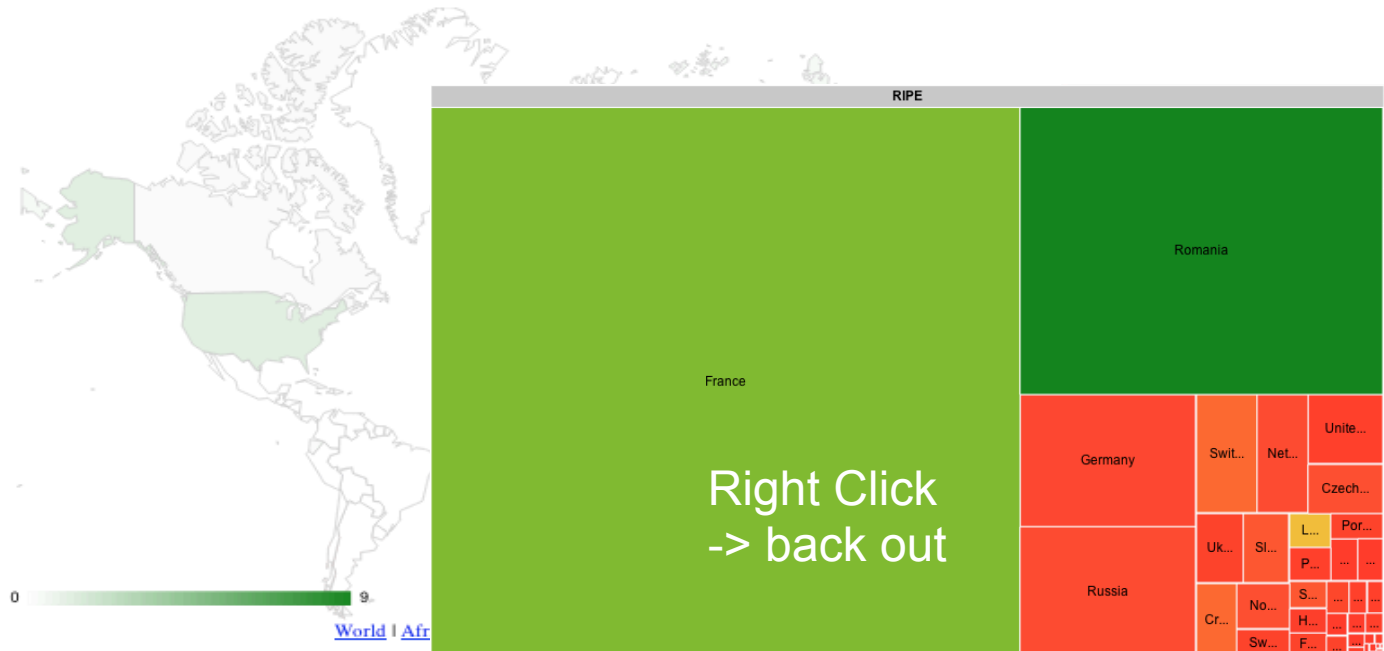
CISCO

[Home](#)
[World-scale data](#)
[Information](#)

Select data type :

All
IPv6 Prefixes
Transit AS
Web Content
Users

MAX :



Click

Right Click
-> back out

Navigation in and out

- In: Left Click
- Out: Right Click



Left Click
-> In



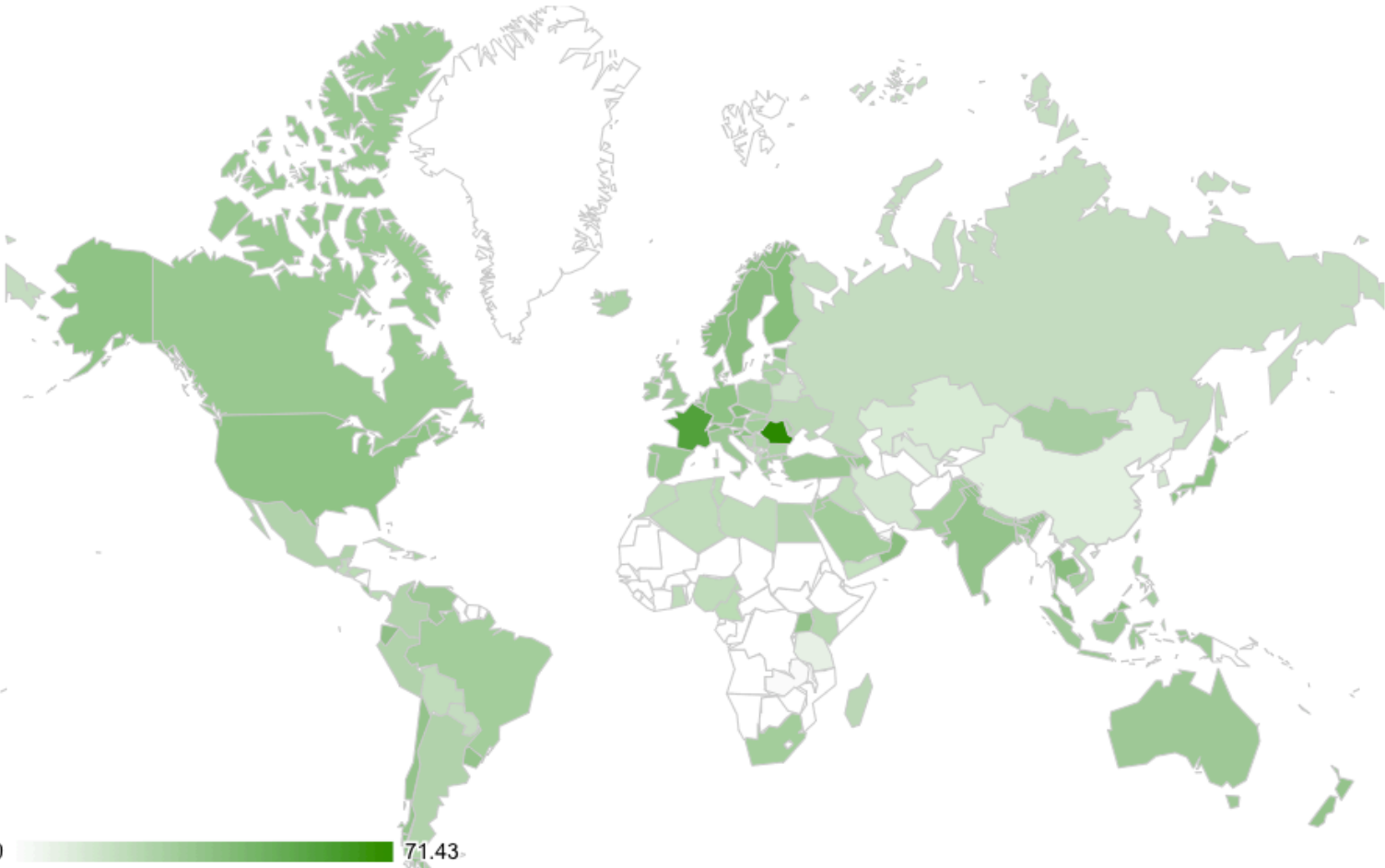
More details: World/Country historical data



[Home](#)
[World-scale data](#)
[Information](#)

Select data type :

- All
- IPv6 Prefixes
- Transit AS
- Web Content
- Users



[World](#) | [Africa](#) | [Asia](#) | [America](#) | [Europe](#) | [Oceania](#)

More details: World/Country historical data

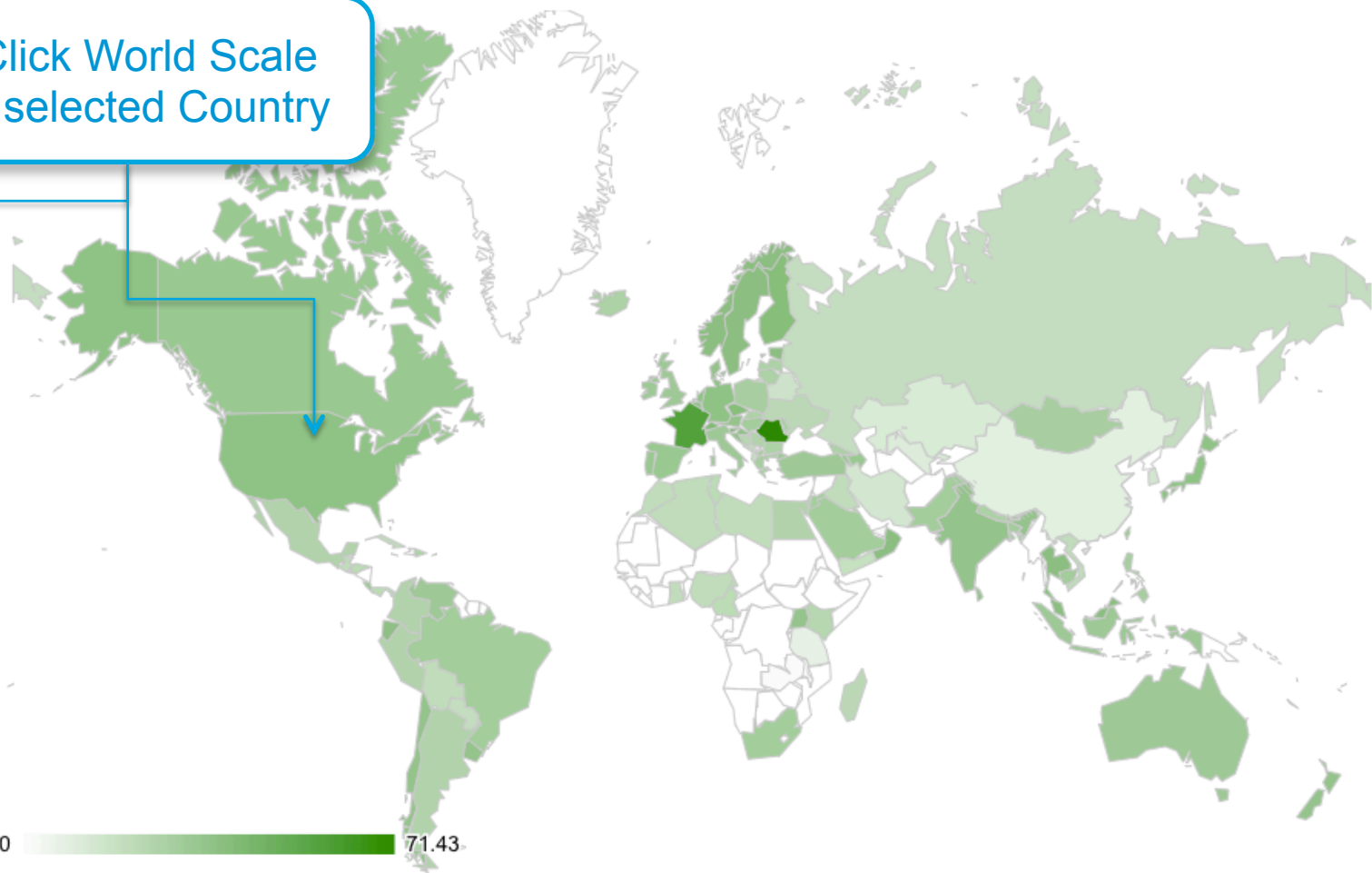


[Home](#)
[World-scale data](#)
[Information](#)

Select data type :

- All
- IPv6 Prefixes
- Transit AS
- Web Content
- Users

1-Click World Scale
OR selected Country



[World](#) | [Africa](#) | [Asia](#) | [America](#) | [Europe](#) | [Oceania](#)

World / Country historical data

IPv6 Prefixes: allocation, routing, alive

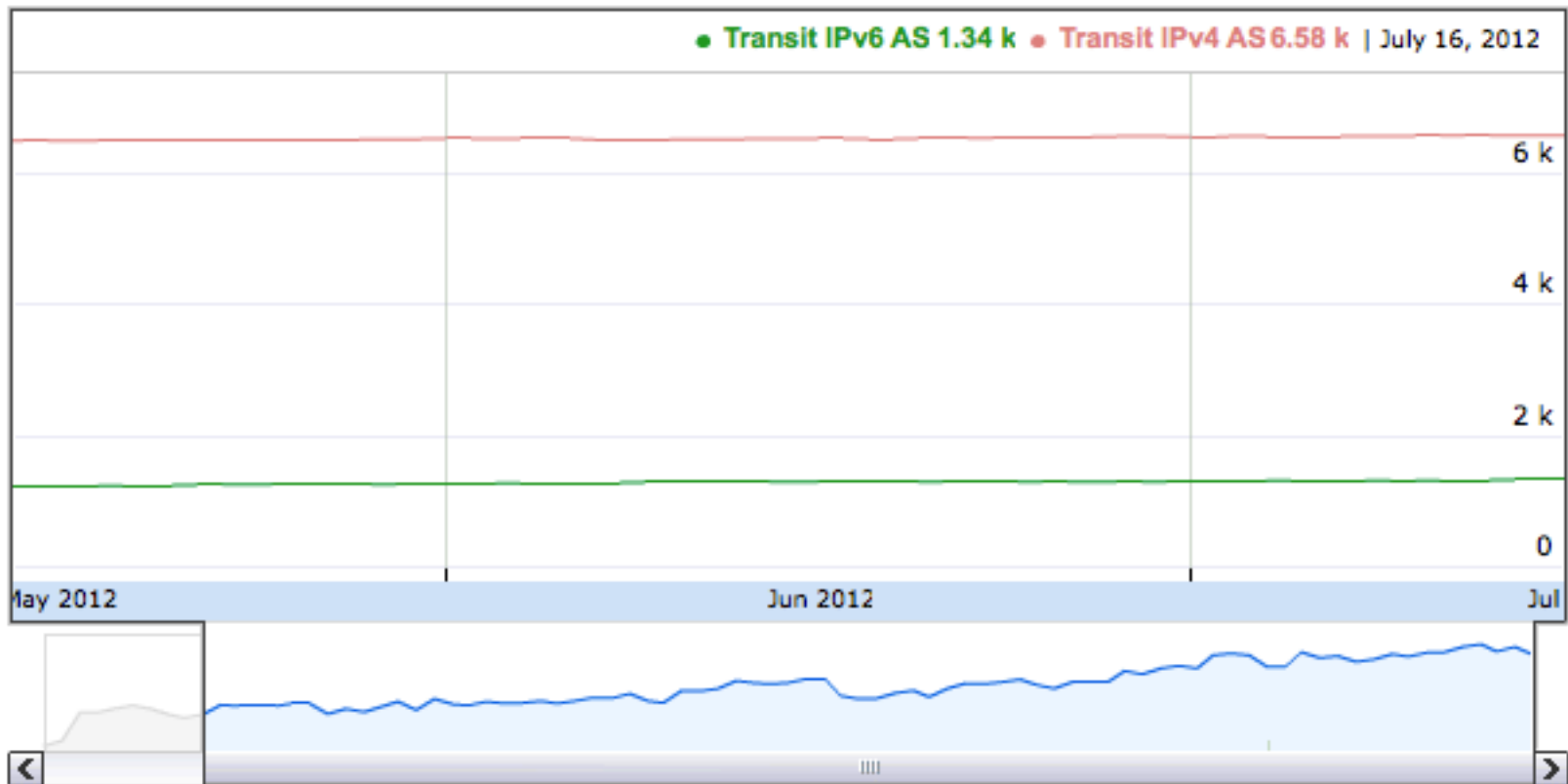
Display IPv6 Prefixes Data



World / Country historical data

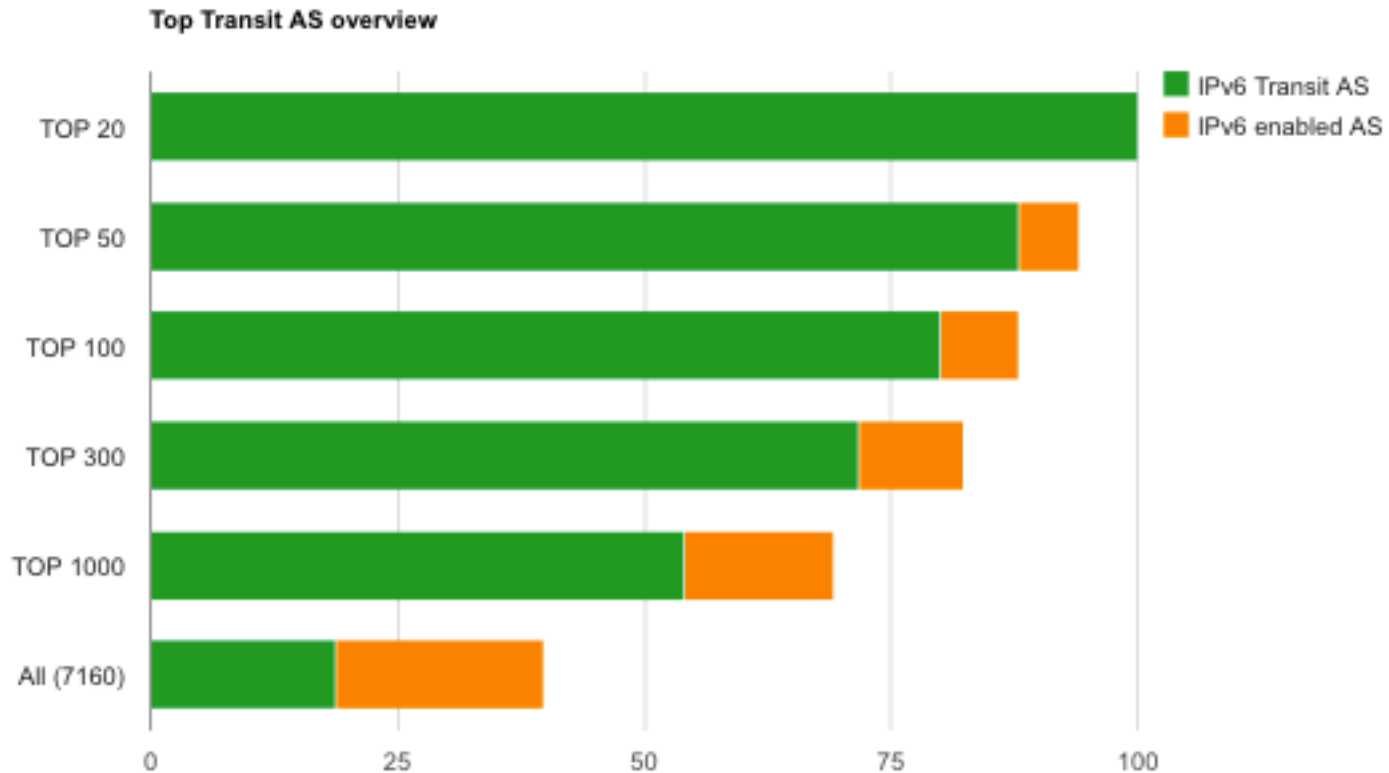
Transit Autonomous Systems

Display Transit AS Data



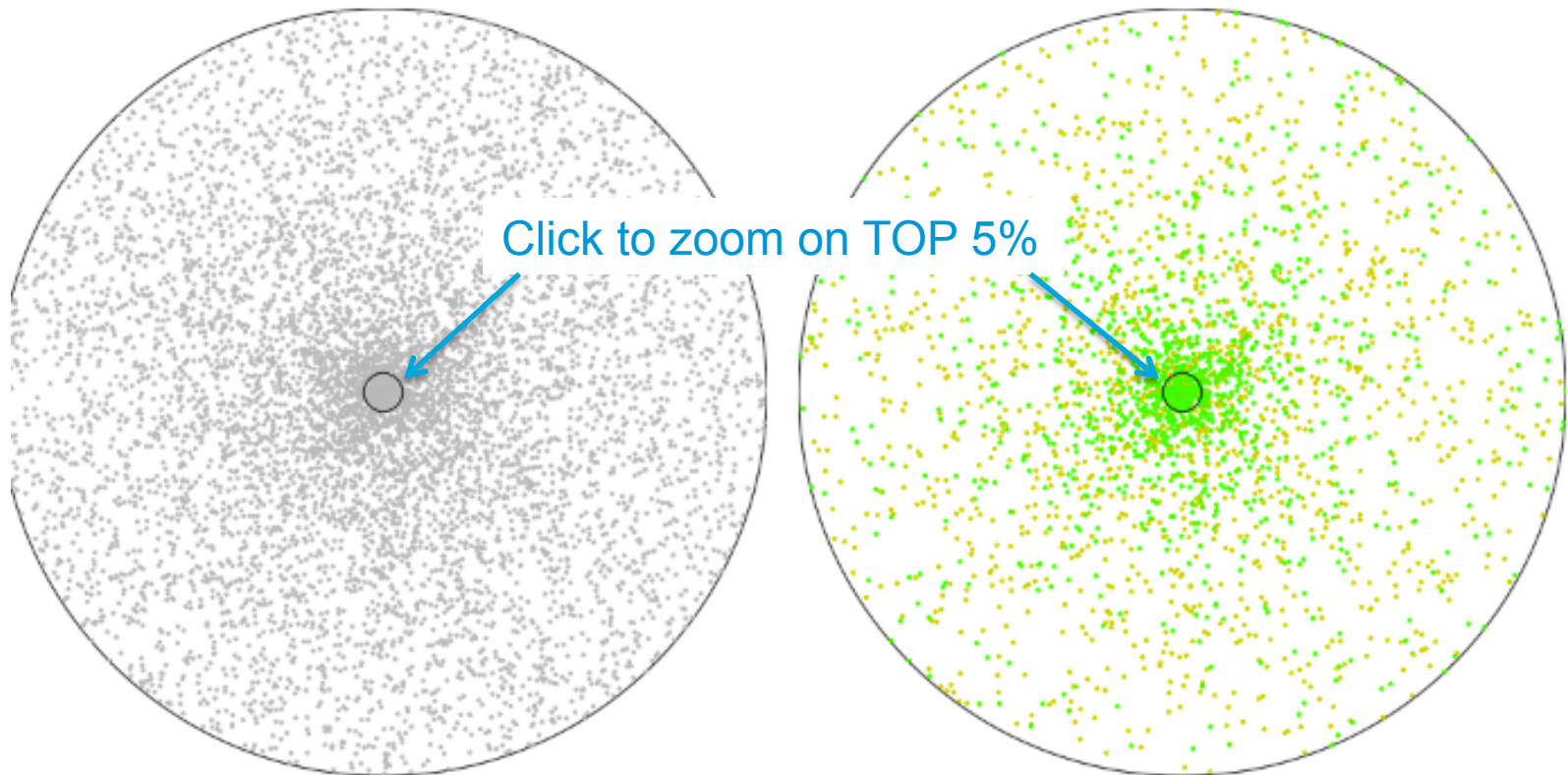
World / Country historical data

IPv6 Transit Autonomous Systems



World and Country historical data

IPv6 Transit Autonomous Systems



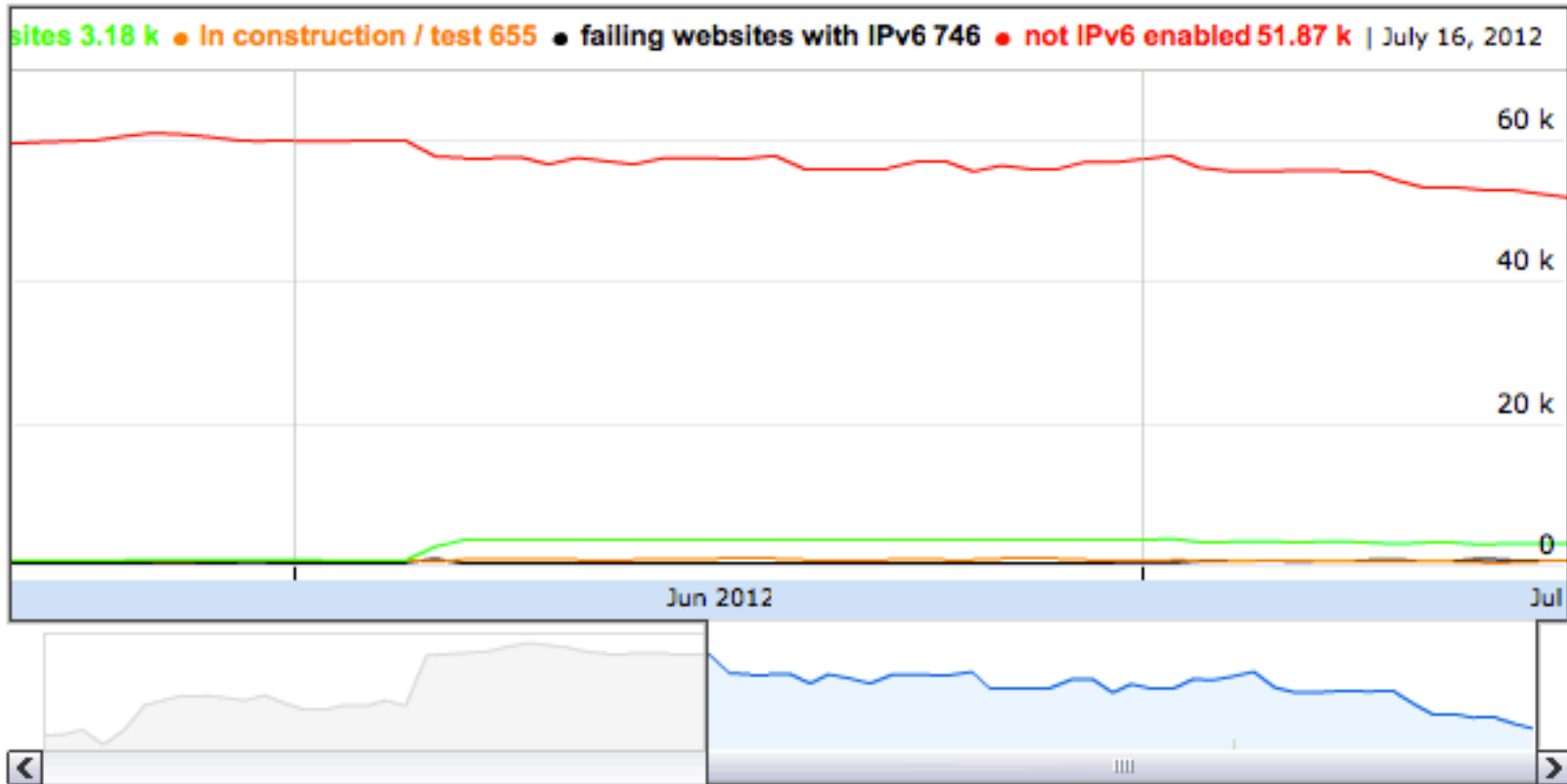
Transit V4 AS (7235)

Transit V6 AS (1337)

V6 enabled AS, Transit only on V4 (2848)

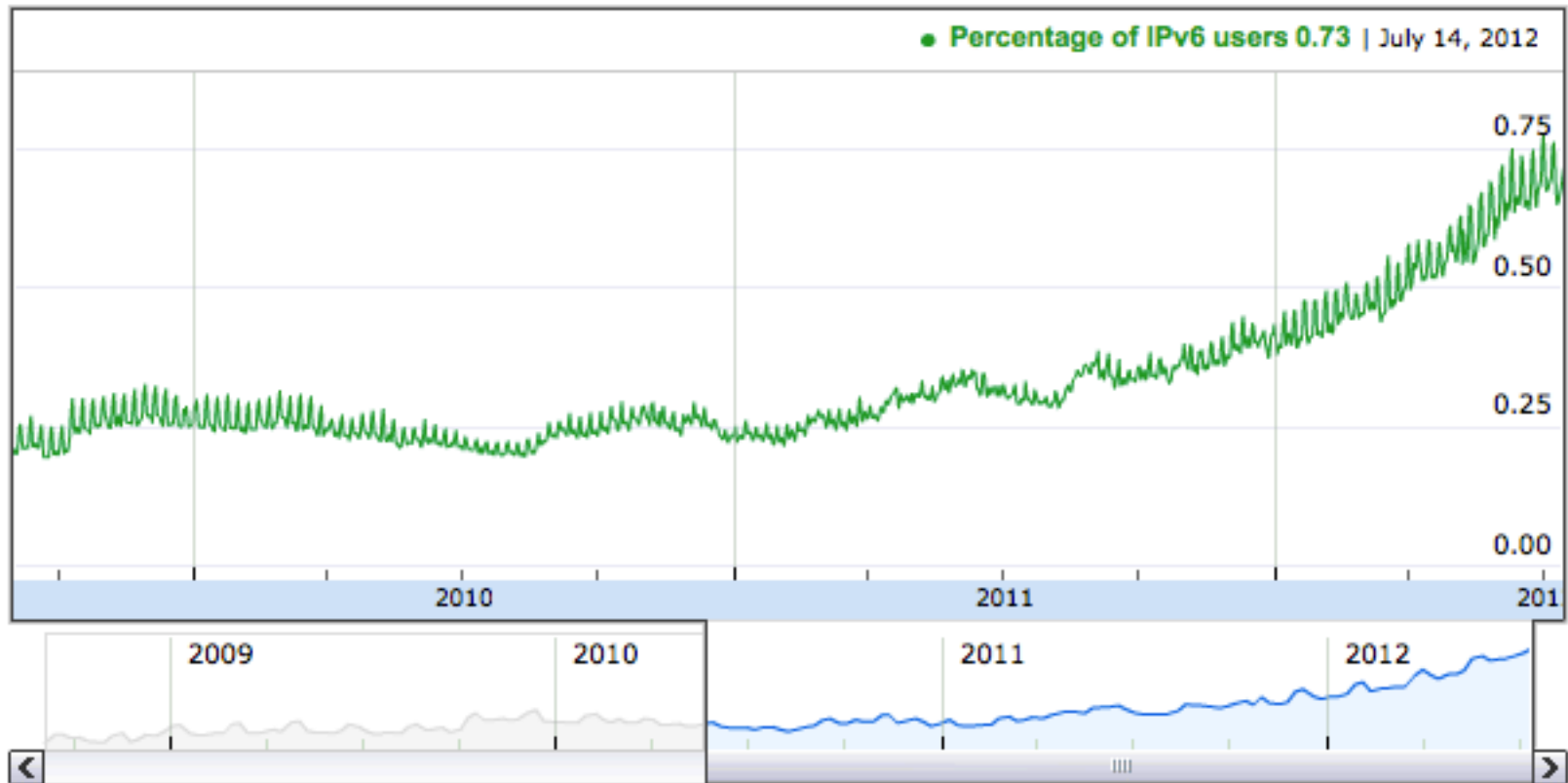
World and Country historical data IPv6 enabled Content-WEB Sites

Display Content Data



World and Country historical data IPv6 enabled users

Display Users Data



Sources

- whois from RIPE, ARIN, APNIC, AFRINIC, LACNIC
- <http://archive.routeviews.org/>
- <http://www.team-cymru.org/Services/ip-to-asn.html>
- <https://www.arin.net/knowledge/rirs/countries.html>
- <http://www.alexa.com/topsites>
- <http://labs.apnic.net/dists/v6dcc.html>
- <http://www.google.com/ipv6/statistics.html>

Thank you.



6lab.cisco.com/stats