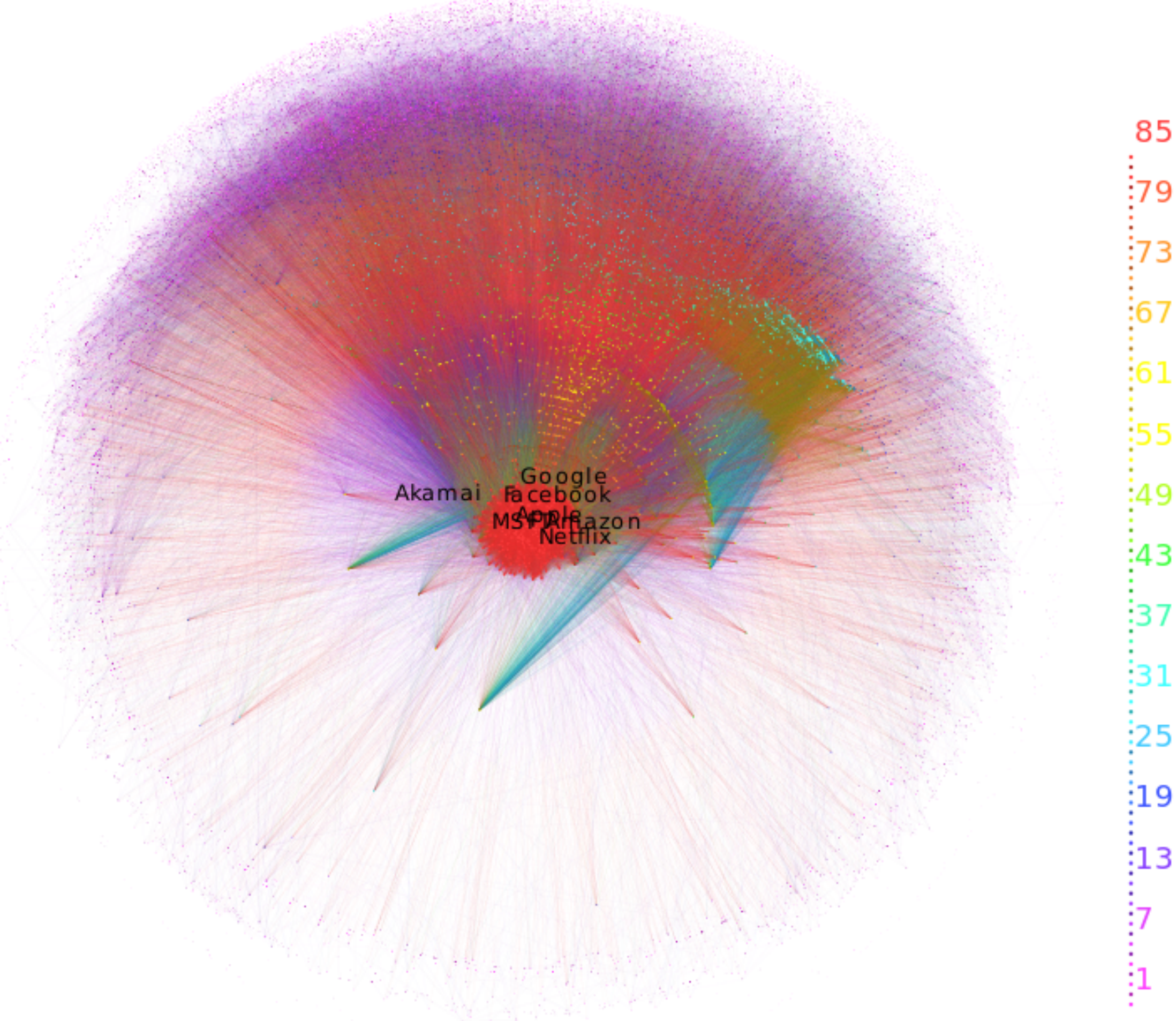




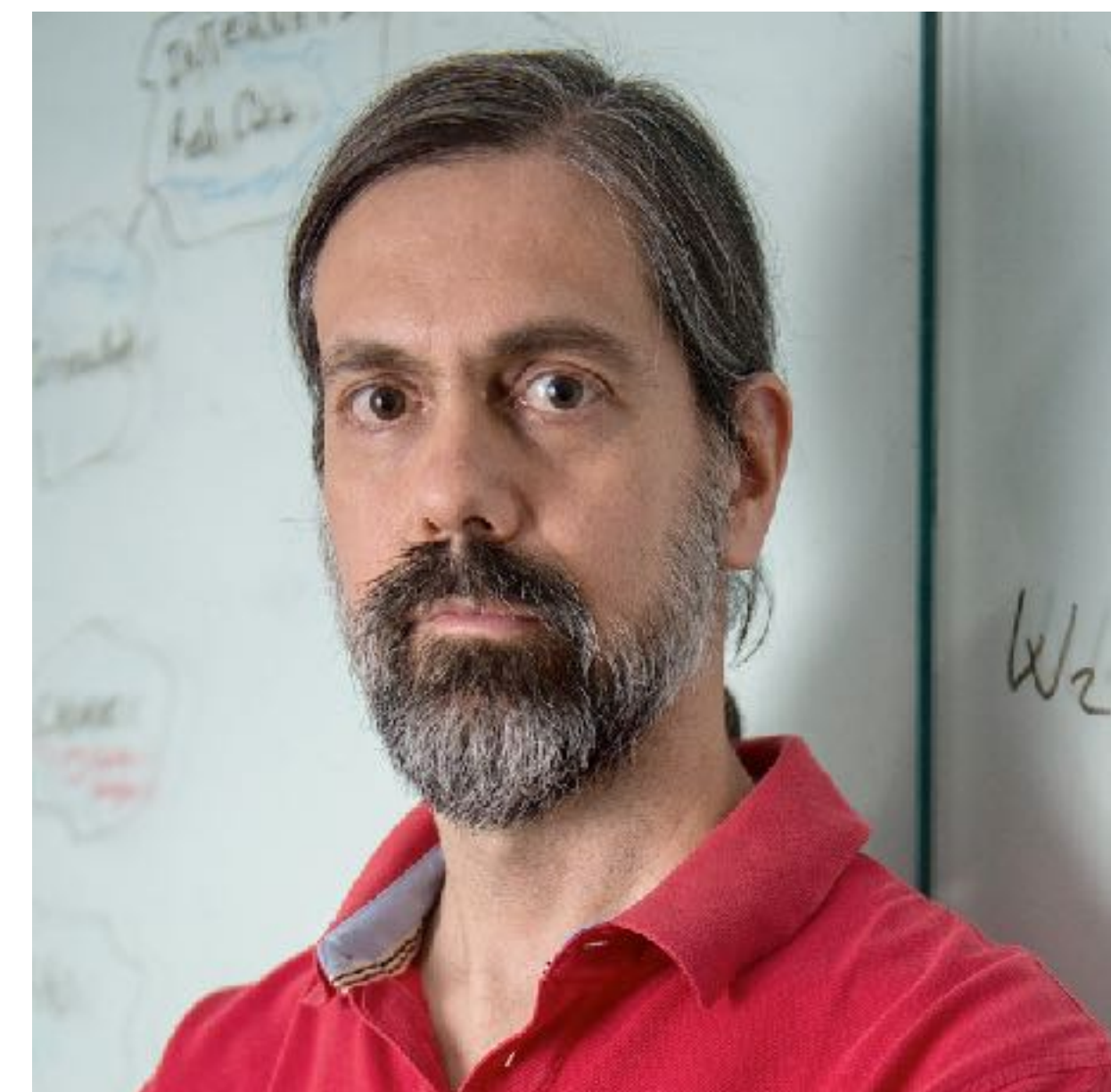
De los Proveedores de Información al usuario: ¿cómo funciona Internet?

Dr. Ing. J. Ignacio Alvarez-Hamelin

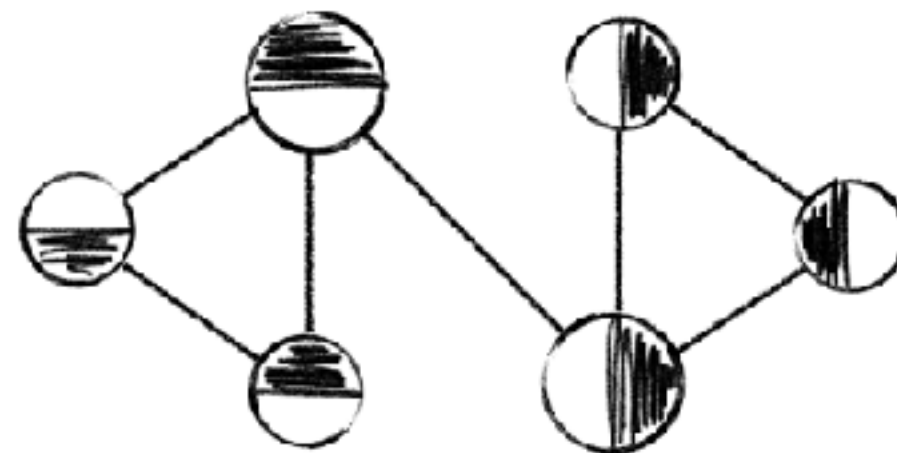
Viernes 27/11/2020 18:00 Argentina (GMT-3)

Registrarse gratuitamente en <https://events.vtools.ieee.org/m/247633>

IEEE ComSoc Argentina Open Webinar — <https://cnet.fi.uba.ar/IEEE/>



De los Proveedores de Información al usuario: ¿cómo funciona Internet?



CoNexDat

IEEE ComSoc Argentina Open Webinar :: 27-Nov-2020



J. Ignacio Alvarez-Hamelin

Mutación del ecosistema de Internet

La era de la NSFNET (hasta 1995)

- Backbone monolítico

La era de los Transit (fin de 1990s-2000s)

- Transits densamente conectados
- *Eyeballs* y CPs en la periferia
- Modelo de TIERs

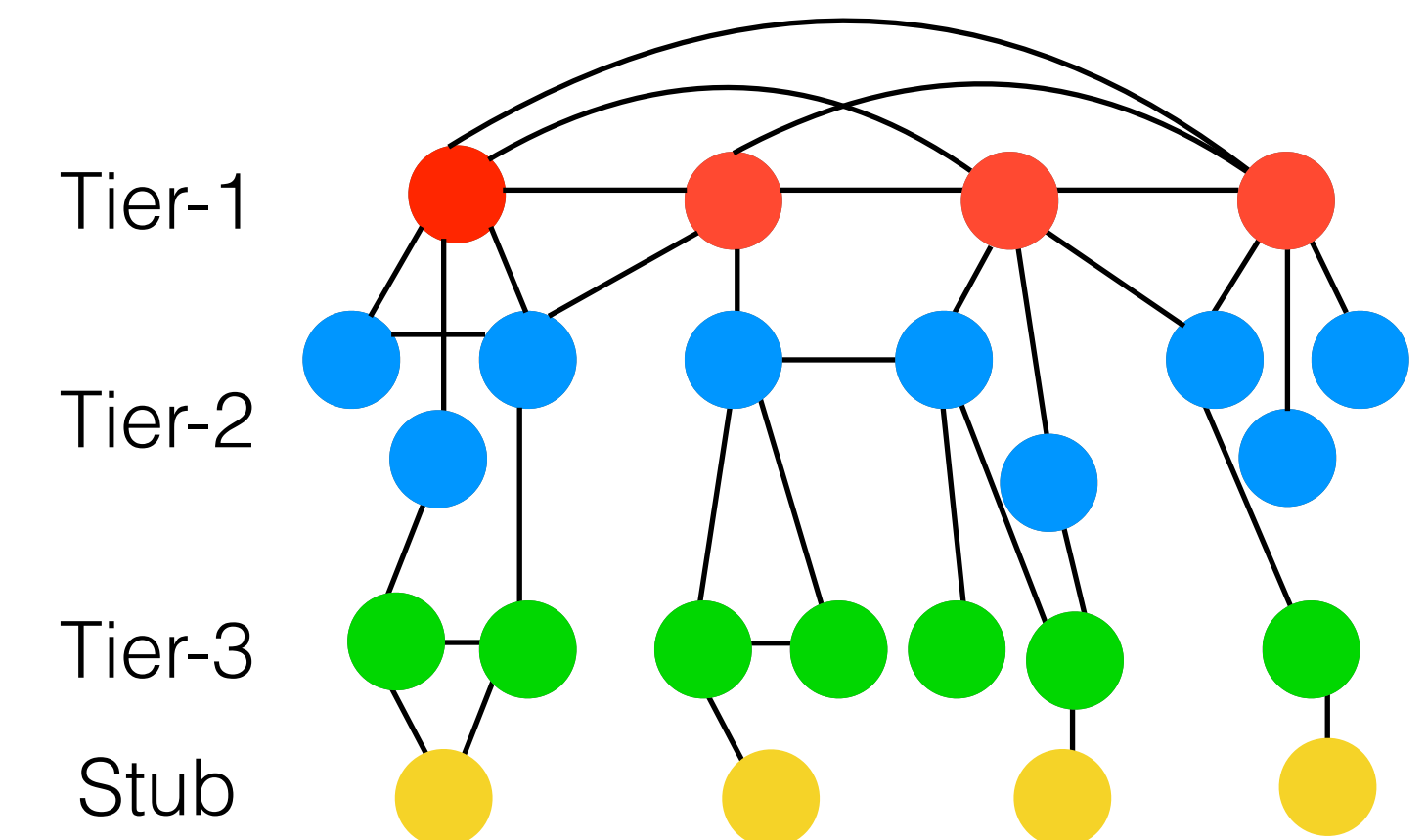
La era del Contenido (2010s)

- Dominancia de contenido multimedia
- CDNs
- Red plana (flat)

NSFNET T3 Network 1992



<https://commons.wikimedia.org/wiki/File:NSFNET-backbone-T3.png>



Aparición de CDNs e IXPs

Despliegue de CDNs

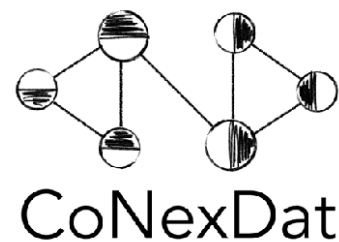
- CDNs de uso general
- Ascenso de las CDNs privadas
- Resultado: CPs densamente conectados (core)

IXPs

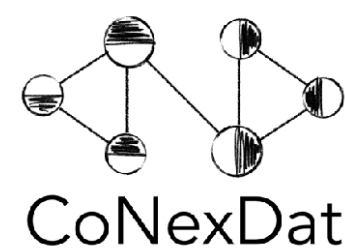
- Responsables *aplanamiento* de Internet
- Interconexión de ASes de diferentes tamaños
- CDNs generalmente en IXPs

IXPs+CDNs: Impacto en el tráfico

- Reducción del tráfico hacia Transits
- Tráfico Peer-to-peer



Evolución de los Proveedores de Contenidos en el núcleo de **Internet**



:: IEEE ComSoc Argentina Open Webinar ::
27/11/2020 :: J. Ignacio Alvarez-Hamelin

Studying the Evolution of Content Providers in the Internet Core

Traffic Measurement and Analysis (TMA) 2018

http://tma.ifip.org/2018/wp-content/uploads/sites/3/2018/06/tma2018_paper16.pdf

Studying the evolution of content providers in IPv4 and IPv6 Internet cores.

Computer Communications, 145:54 -- 65, 2019

**Esteban Carisimo, Carlos Selmo,
J. Ignacio Alvarez-Hamelin, Amogh Dhamdhere**



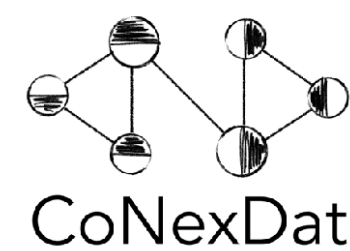
Motivaciones

Google and Netflix Make Land Grab On Edge Of Internet

Many of these deals are secret, but Deepfield Networks knows of about 40 companies that are setting up their own content delivery networks with service providers, according to Craig Labovitz. But he's bound by non-disclosure agreements, and can't name names.

Wired. Junio 2012

<https://www.wired.com/2012/06/cdn/>



Motivaciones

Seeking Alpha α Portfolio People News Analysis Search by symbol, a

Apple, Microsoft And Facebook Bring More Traffic To In-House CDNs, Impacting Akamai's Media Business

Oct. 28, 15 | About: Akamai Technologies, (AKAM)

Dan Rayburn Research analyst, streaming and online video
StreamingMedia (819 followers)

Follow

Summary

- Akamai reported Q3 earnings and announced that revenue from their media delivery business would be flat or down for Q4, year-over-year.
- Akamai suggested the reason they expect media growth rates to continue to moderate in the "near term" was due to customers having "less traffic growth overall."
- The cause of what Akamai is seeing is a result of Apple, Microsoft and Facebook moving a larger percentage of their traffic to their in-house delivery networks.

<https://seekingalpha.com/article/3613736-apple-microsoft-facebook-bring-traffic-house-cdns-impacting-akamais-media-business>

Motivaciones

BLOG SEARCH

ADVANCED

APNIC

Get IP ▾ Manage IP ▾ Training ▾ Events ▾ Research ▾ Community ▾

The death of transit?

By **Geoff Huston** on 28 Oct 2016

Category: [Tech matters](#)

Tags: [ISPs](#), [data centres](#), [peering](#)

12 Comments



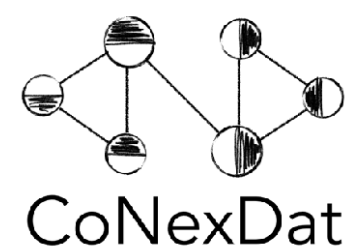
Geoff Huston, Octubre 2016

 Is there light at the end of the tunnel for transit providers?

I was struck at a [recent NANOG meeting](#) just how few presentations looked at the ISP space and the issues relating to ISP operations, and how many were looking at the data centre environment.

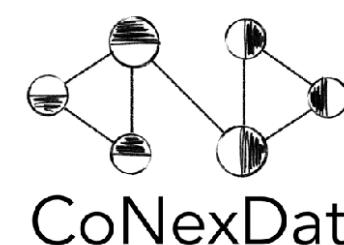
<https://blog.apnic.net/2016/10/28/the-death-of-transit/>

<https://labs.apnic.net/presentations/store/2017-05-25-death-of-transit.pdf>

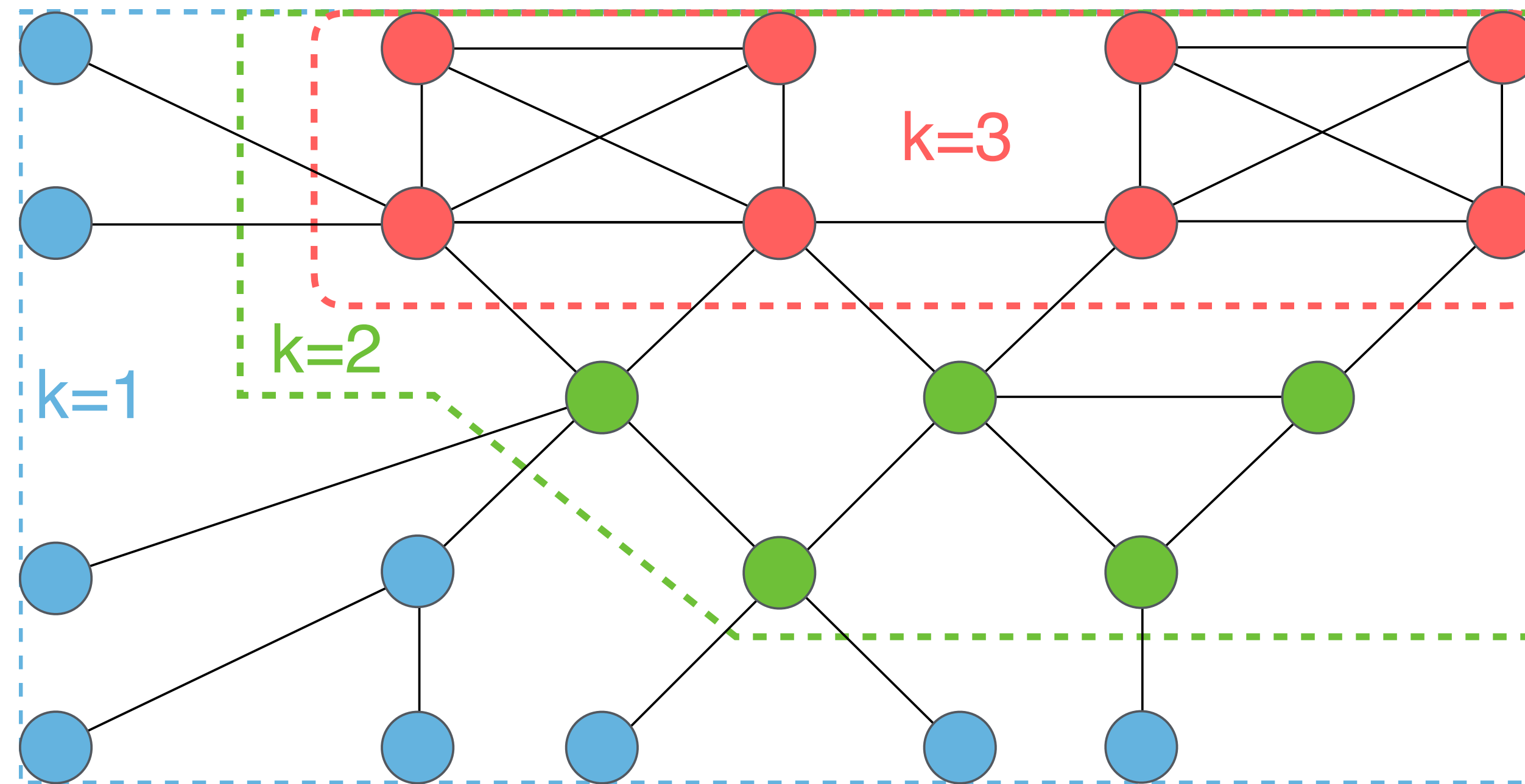


¿Pertenecen los CPs al core de Internet?

- ¿Cómo identificarlos? ¿Quiénes son? ¿Desde cuándo lo integran?
- ¿Diferencias en el core por región?
- ¿Cómo detectar CDNs en ascenso?
- Vincular la evolución en la conectividad con estrategias de negocios

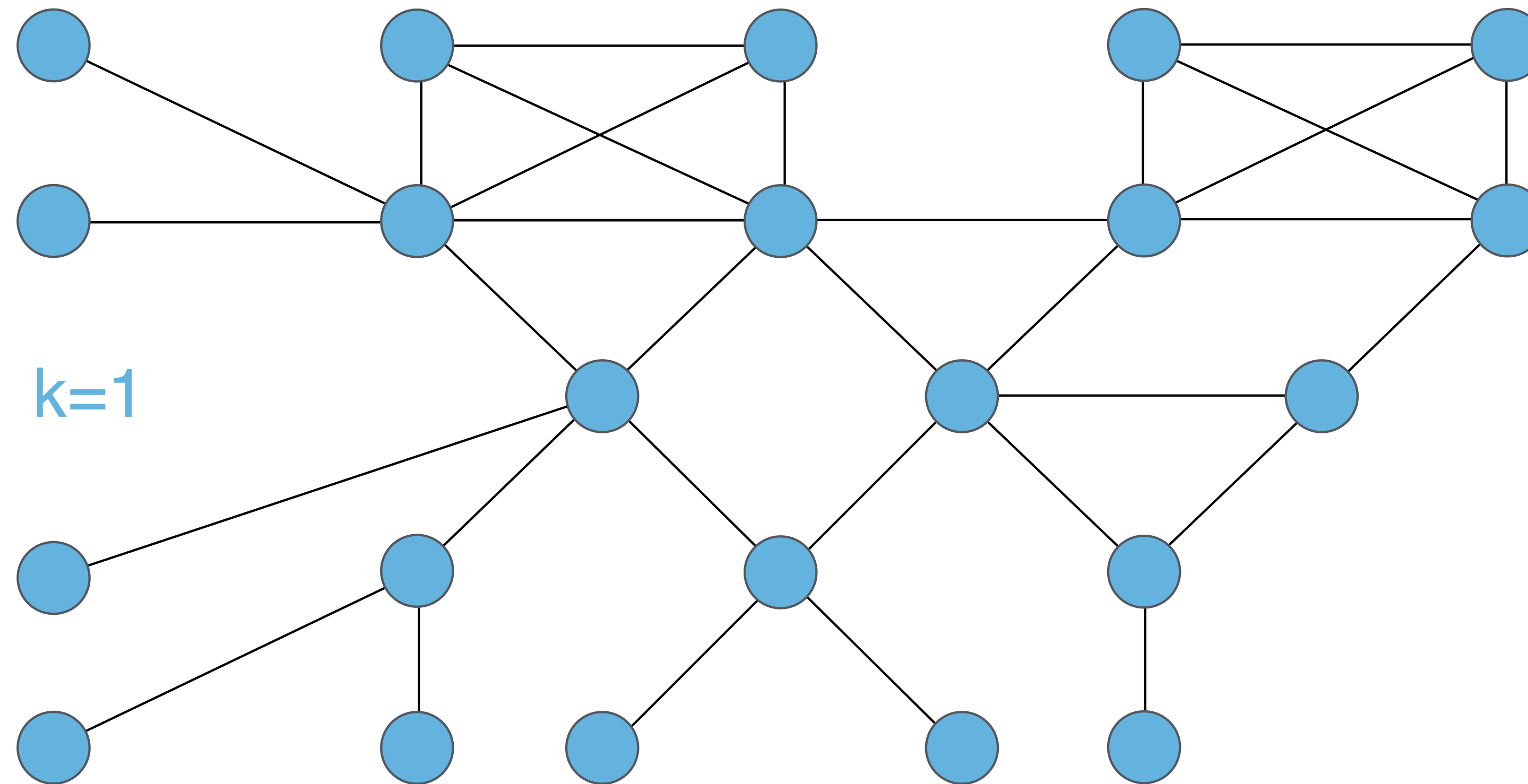


Metodología: Descomposición en k-cores

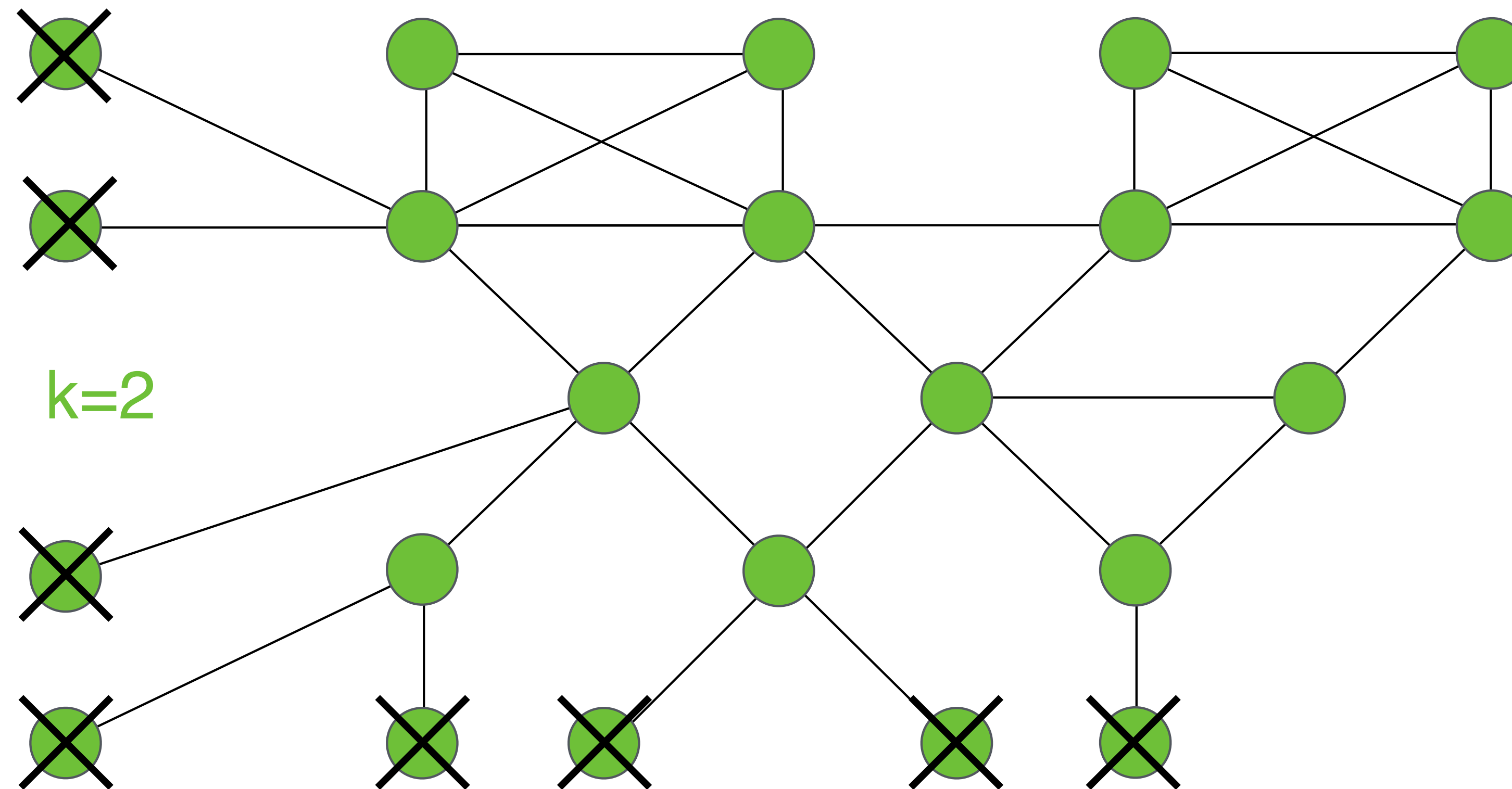


- Core de Internet: ASes densamente conectados
- ¿Cómo detectarlos?: k-cores
- k-cores: *shell-index* dado por:
 - el número **Y** el grado de los vecinos

Metodología: Descomposición en k-cores

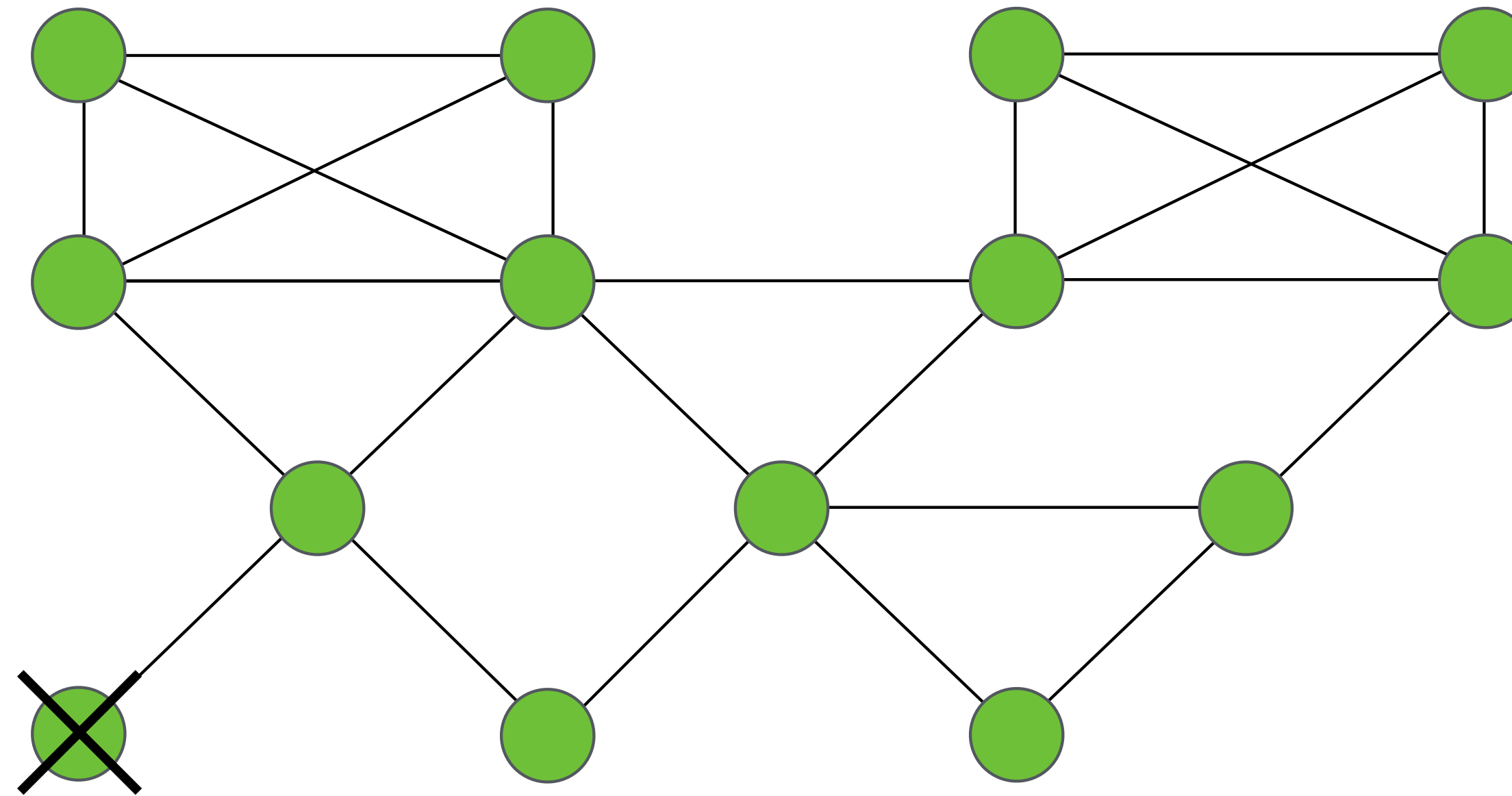


Metodología: Descomposición en k-cores



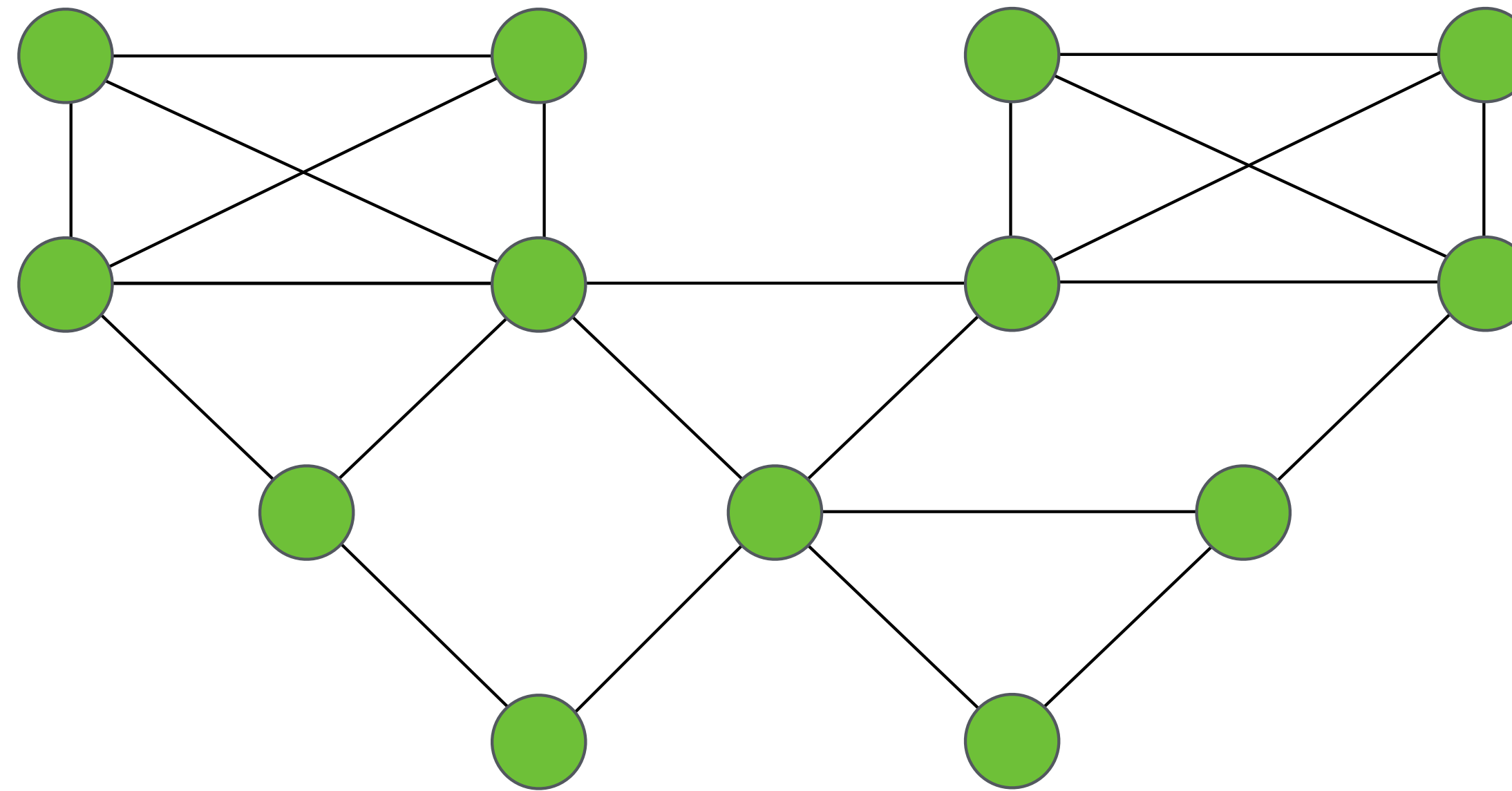
Metodología: Descomposición en k-cores

$k=2$



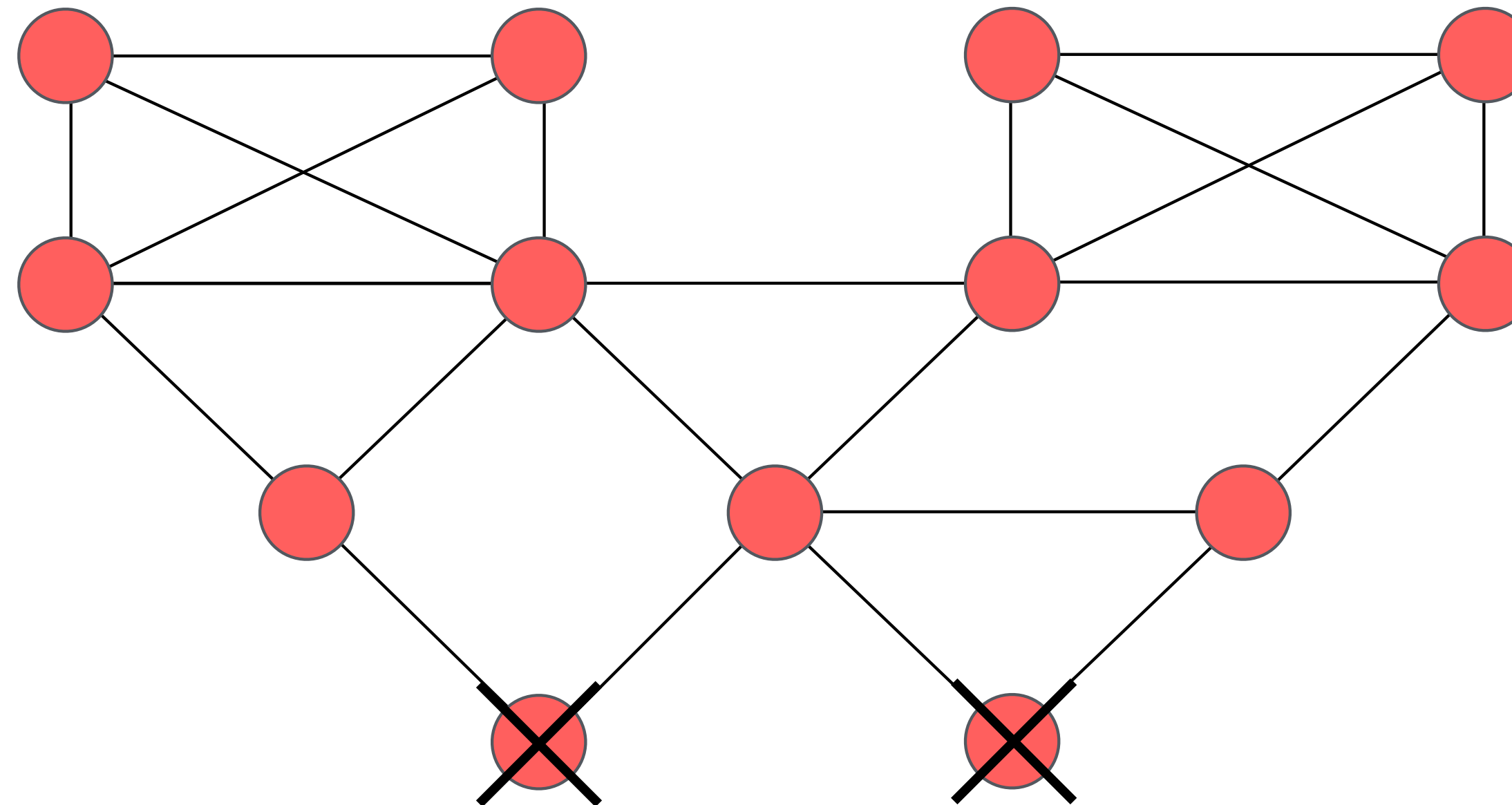
Metodología: Descomposición en k-cores

$k=2$



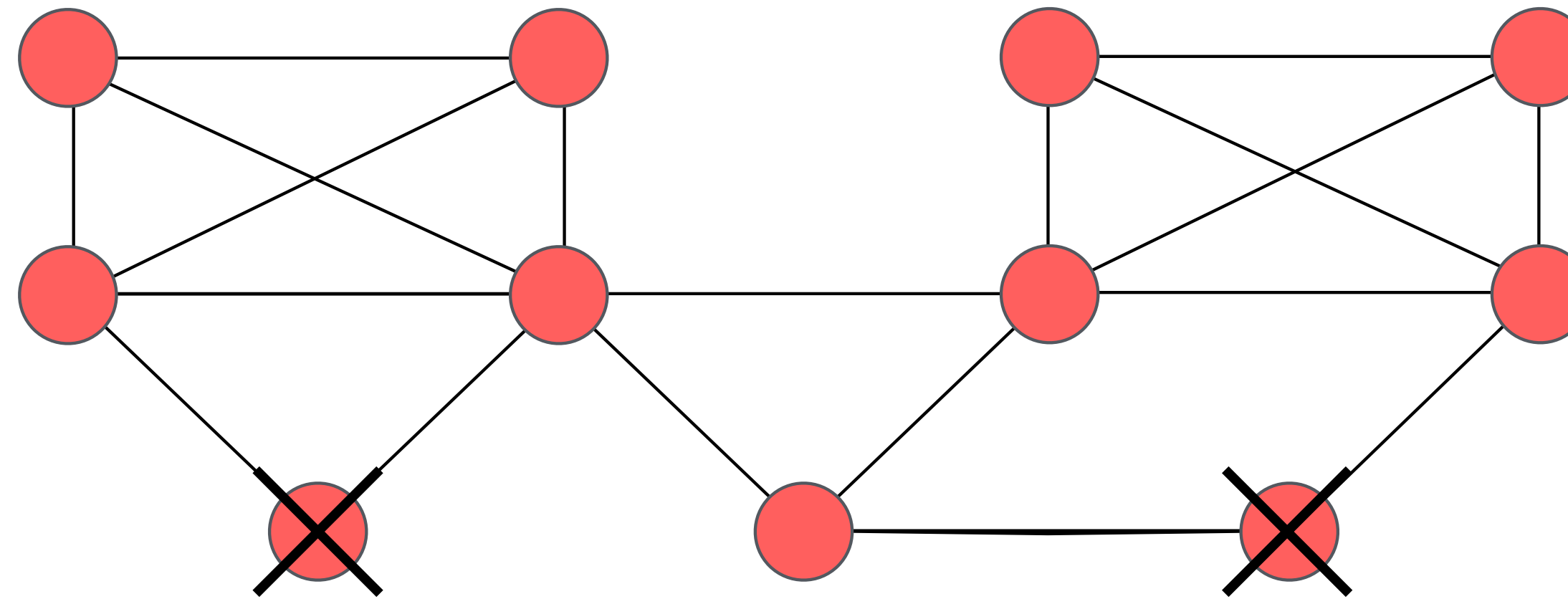
Metodología: Descomposición en k-cores

$k=3$



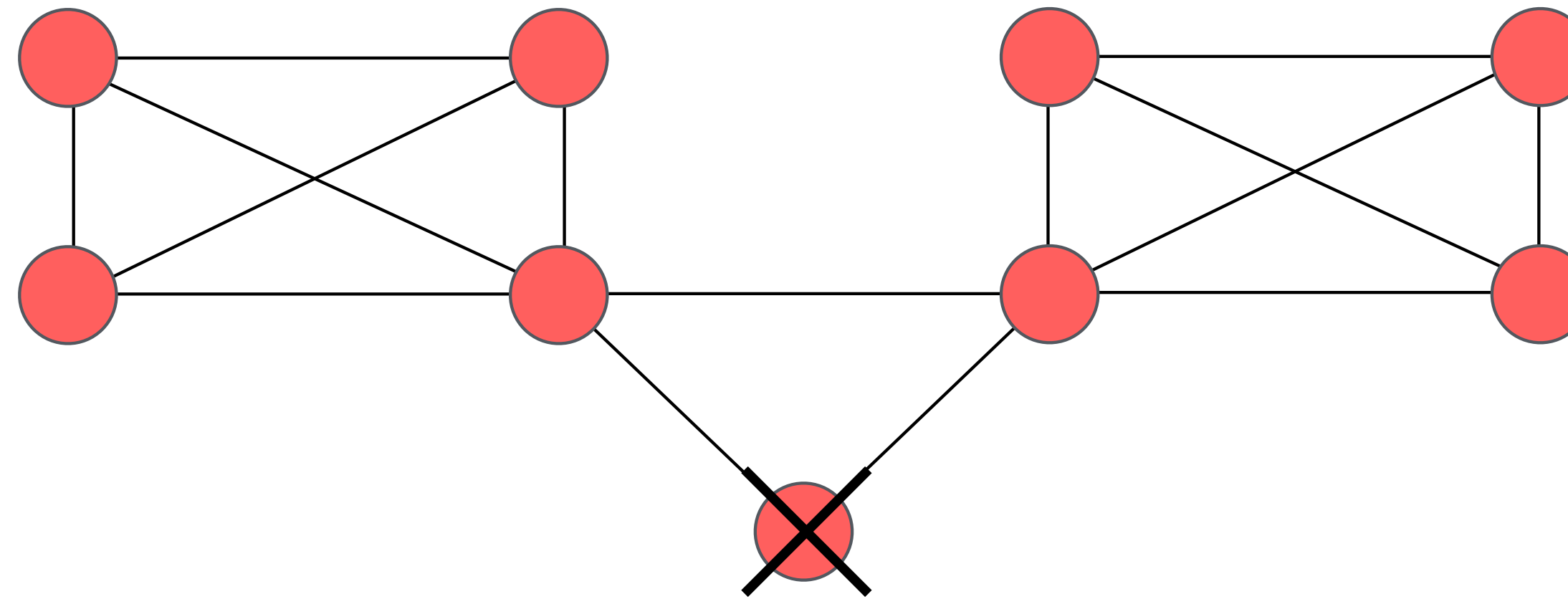
Metodología: Descomposición en k-cores

$k=3$



Metodología: Descomposición en k-cores

$k=3$



Metodología: Descomposición en k-cores



$k=3$

Metodología: Descomposición en k-cores



$k=3$

Conclusión

Si un AS pertenece al core K , entonces tiene conexiones con K ASes que tienen al menos K vecinos

Metodología: Descomposición en k-cores



$k=3$

TOPcore: El máximo K obtenido en el grafo bajo análisis

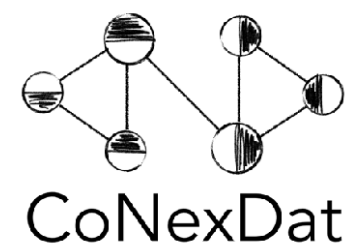
Dataset

Fuente de información

- Datos públicos brindados por CAIDA
- BGP dumps
 - Routeviews
 - RIPE RIS
- Campañas de traceroute (Ark)

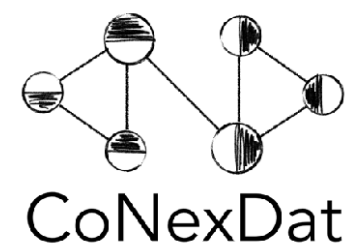
Detalles

- Granularidad mensual
- Desde 1999 hasta fines de 2017



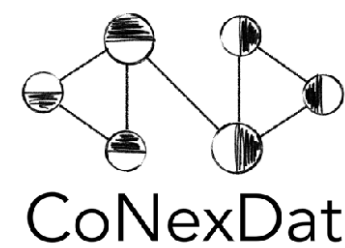
Análisis

1. Evolución de algunos grandes CPs a lo largo de los años
2. Diferencias por región
3. Otros miembros del core



Análisis

- 1. Evolución de algunos grandes CPs a lo largo de los años**
2. Diferencias por región
3. Otros miembros del core



Siguiendo a *Los 7 Grandes*



Basado en estadísticas de tráfico

- Sandvine report
- PeeringDB

Algunas limitaciones

CPs pueden tener más de un ASN

- Sólo nos enfocamos en los **primarios**

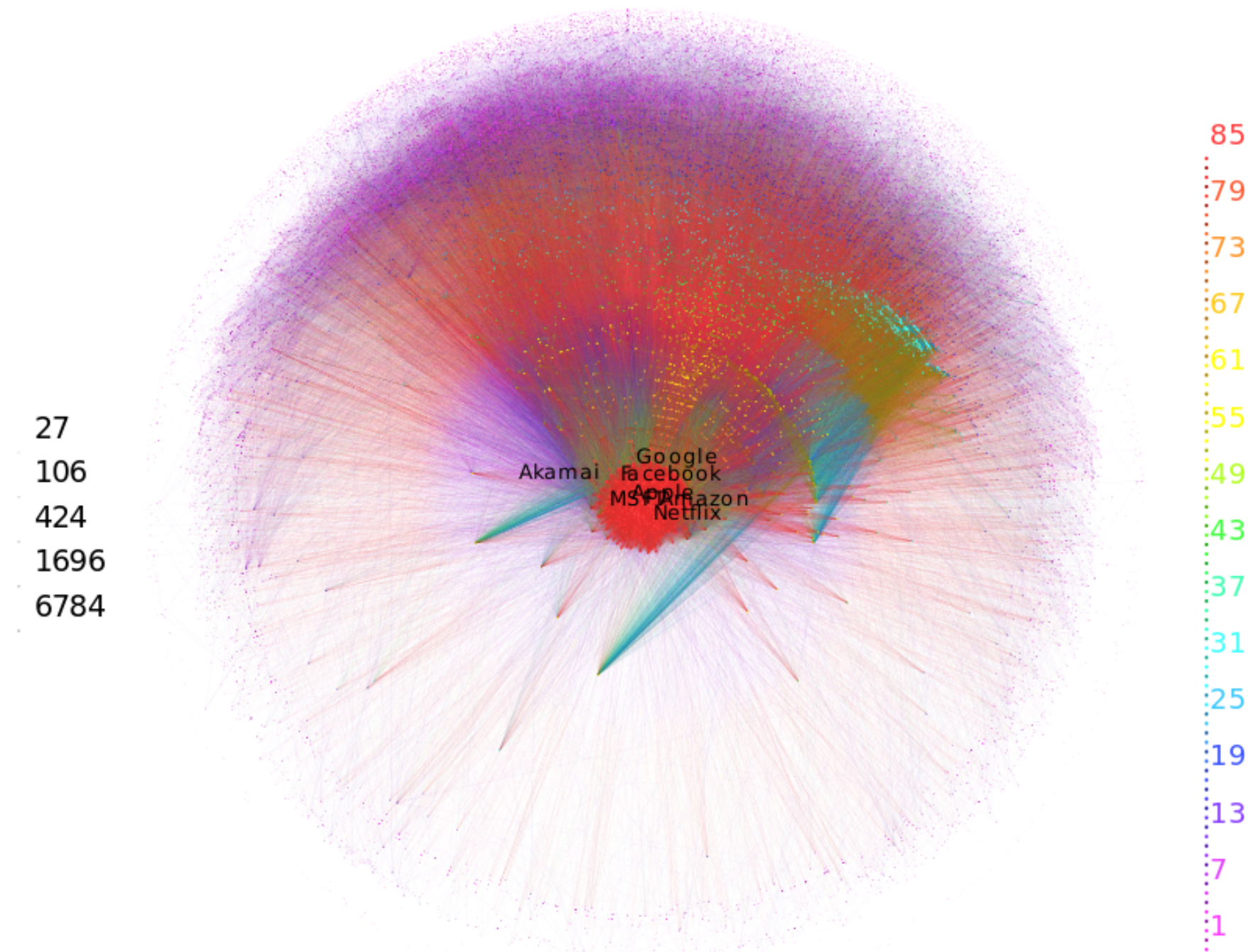
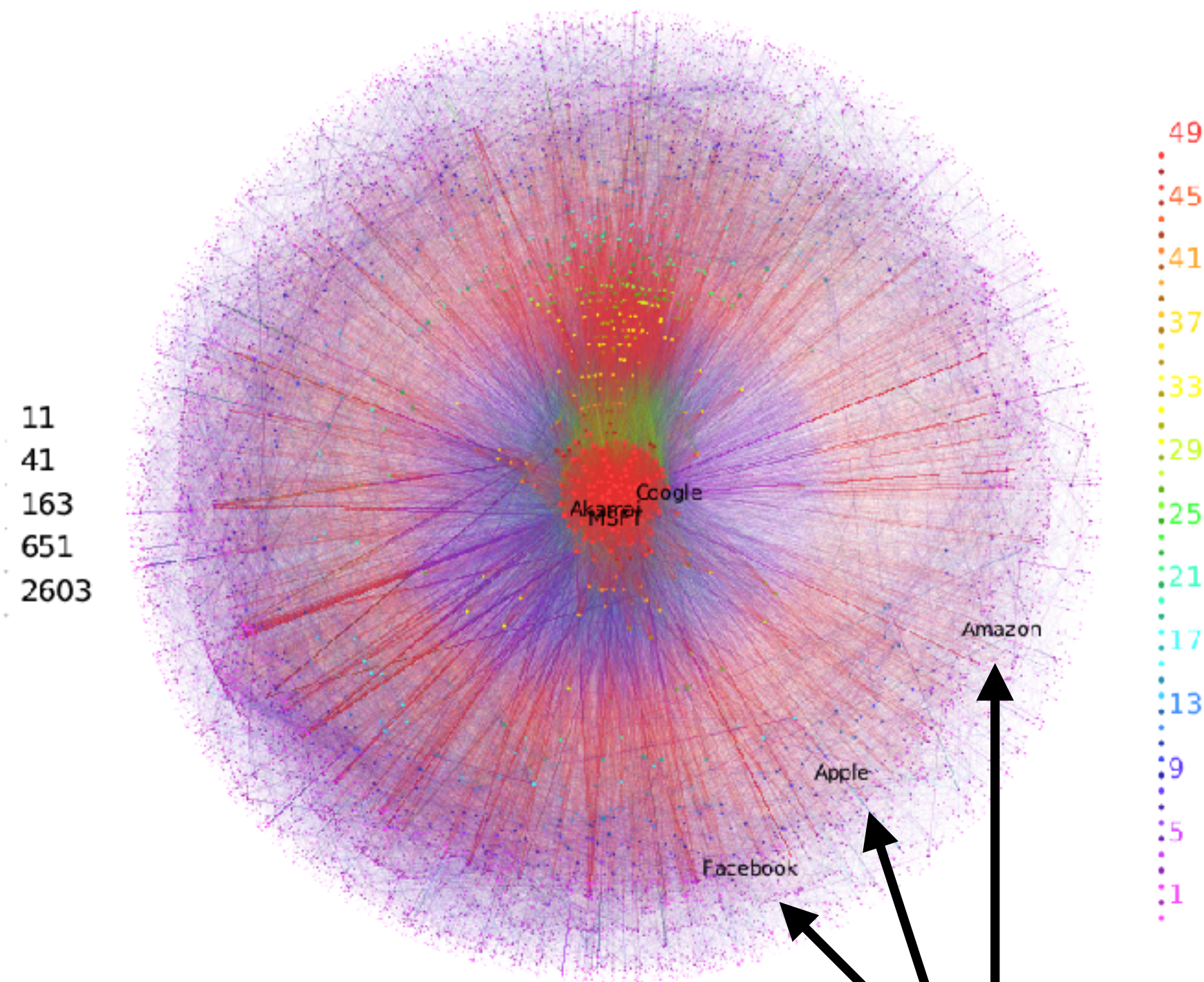
Caches

- El contenido es frecuentemente servido desde caches
- **Caches** en bajo las **direcciones** de los **ISP**
- Sin embargo, enlaces P2P necesarios
 - Llenar caches
 - Servir contenido dinámico
 - Servir ISPs que no desean tener un cache

Evolución a *Los 7 Grandes*

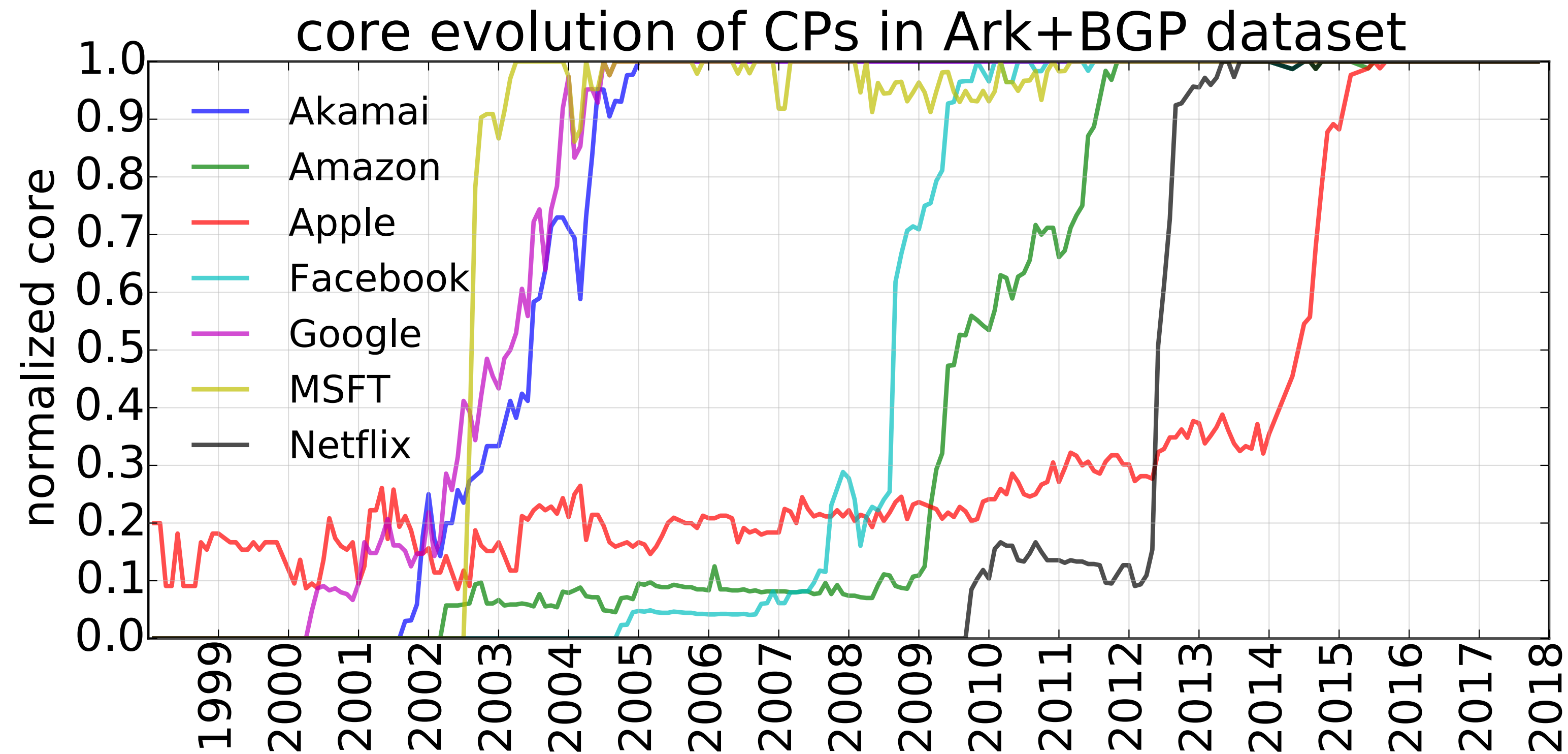
oct-2006

oct-2016

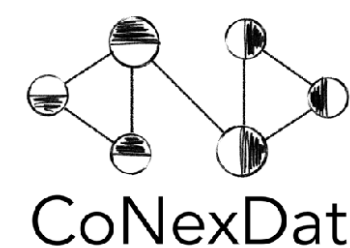


Facebook, Apple
& Amazon

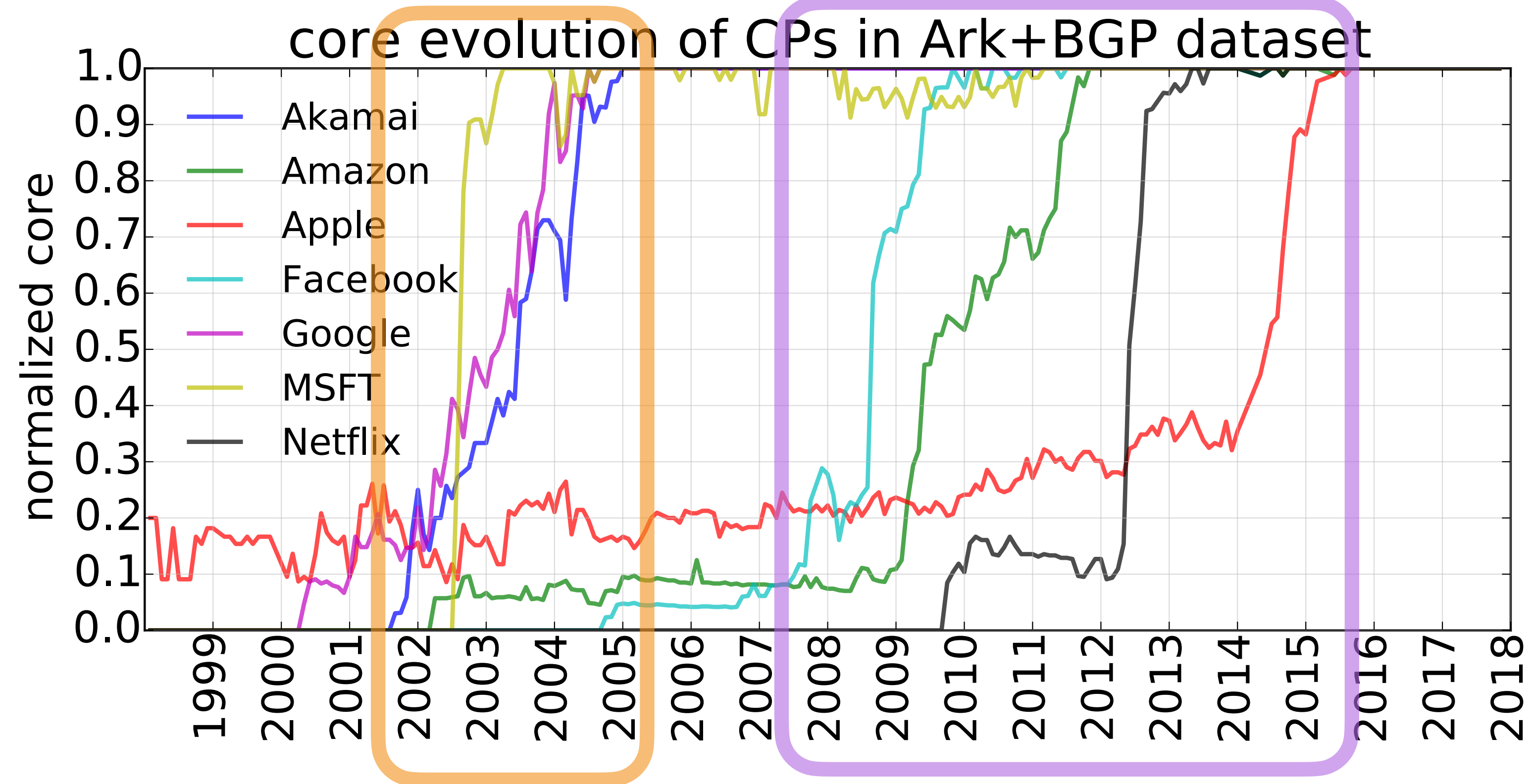
Evolución a *Los 7 Grandes*



E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.



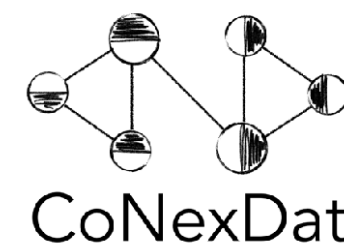
Evolución a *Los 7 Grandes*



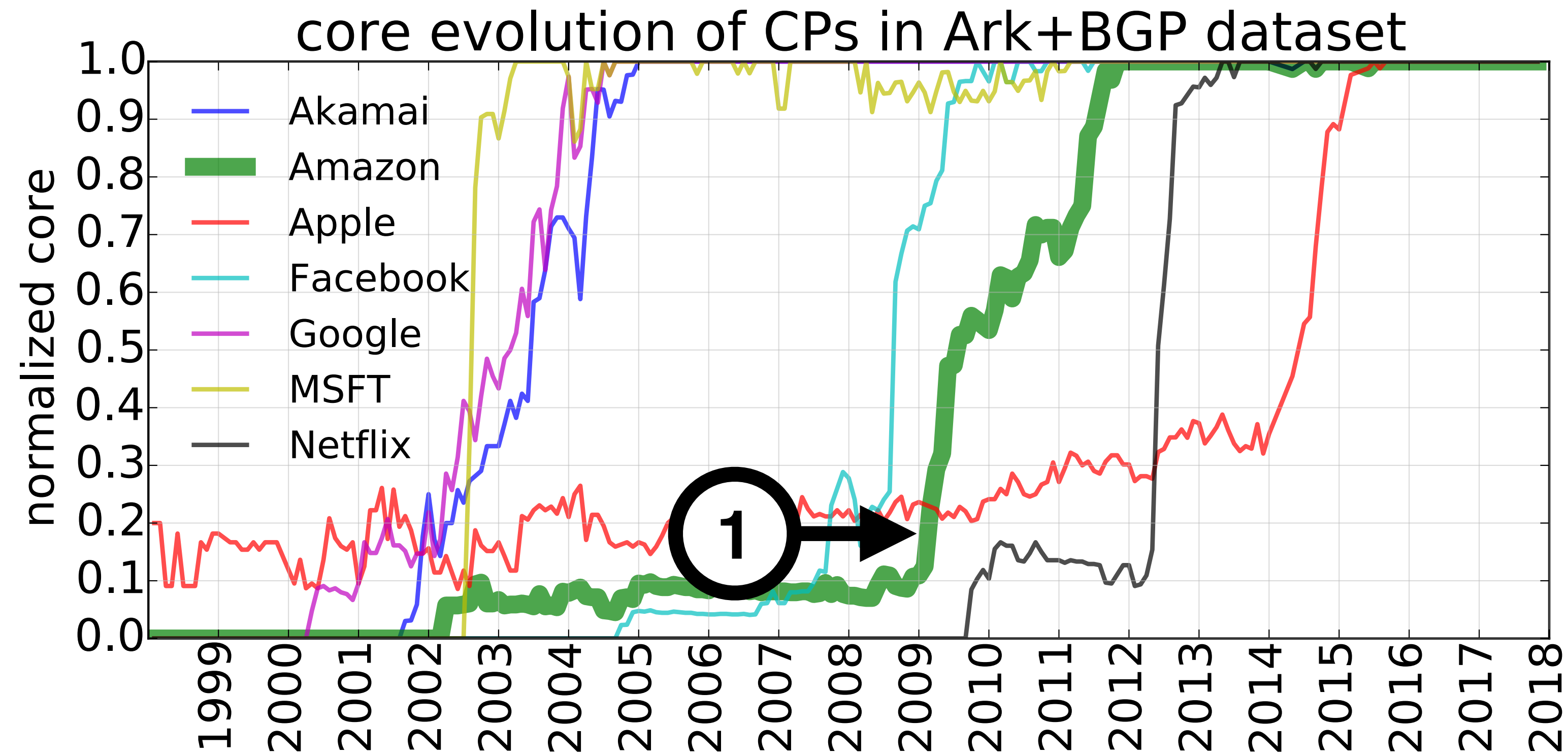
Algunas décadas
en el mercado

Recientemente
retiraron su
contenido desde
CDNs de terceros

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.

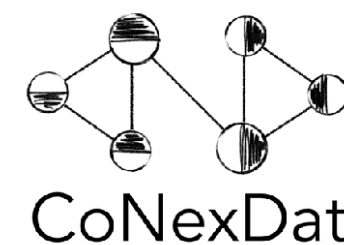


Evolución Amazon

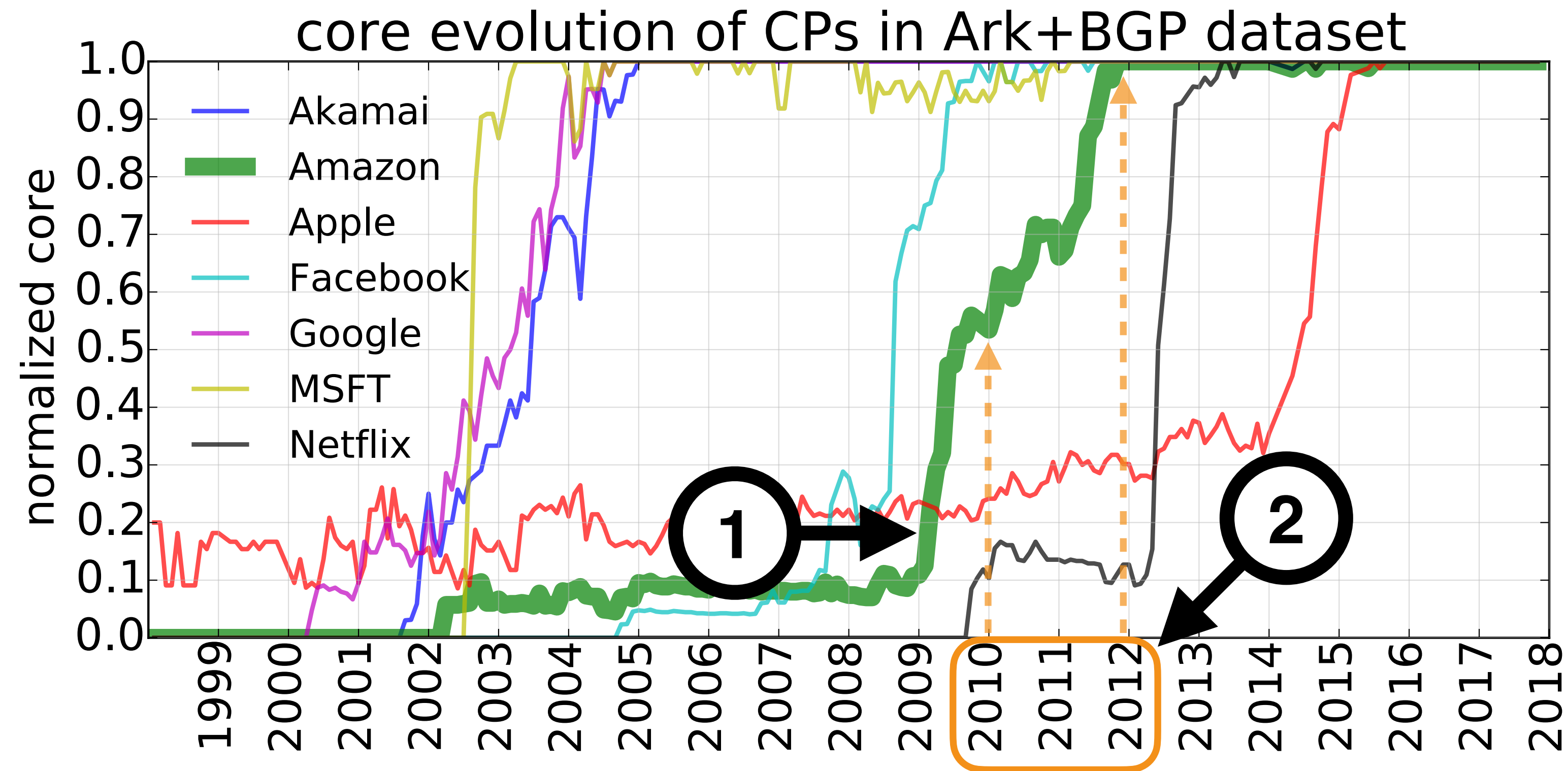


1. Lanzamiento DC en California

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.

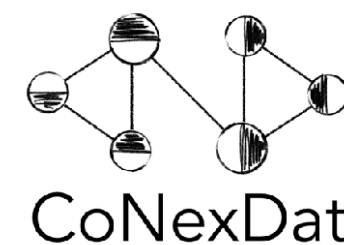


Evolución Amazon

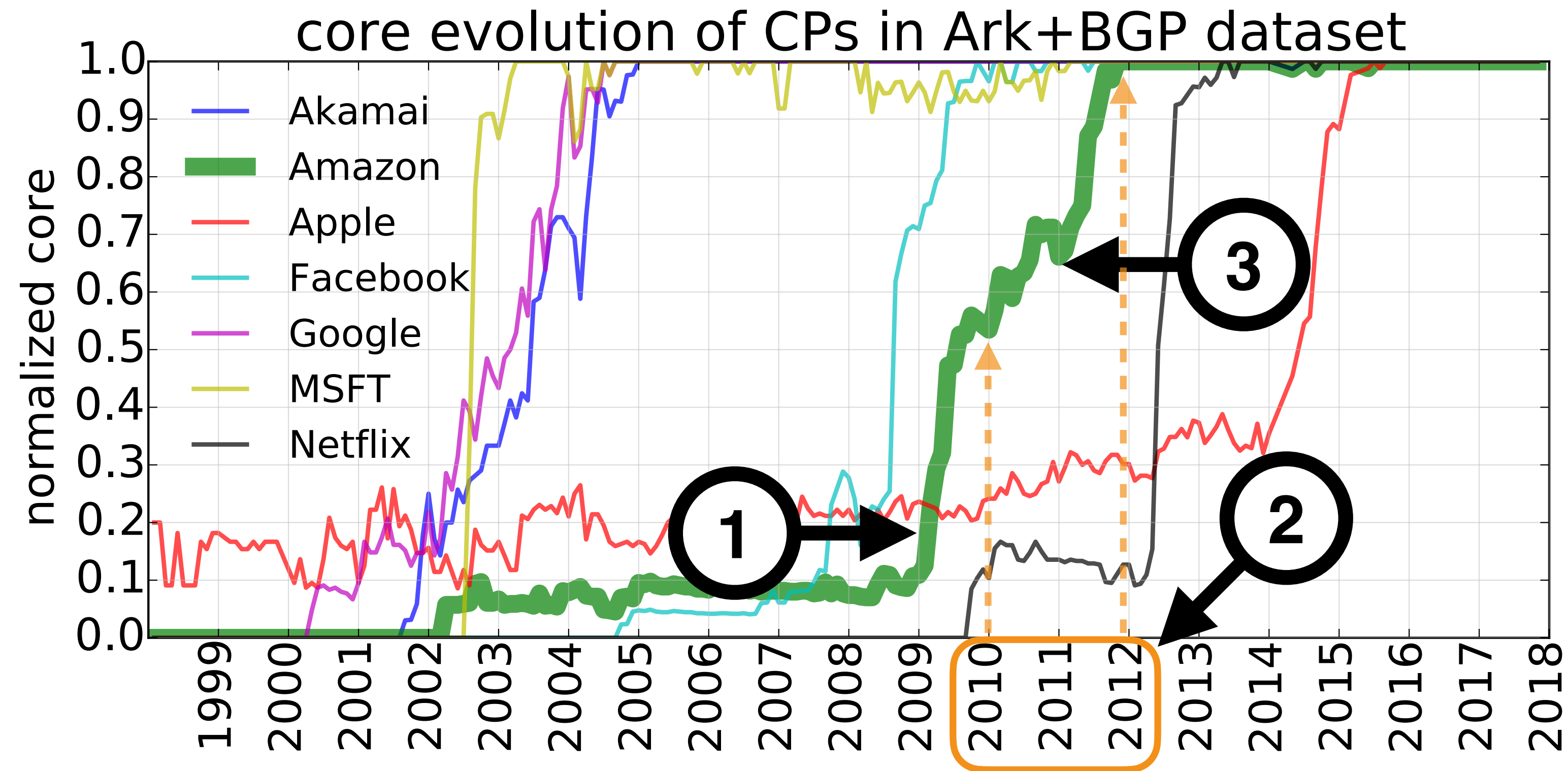


1. Lanzamiento DC en California
2. Expansión internacional (Brasil, Europa & Asia)

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.

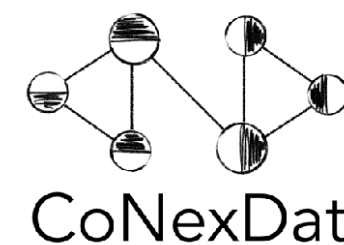


Evolución Amazon

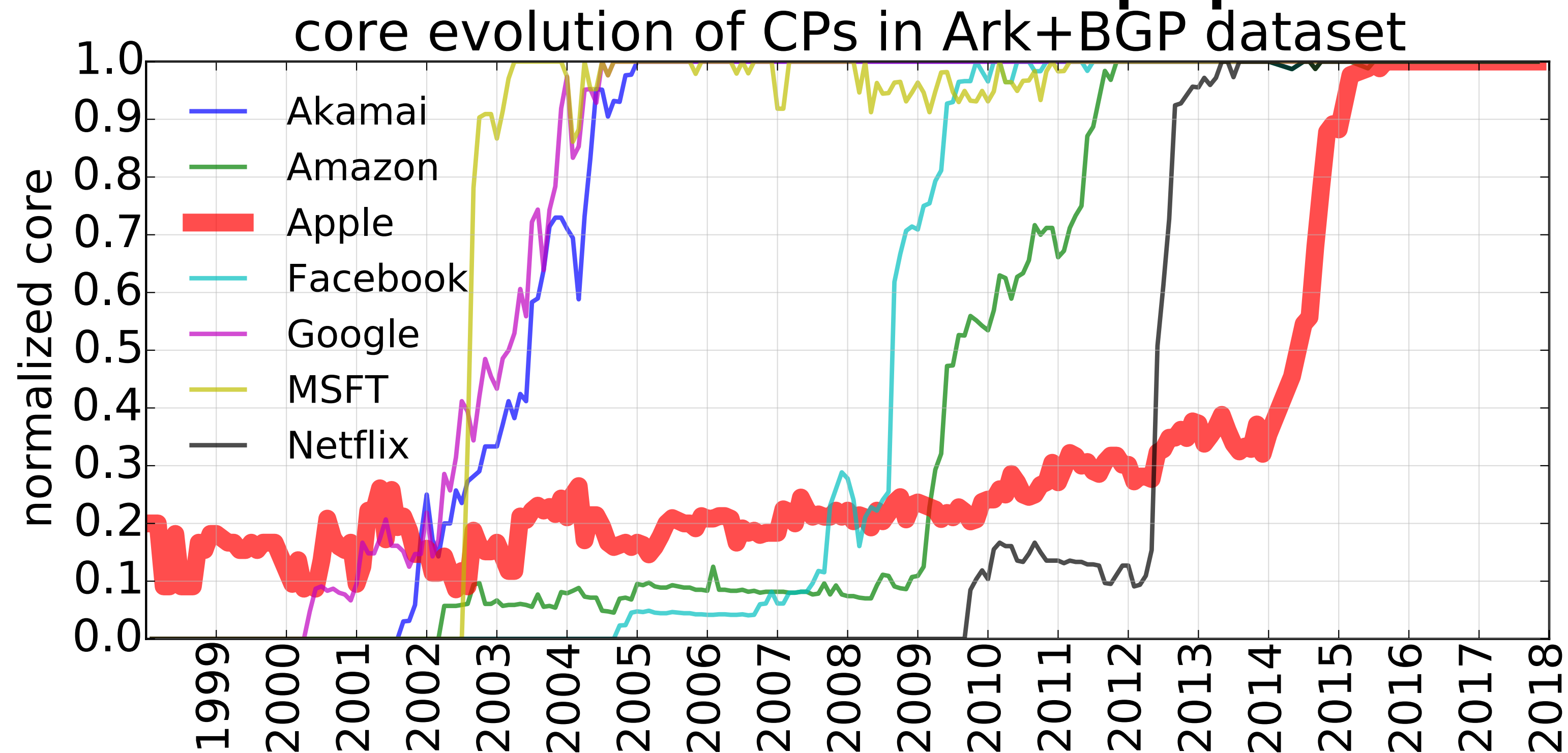


1. Lanzamiento DC en California
2. Expansión internacional (Brasil, Europa & Asia)
3. Creación WHOIS para Amazon NS zone

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.

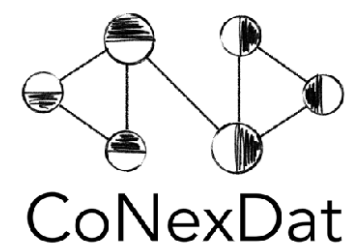


Evolution of Apple

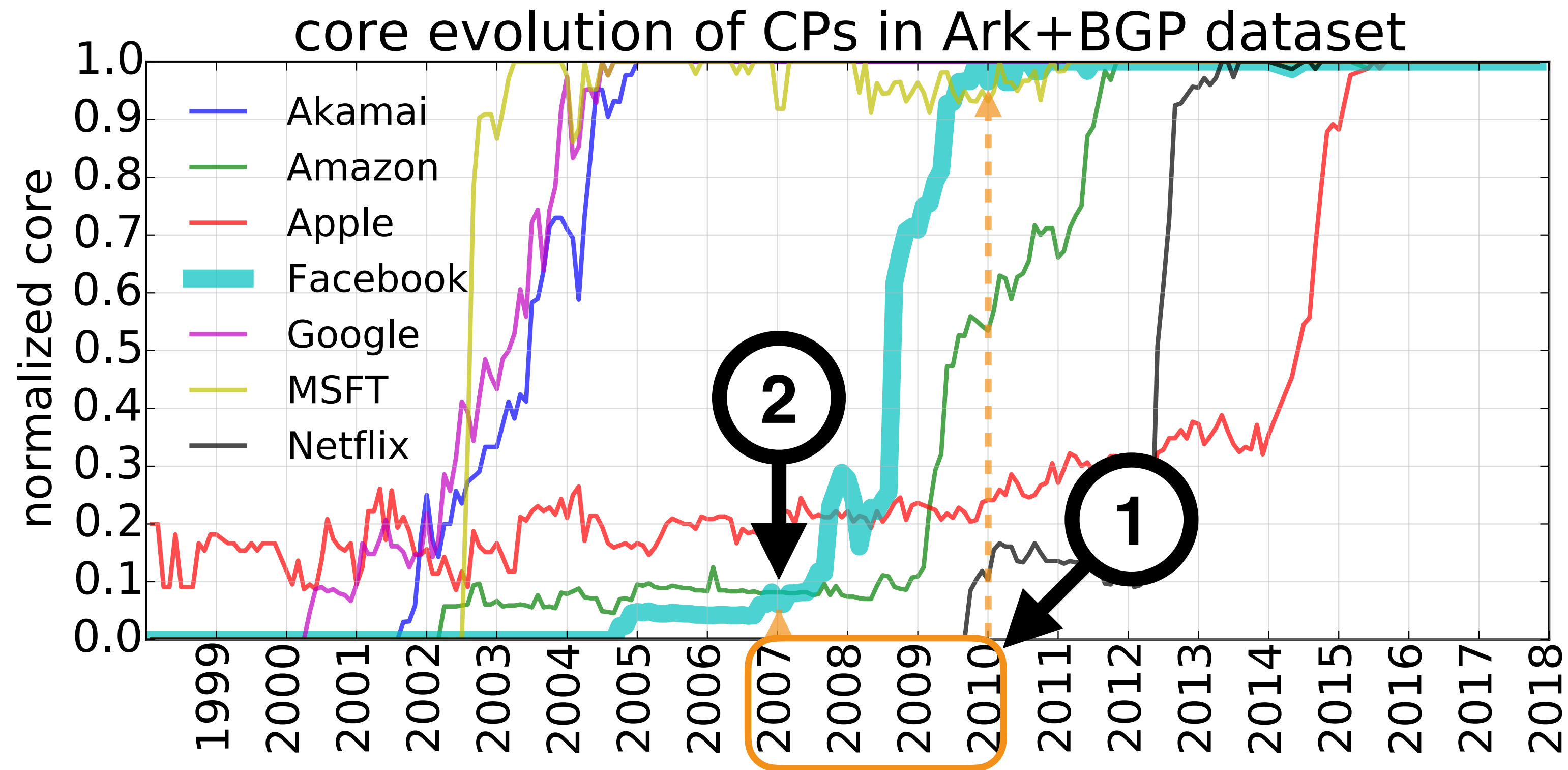


- Crecimiento marcado luego del 2014
- Desafecta contenido de Akamai [45]
- Grandes transferencias por actualización de OS [46]
- Planea competir en el mercado de TV [47]

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.



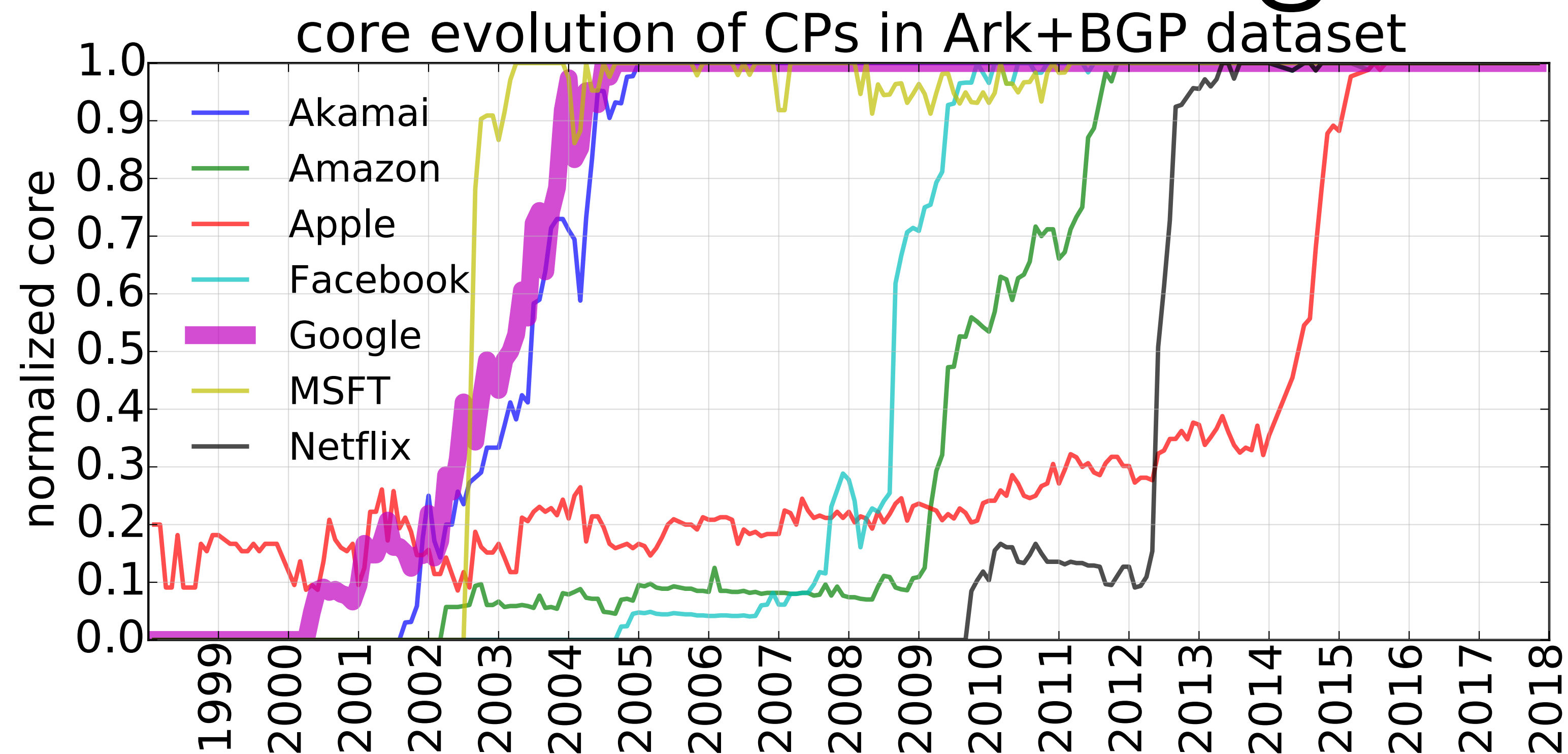
Evolution of Facebook



- Crecimiento de usuarios de Facebook de 12M a 350M
- Creación del registro WHOIS de fbcdn.net

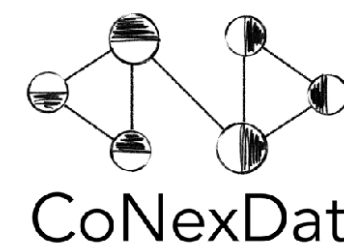
E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.

Evolution of Google

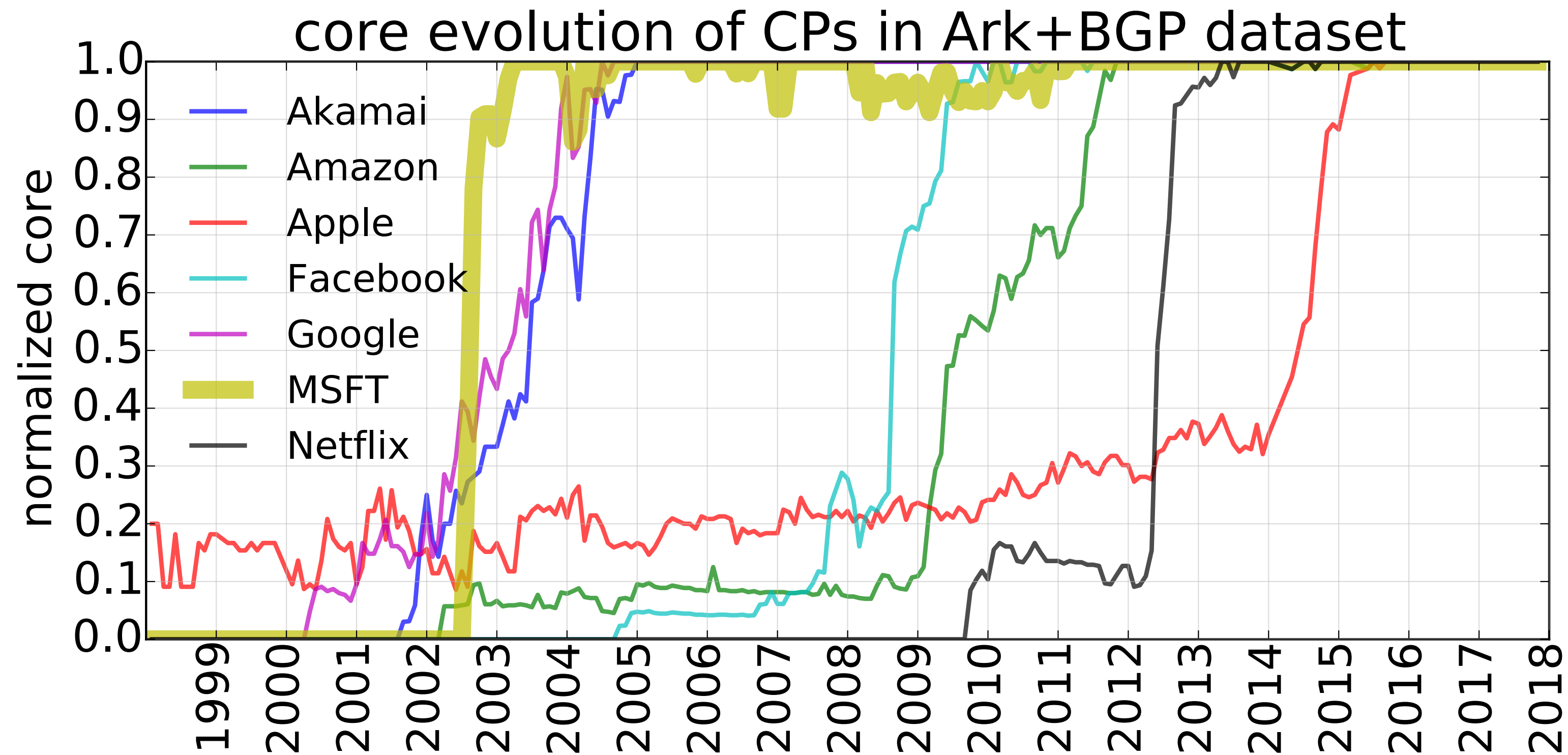


- Alcanzó TOPcore antes de adquirir YouTube en 2006
- Sin CDN en aquel tiempo, pero *peers* con TIER-1s

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.

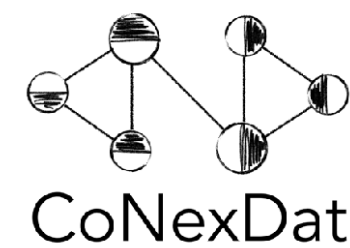


Evolution of Microsoft

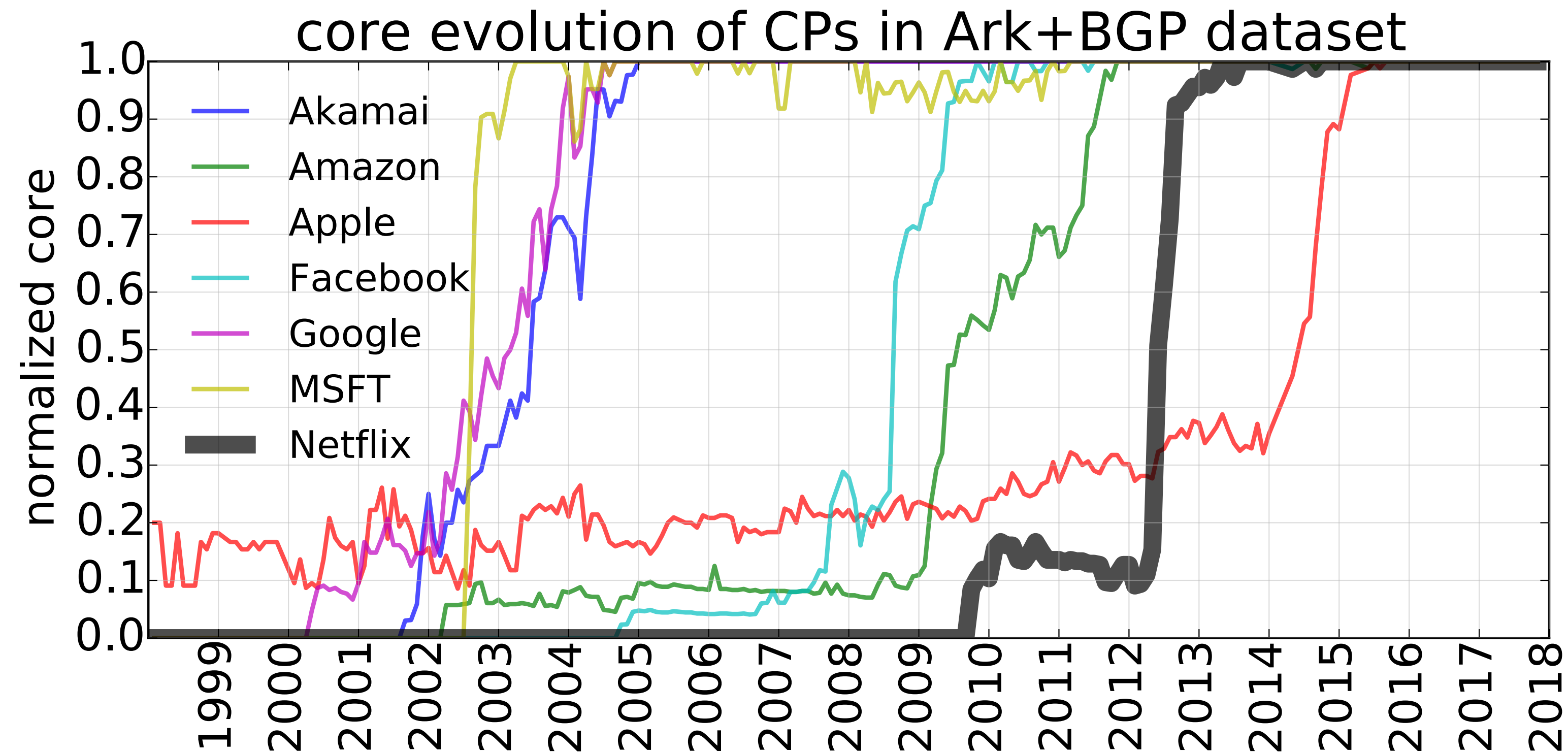


- Provee servicios web desde los 90s
- Ha sacado cierto contenido de Akamai
- Posee varios TIER-1 Transits desde 2000s; tales como Level3 (AS3356), TATA (AS6453), Telefonica (AS12956)

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.

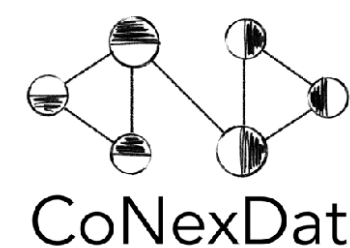


Evolution of Netflix



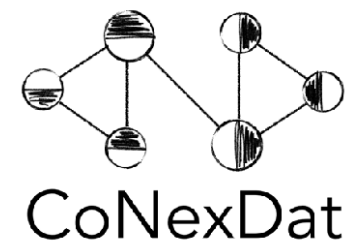
- Gran fuente de tráfico en EE.UU. desde 2011
- En 2012 Netflix movió su contenido de Akamai a su CDN
- El despliegue de OCA llevó a disputas legales con ISPs

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.



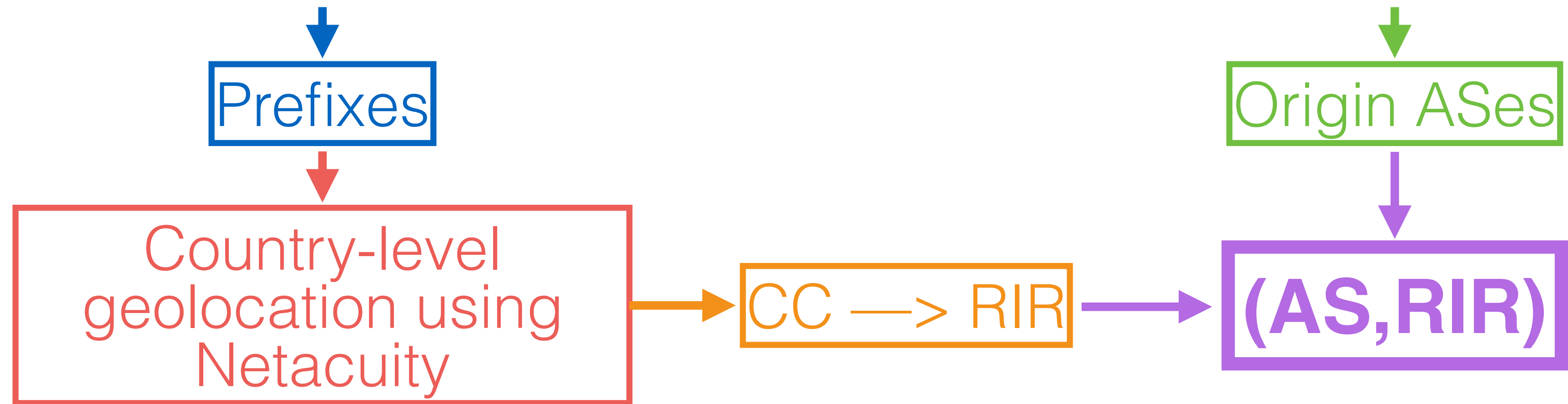
Análisis

1. Evolución de algunos grandes CPs a lo largo de los años
- 2. Diferencias por región**
3. Otros miembros del core



Método de geolocalización de AS basado en RIR

	Network	Next Hop	Metric	LocPrf	Weight	Path
*	0.0.0.0/0	94.156.252.18	0	0	0	34224 3356 i
*	0.0.0.0/0	202.73.40.45	0	0	0	18106 i
*	1.0.4.0/22	195.22.216.188	100	0	0	6762 174 4826 38803 56203 i
*	1.0.4.0/22	5.101.110.2	0	0	0	202018 6939 4826 38803 56203 i
*	157.92.0.0/16	198.129.33.85	1	0	0	293 27750 3597 3449 i
*	157.92.0.0/16	37.139.139.0	0	0	0	57866 1299 19037 11664 3449 i
*	157.92.0.0/16	91.218.184.60	0	0	0	49788 1299 19037 11664 3449 i
*	157.92.0.0/16	162.243.188.2	0	0	0	393406 1299 19037 11664 3449 i
*	157.92.0.0/16	198.58.198.255	0	0	0	1403 1299 19037 11664 3449 i
*	157.92.0.0/16	195.22.216.188	100	0	0	6762 1299 19037 11664 3449 i



Full RIB downloaded from Routeviews: <http://archive.routeviews.org/oix-route-views/2018.01/oix-full-snapshot-2018-01-17-1400.bz2>

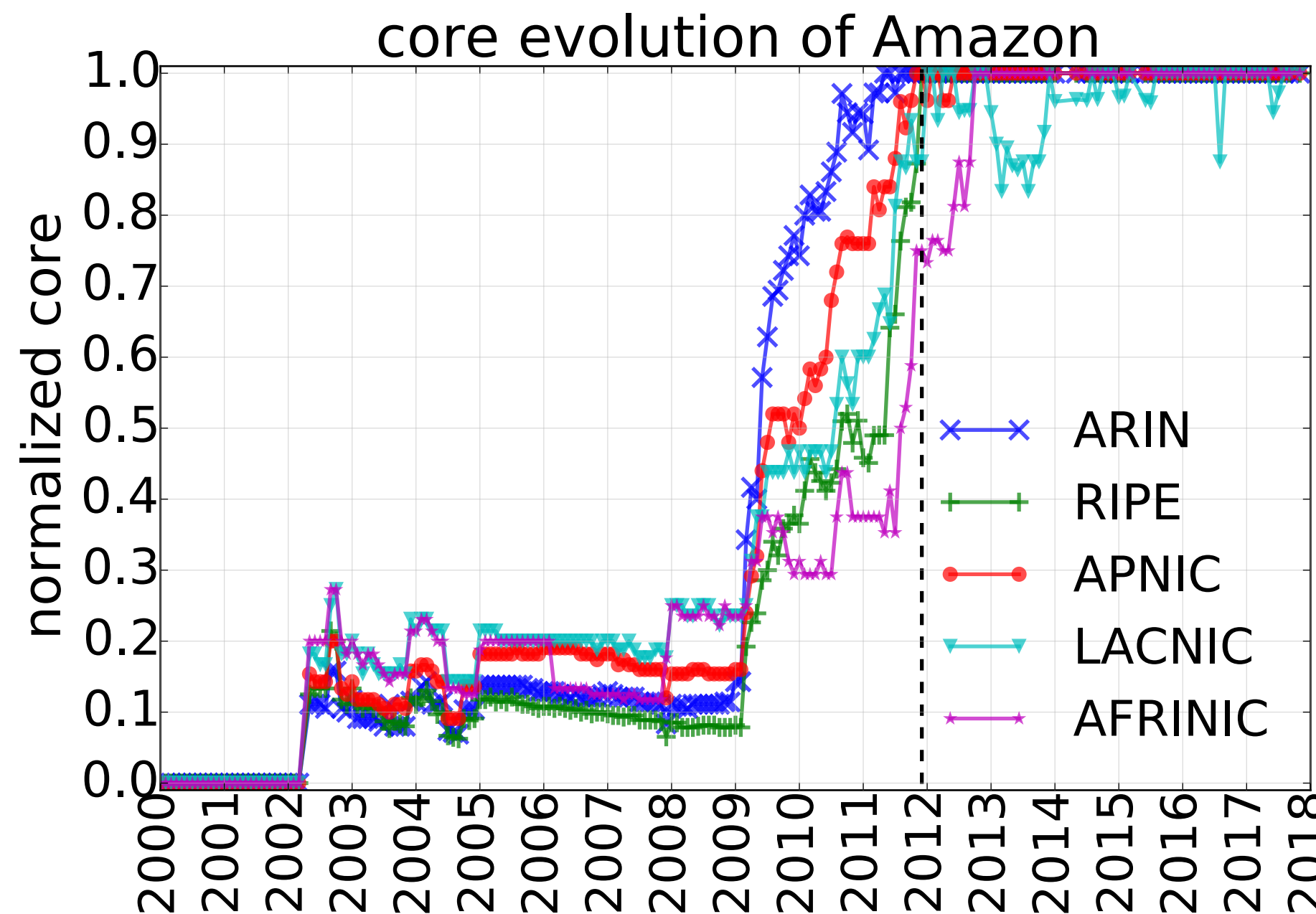
Consideraciones sobre la geolocalización

- CAIDA utiliza la base de datos **Netacuity** desde **fin**es de **2011**
- Encontramos una **demora** entre la **activación** de un AS en una **localidad** particular y su aparición en los **reportes** de **Netacuity** en esa **localidad** (*Netflix @ Brazil*)

Limitaciones de la geolocalización

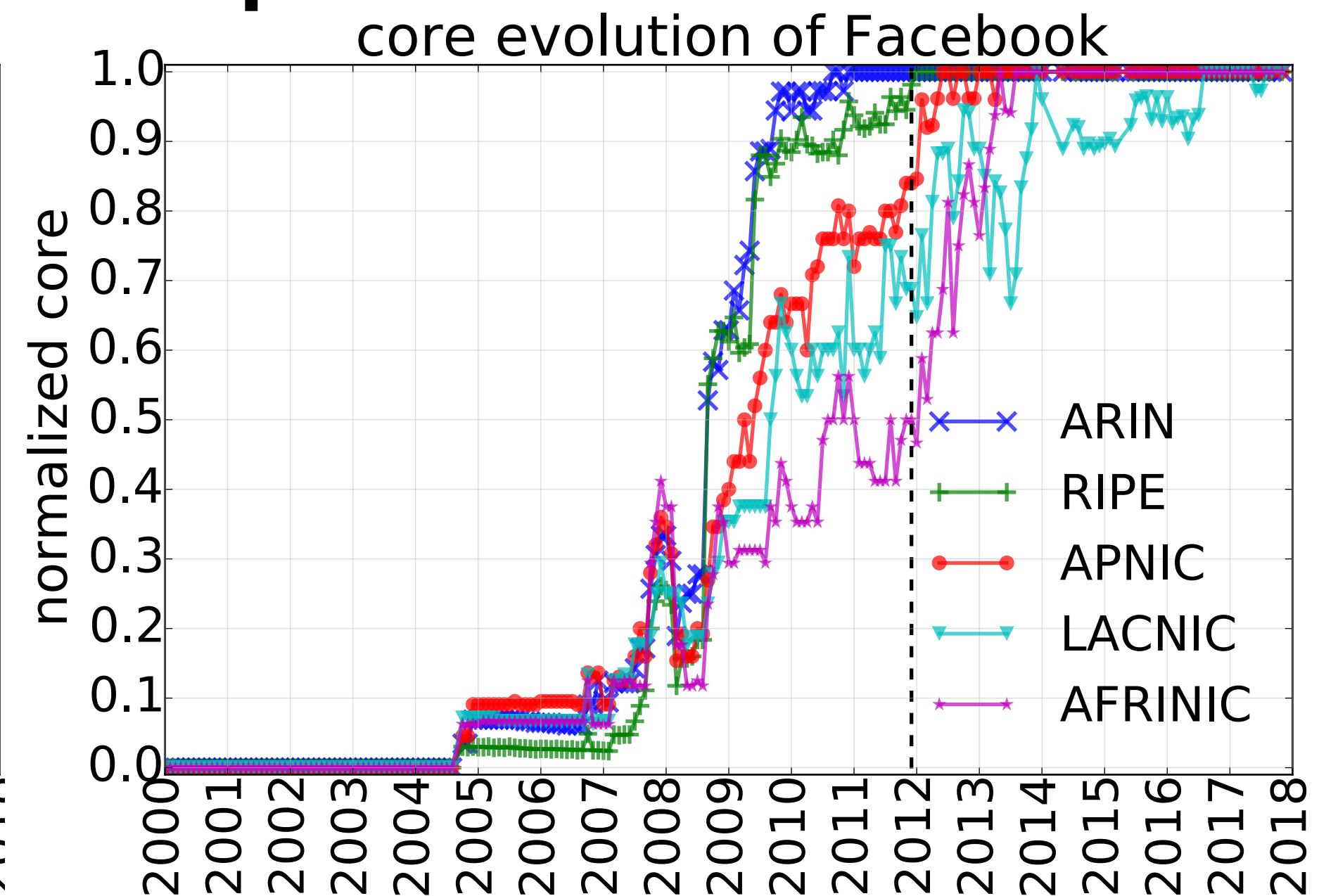
- Consideramos que los Big Seven siempre tuvieron presencia en cada RIR
- Extendemos la información de la geolocalización desde el primer registro disponible (2011) a los años previos (1997-2011)

Diferencias por RIR



Amazon

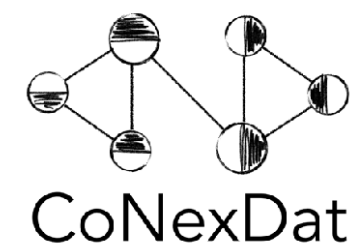
1. 2009: DCs en los US
2. 2010-2012: DCs afuera
 - EU, Asia & Brazil



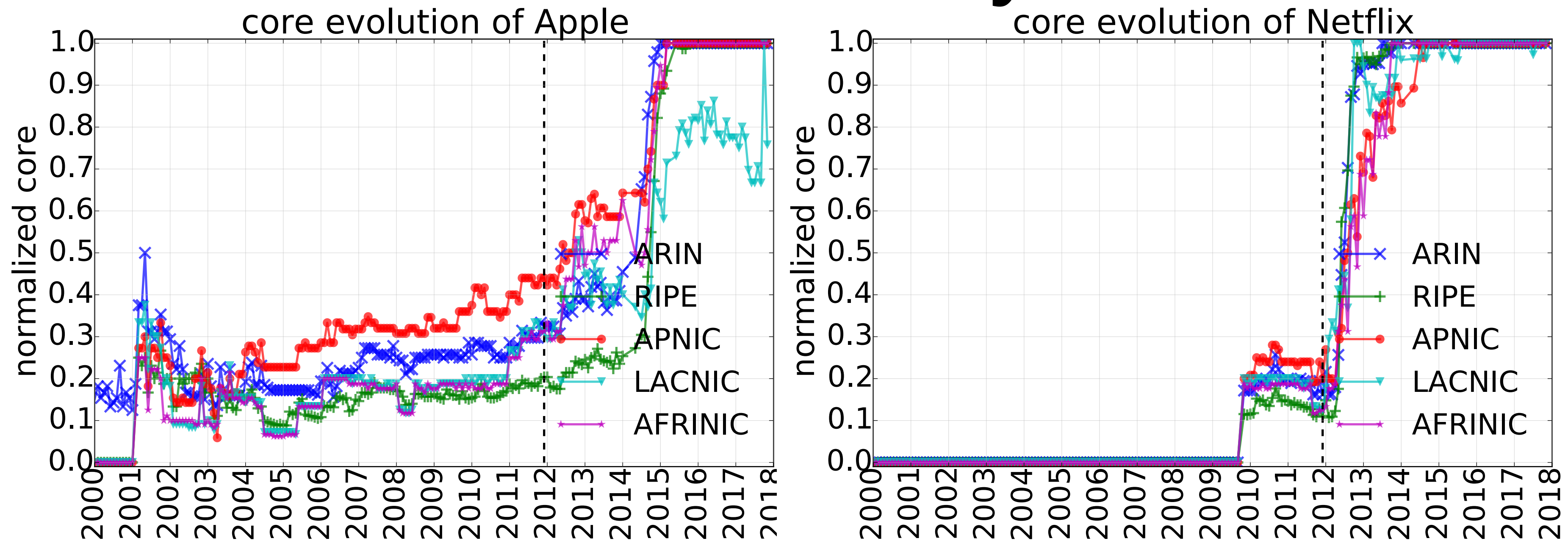
Facebook

In 2011 Facebook reconoce su pobre QoE afuera de US

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.



Differences by RIRs

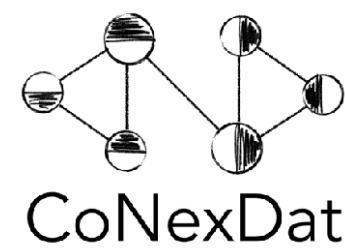


Core regional usando Geolocalización (Netacuity)

Apple and Netflix

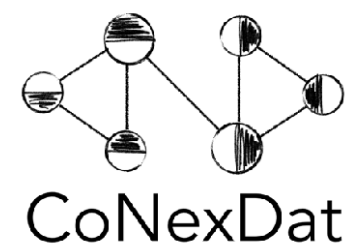
- Both have recently deployed CDNs
- Fairly similar evolution in each RIR

E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.

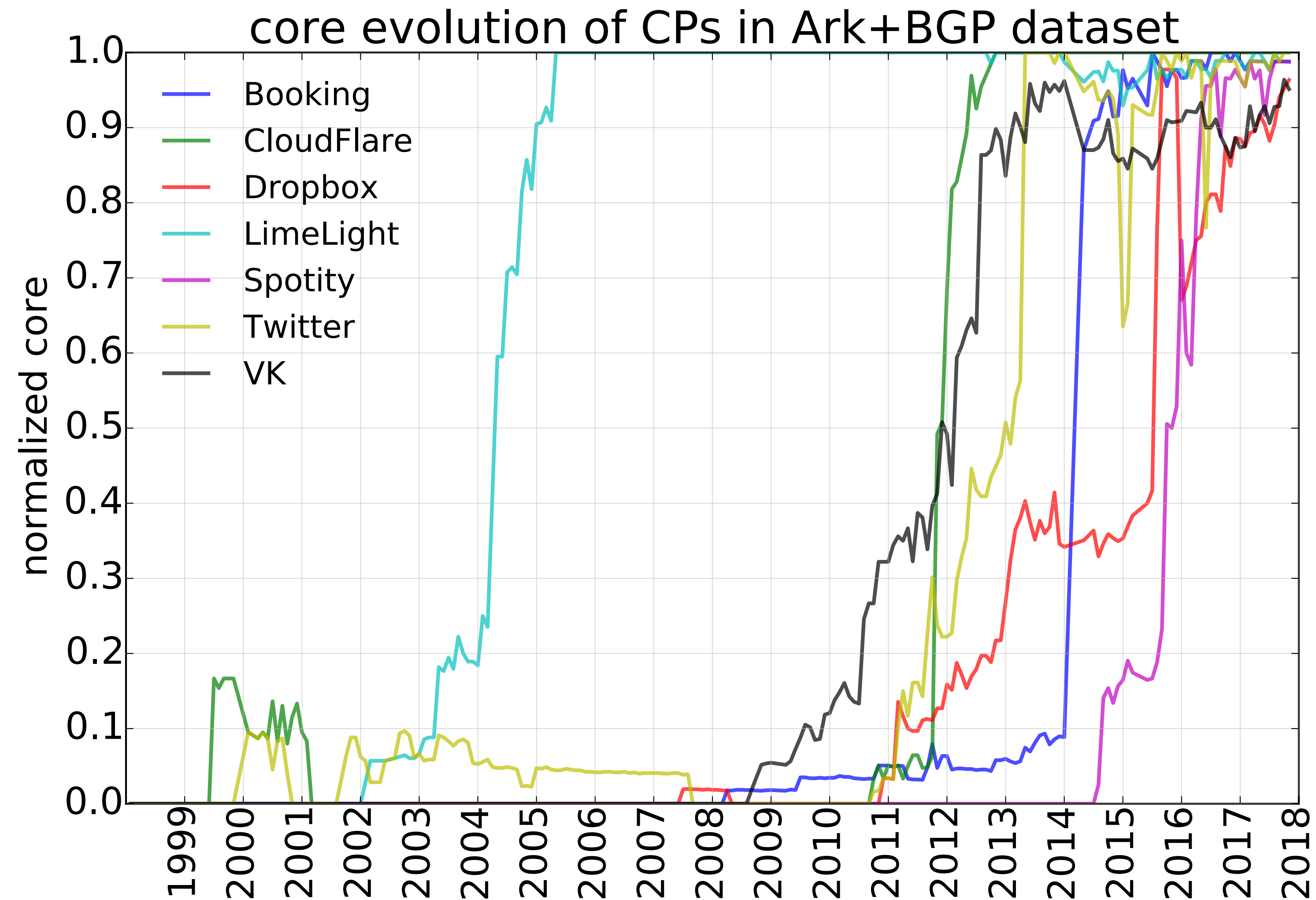


Análisis

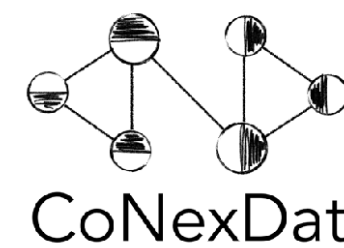
1. Evolución de algunos grandes CPs a lo largo de los años
2. Diferencias por región
- 3. Otros miembros del core**



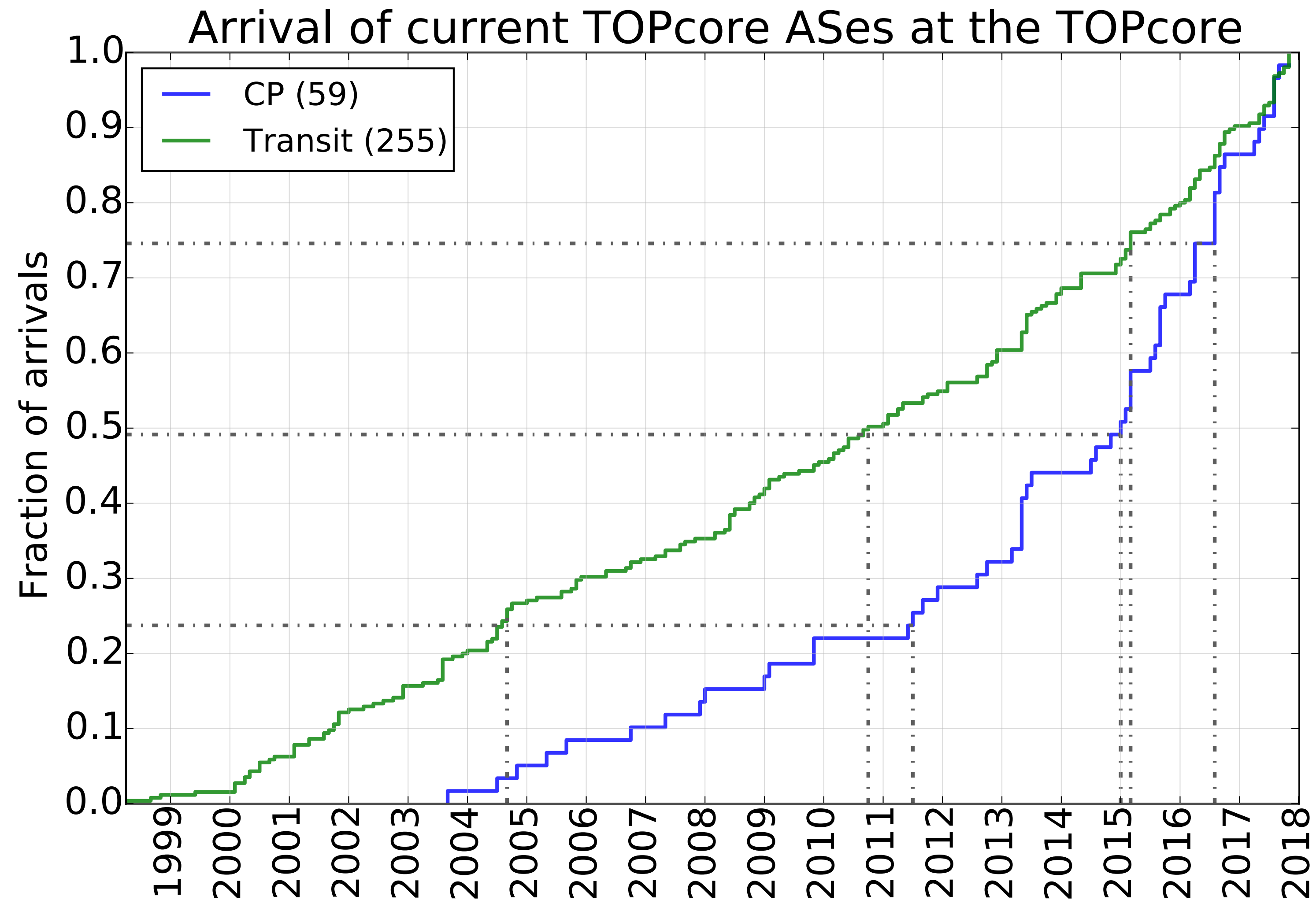
Otros CPs en el core



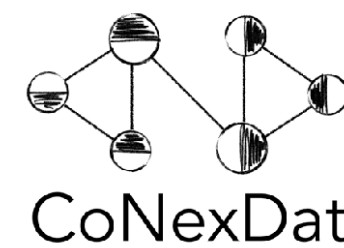
E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.



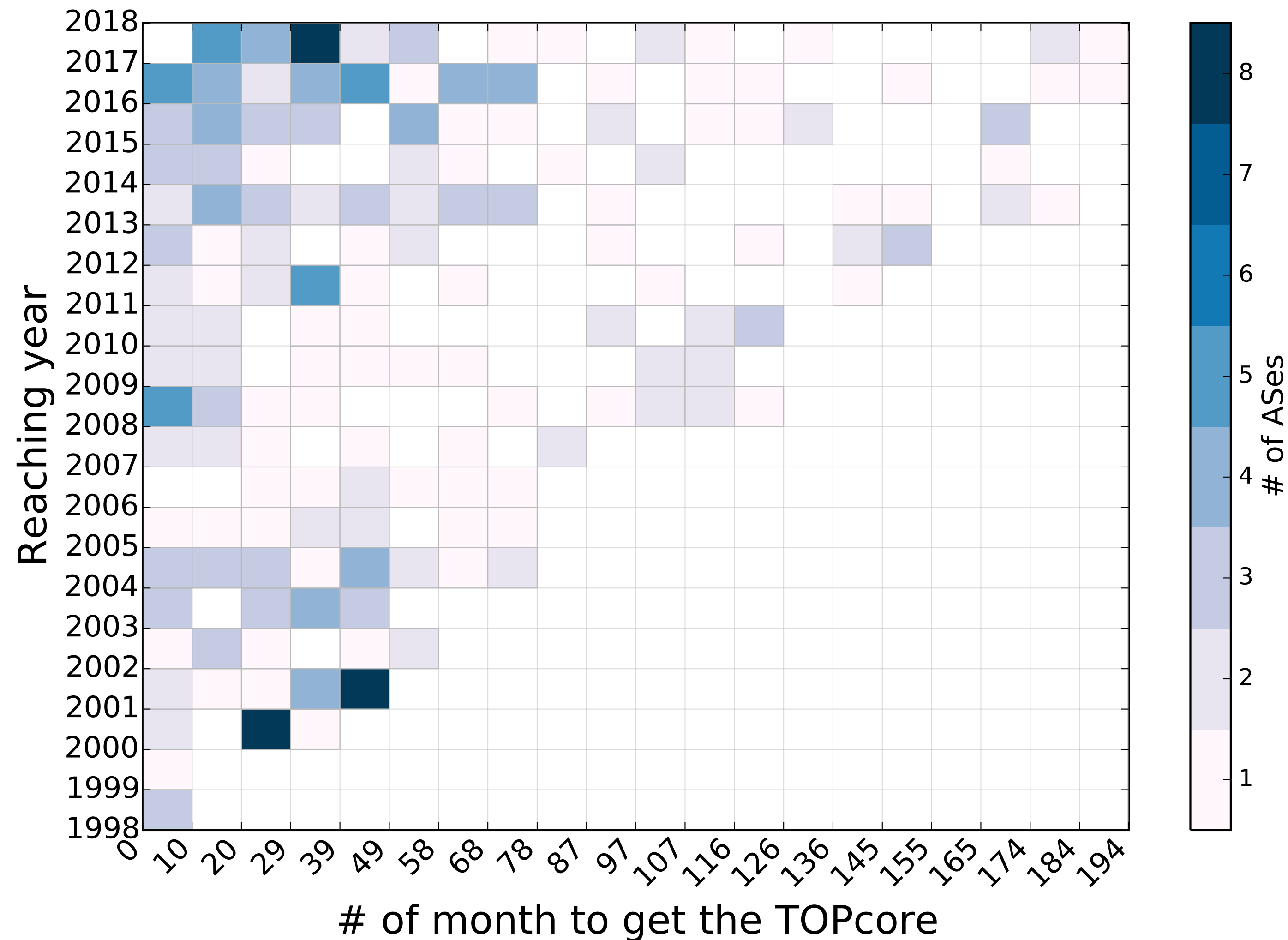
Arribo al core



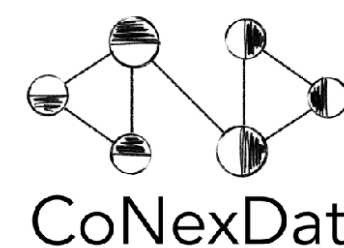
E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.



Arribo al core



E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In 2018 Network Traffic Measurement and Analysis Conference (TMA), pages 1--8, June 2018.



Overview

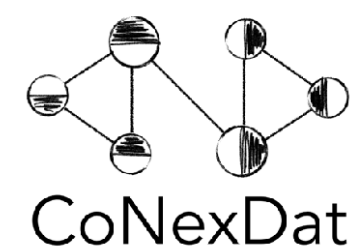
This website goal is to examine the role of the Content Providers in the AS ecosystem after the widespread growth of private CDNs. There is recent evidence that the core of the Internet, which was formerly dominated by large Transit Providers, has been reshaped after the transition to a multimedia-oriented network, first by general-purpose CDNs and now by private CDNs, the so-called *flattening* of the Internet topology. To do so, this website based its methodology on *k*-cores, an element of graph theory, to define which ASes compose the core of the network and to track the evolution of the core since 1999. Applying the *k*-cores technique this website provides two services: i) a graph gallery to visualize the core evolution of *big players* throughout the years ii) an interactive analysis of our datasets to detect, for example, "up and coming" ASes using customized [queries](#).

Graph
Gallery

Custom
Query



Visite: <https://cnet.fi.uba.ar/TMA2018>



cnet.fi.uba.ar

Content Providers towards the core of the network Methodology People

Submit your query

From

Threshold

0.3

month: September year 2007

To

Threshold

0.9

month: July year 2011

Maximum months of grow

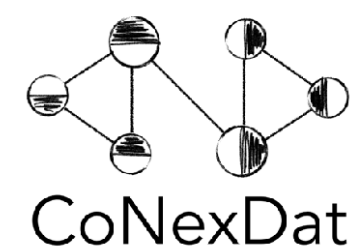
12

Submit

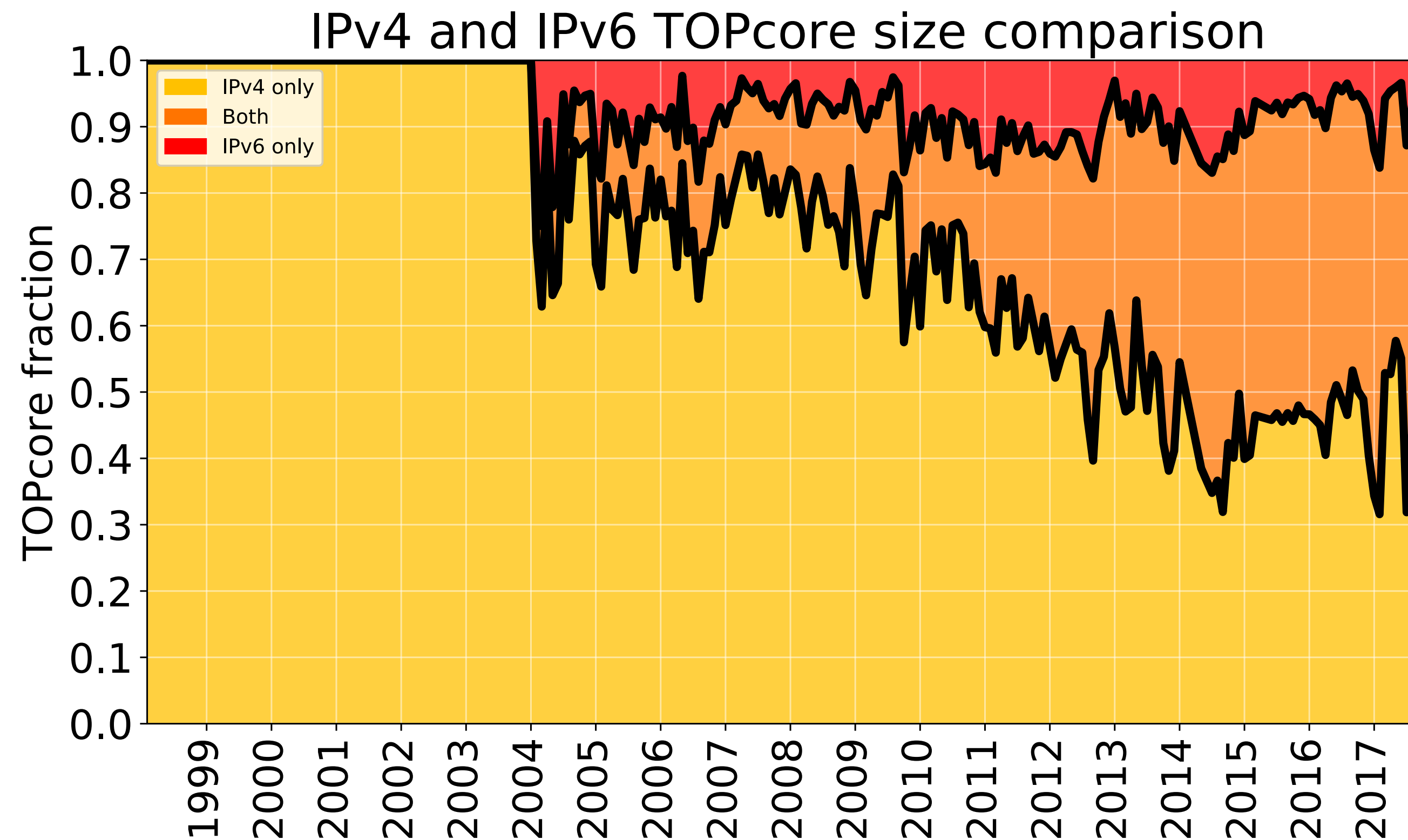


This website was developed by [CoNexDat](#). This template has not been developed by us and it is available on [GitHub](#).

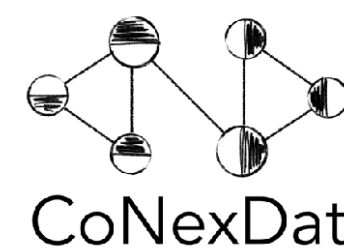
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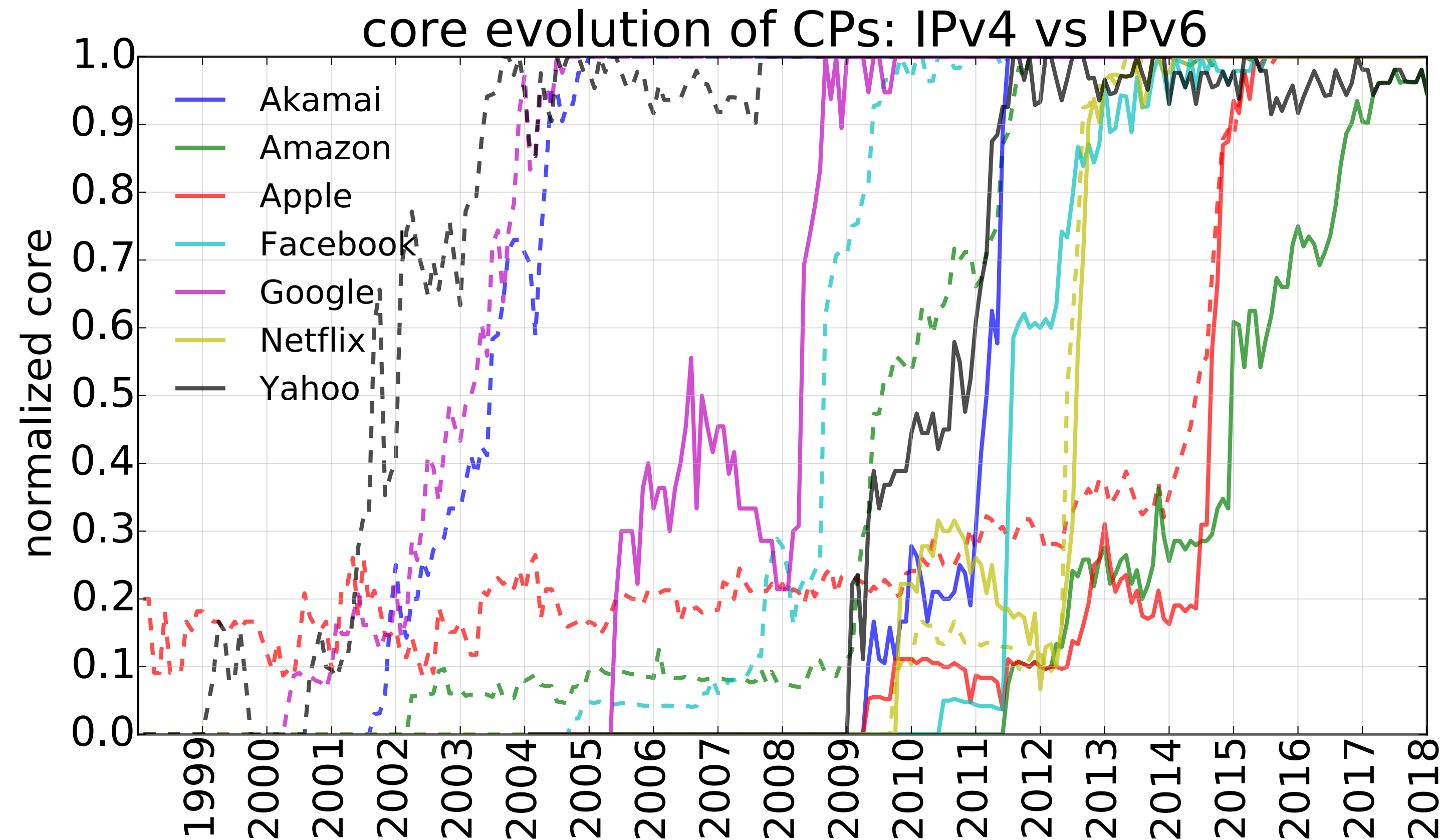
Evolución del core en IPv6



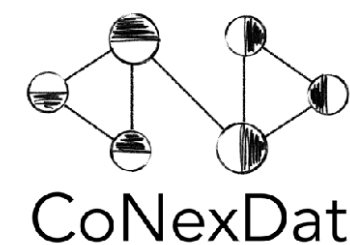
Esteban Carisimo, Carlos Selmo, J. Ignacio Alvarez-Hamelin, and Amogh Dhamdhere. Studying the evolution of content providers in IPv4 and IPv6 internet cores. *Computer Communications*, 145:54 -- 65, 2019.



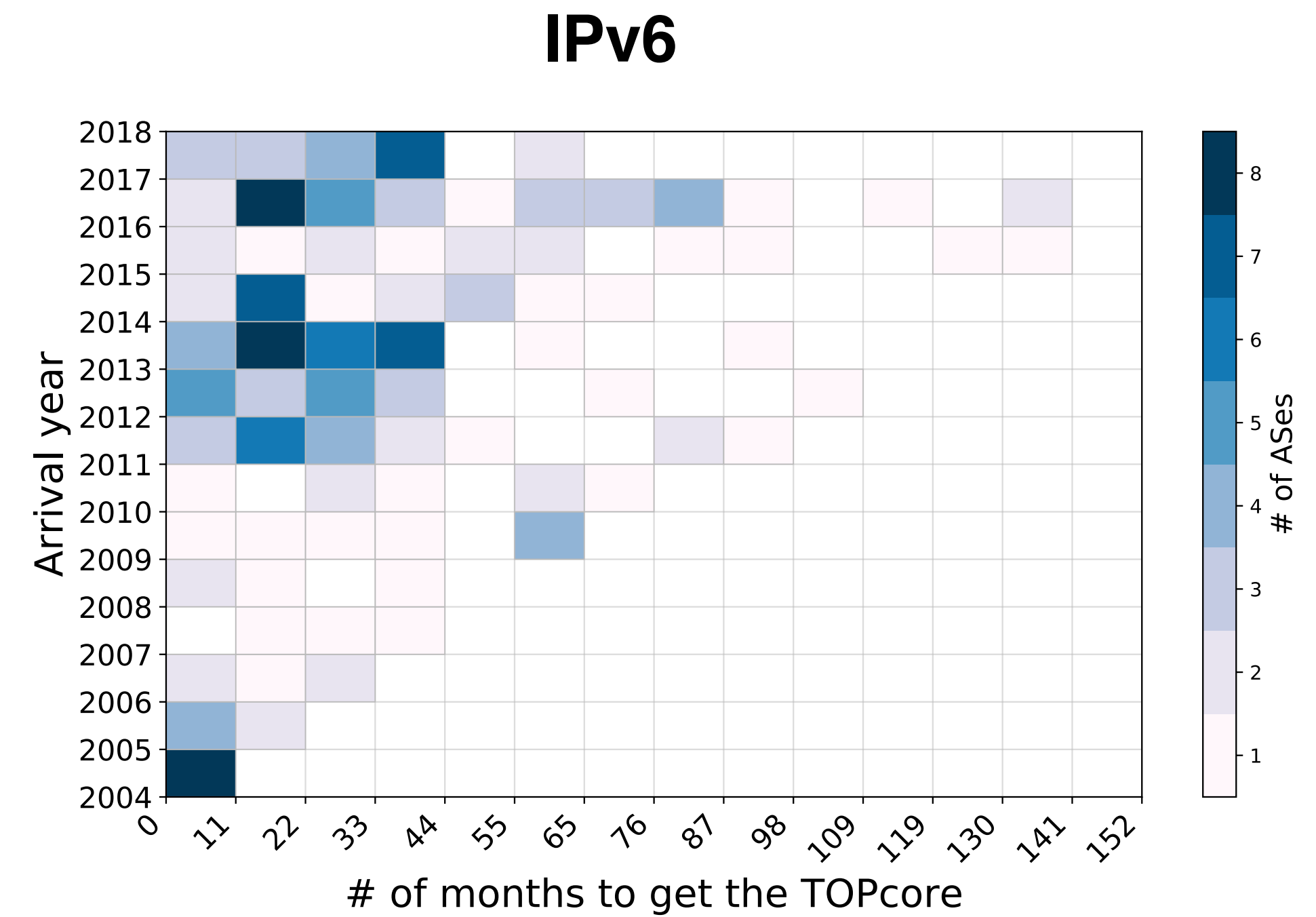
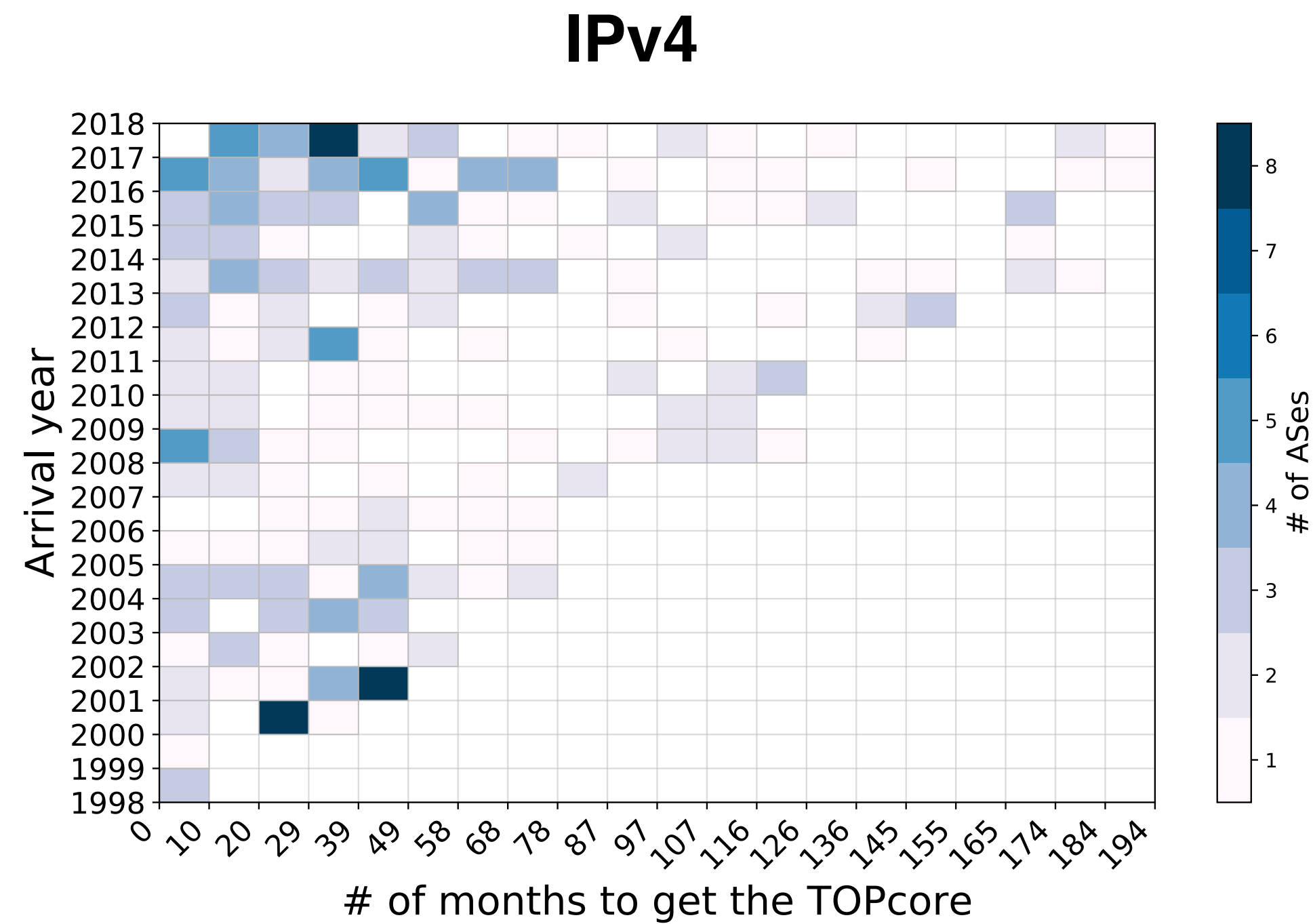
Evolución del core en IPv6



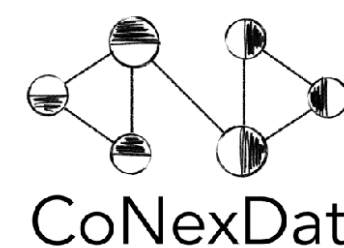
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Evolución del core en IPv6



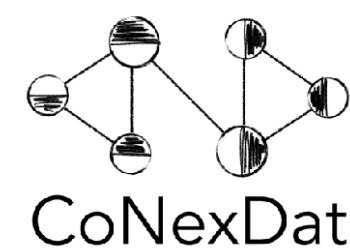
Esteban Carisimo, Carlos Selmo, J. Ignacio Alvarez-Hamelin, and Amogh Dhamdhere. Studying the evolution of content providers in IPv4 and IPv6 internet cores. *Computer Communications*, 145:54 -- 65, 2019.



Conclusiones

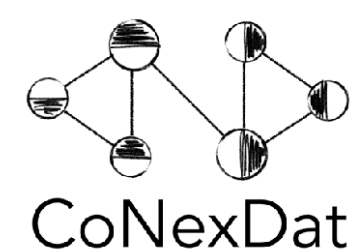
- Grandes **CPs** desplegaron y manejan **ASes** densamente conectados
- **Contenido** se esta moviendo a **CDNs** privadas
- Prueba de **crecimiento** de **CDNs privadas** con estrategias comerciales vistas

Muchas gracias por su atención



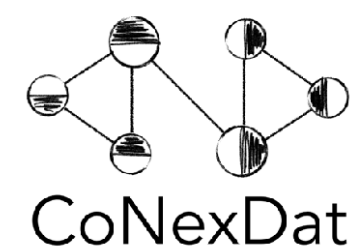
:: IEEE ComSoc Argentina Open Webinar ::
27/11/2020 :: J. Ignacio Alvarez-Hamelin

- [1] Esteban Carisimo, Carlos Selmo, J. Ignacio Alvarez-Hamelin, and Amogh Dhamdhere. Studying the evolution of content providers in ipv4 and ipv6 internet cores. *Computer Communications*, 145:54 -- 65, 2019. [bib | DOI | .pdf]
- [2] Tomás Mussi Reyero, José Ignacio Alvarez-Hamelin, and Mariano Gastón Beiró. Topic-based study of a Twitter political network. Technical report, NetSciX2019, Jan 2019. [bib | .html]
- [3] Jose Alvarez-Hamelin, David Samaniego, Alfredo Ortega, and Ruediger Geib. Synchronizing internet clock frequency protocol (sic). Internet-Draft draft-alvarez-hamelin-tictoc-sic-02, IETF Secretariat, October 2018. <http://www.ietf.org/internet-drafts/draft-alvarez-hamelin-tictoc-sic-02.txt>. [bib | .txt]
- [4] Jose Alvarez-Hamelin, Alfred Morton, Joachim Fabini, Carlos Pignataro, and Ruediger Geib. Advanced unidirectional route assessment (aura). Internet-Draft draft-ietf-ippm-route-03, IETF Secretariat, October 2018. <http://www.ietf.org/internet-drafts/draft-ietf-ippm-route-03.txt>. [bib | .txt]
- [5] Diego Kiedanski, Eduardo Grampín, and J. Ignacio Alvarez-Hamelin. The Atlas Vision of IPv6 in Latin America: Topology and Latency. In *Proceedings of the 10th Latin America Networking Conference, LANC '18*, pages 40--47, New York, NY, USA, 2018. ACM. [bib | DOI | http]
- [6] E. Carisimo, C. Selmo, J. I. Alvarez-Hamelin, and A. Dhamdhere. Studying the evolution of content providers in the internet core. In *2018 Network Traffic Measurement and Analysis Conference (TMA)*, pages 1--8, June 2018. [bib | DOI]
- [7] P. Etchepareborda, M. E. Bierzychudek, L. Carducci, F. E. Veiras, F. G. Zacchigna, E. Corbellini, S. G. Marra, M. Iglesias, M. M. Teggia, J. I. Alvarez-Hamelin, and R. A. Veiga. A project-based learning method applied to an introductory course in electronics engineering. In *2018 IEEE World Engineering Education Conference (EDUNINE)*, pages 1--4, March 2018. [bib | DOI]
- [8] Esteban Carisimo, Sebastián Grynberg, and José Ignacio Alvarez-Hamelin. Influence of traffic in stochastic behavior of latency. In *7th PhD School on Traffic Monitoring and Analysis (TMA)*, Ireland, Dublin, June 2017. [bib | .pdf]
- [9] Yannick Leo, Eric Fleury, J. Ignacio Alvarez-Hamelin, Carlos Sarraute, and Márton Karsai. Socioeconomic correlations and stratification in social-communication networks. *Journal of the Royal Society Interface*, 13(125):0598, 2016. [bib | DOI | http]
- [10] Eduardo Mucelli Rezende Oliveira, Aline Carneiro Viana, Carlos Sarraute, Jorge Brea, and Ignacio Alvarez-Hamelin. On the regularity of human mobility. *Pervasive and Mobile Computing*, (33):73--90, 2016. [bib | DOI | http]
- [11] Sofía Silva Berenguer, Esteban Carisimo, J. Ignacio Alvarez-Hamelin, and Francisco Valera Pintor. Hidden Internet Topologies Info: Truth or Myth? In *Proceedings of the 2016 Workshop on Fostering Latin-American Research in Data Communication Networks, LANCOMM '16*, pages 4--6, New York, NY, USA, 2016. ACM. [bib | DOI | .pdf]
- [12] Gabriel Davila Revelo, Mauricio Anderson Ricci, Benoit Donnet, and José Ignacio Alvarez-Hamelin. Unveiling the mpls structure on internet topology. In *Traffic Monitoring and Analysis Workshop (TMA)*, Belgium, Louvain La Neuve, April 2016. [bib | .pdf]
- [13] Esteban Carisimo, Sebastián Grynberg, and José Ignacio Alvarez-Hamelin. Revisiting RTT models. In *6th PhD School on Traffic Monitoring and Analysis (TMA)*, Belgium, Louvain La Neuve, April 2016. [bib | .pdf]
- [14] Mariano G Beiró, Sebastián P Grynberg, and J Ignacio Alvarez-Hamelin. Router-level community structure of the Internet Autonomous Systems. *EPJ Data Science*, 04(12):1--22, 2015. [bib | DOI | http]
- [15] Esteban Carisimo, Hernan Galperin, and José Ignacio Alvarez-Hamelin. A new intrinsic way to measure IXP performance: an experience in Bolivia. *arXiv e-print*, abs/1505.00837, May 2015. [bib | http]
- [16] Carlos Sarraute, Jorge Brea, Javier Burroni, Klaus Wehmuth, Arthur Ziviani, and José I Alvarez Hamelin. Social events in a time-varying mobile phone graph. In *Simposio Argentino de GRANdes DATos (AGRANDA 2015)-JAIIO 44 (Rosario, 2015)*, 2015. [bib]
- [17] Yannick Leo, Eric Fleury, Carlos Sarraute, José Ignacio Alvarez-Hamelin, and Márton Karsai. Socioeconomic correlations in communication networks. In *Fourth conference on the Analysis of Mobile Phone Datasets (NetMob 2015)*, <hal-01134295, MIT Media Lab, United States, April 2015. [bib | http]



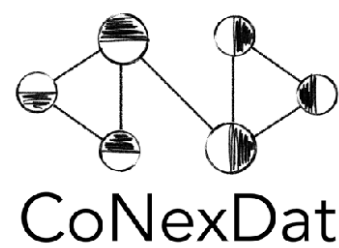
:: IEEE ComSoc Argentina Open Webinar ::
27/11/2020 :: J. Ignacio Alvarez-Hamelin

- [18] Hernán Galperin, José Ignacio Alvarez-Hamelin, and Maria Fernanda Vicens. Do Internet Exchange Points Really Matter? Evidence from Bolivia. In *2014 TPRC Conference*, page 33, Arlington, VA, September 2014. TPRC. [bib | http]
- [19] Ernesto Corbellini, Sebastián García Marra, Marcos Bierzychudek, Ariel Burman, Daniel Cabibbo, Leonardo Carducci, Francisco Veiras, Ignacio Alvarez-Hamelin, and Ricardo Veiga. Aplicación de las tic en un curso con metodología de trabajo centrada en clases íntegramente de laboratorio. In *I Jornada de Integración de las TIC en la Enseñanza de la Ingeniería*, page 2, Ciudad de Buenos Aires, Noviembre 2014. Facultad de Ingeniería. [bib | http]
- [20] José Ignacio ALVAREZ HAMELIN, Victor Alexis BETTACHINI, and Alfredo ORTEGA. Device and Method for the Secure Transmission of Data over Z-Channels Using CDMA (P11104EPPC). EPO, July 2014. [bib | www:]
- [21] Alfredo A. Ortega, Víctor A. Bettachini, Pablo I. Fierens, and Jos'e Ignacio Alvarez-Hamelin. Encrypted CDMA audio network. *Journal of Information Security*, 05(03):73--82, 2014. [bib | DOI | http]
- [22] Roberto P.J. Perazzo, Laura Hernández, Horacio Ceva, Enrique Burgos, and José Ignacio Alvarez-Hamelin. Study of the influence of the phylogenetic distance on the interaction network of mutualistic ecosystems. *Physica A: Statistical Mechanics and its Applications*, 394(0):124 -- 135, 2014. [bib | DOI | http]
- [23] Pol Colomer de Simon, M.Angel Serrano, Mariano G. Beiró, J. Ignacio Alvarez-Hamelin, and Marian Boguñá. Deciphering the global organization of clustering in real complex networks. *Sci. Rep.*, 3:2517, Aug 2013. [bib | http]
- [24] Mariano G. Beiró, Jorge R. Busch, Sebastian P. Grynberg, and J. Ignacio Alvarez-Hamelin. Obtaining communities with a fitness growth process. *Physica A: Statistical Mechanics and its Applications*, 392(9):2278 -- 2293, 2013. [bib | DOI | http]
- [25] AA Ortega, VA Bettachini, JI Alvarez-Hamelin, and DF Grosz. Hamming-weight minimisation coding for cdma optical access networks with enhanced security. In *Future Generation Communication Technology (FGCT), 2012 International Conference on*, pages 185--189. IEEE, 2012. [bib | DOI | .pdf]
- [26] José Ignacio ALVAREZ HAMELIN, Victor Alexis BETTACHINI, and Alfredo ORTEGA. Device and Method for the Secure Transmission of Data over Z-Channels Using CDMA (WO2013084172). PCT, 12 2012. [bib | http]
- [27] A. A. Ortega, V. A. Bettachini, and J. I. Alvarez-Hamelin. CDMA time-hopping optical network with enhanced securit. *Journal of E-Technology*, 3(4):196--204, November 2012. [bib | http]
- [28] Esteban Sergio Poggio and J. Ignacio Alvarez-Hamelin. Enriched internet topology. In *41 Jornadas Argentinas de Informática e Investigación Operativa-Argentine Symposium on Computing Technology (JAIIO-AST '12)*, pages 13--24, La Plata, Argentina, 2012. SADIO. [bib | .pdf]
- [29] Roberto Perazzo, Laura Hernandez, Horacio Ceva, Enrique Burgos, and José Ignacio Alvarez-Hamelin. The organisation of mutualistic ecosystems: Phylogenetic proximity and nestedness. In *ECCS - European Confrence in Complex Systems*, pages 53--, Brussels, Belgium, September 2012. INRIA. [bib | .pdf]
- [30] Beiró Mariano Gastón, Jorge Rodolfo Busch, Sebastian P. Grynberg, and José Ignacio Alvarez-Hamelin. Obtaining communities with a fitness growth process. *arXiv e-print*, abs/1206.1313, Jun 2012. [bib | http]
- [31] José Ignacio Alvarez-Hamelin. Is it possible to find the maximum clique in general graphs? *arXiv e-print*, abs/1110.5355, Oct 2011. [bib | http]
- [32] J. Ignacio Alvarez-Hamelin, Mariano G. Beiró, and Jorge R. Busch. Understanding Edge Connectivity in the Internet through Core Decomposition. *Internet Mathematics*, 7(1):45--66, 2011. [bib | http]
- [33] Jorge Rodolfo Busch, Beiró Mariano Gastón, and José Ignacio Alvarez-Hamelin. On weakly optimal partitions in modular networks. *arXiv e-print*, abs/1008.3443, Aug 2010. [bib | http]
- [34] Roberto P.J. Perazzo, Laura Hernández, Horacio Ceva, Enrique Burgos, and José Ignacio Alvarez-Hamelin. Phylogenetic Proximity and Nestedness in Mutualistic Ecosystems. *arXiv e-print*, abs/1007.5519, Jul 2010. [bib | http]
- [35] Mariano G. Beiró, Jorge R. Busch, and J. Ignacio Alvarez-Hamelin. Visualizing communities in dynamic networks. In *LAWDN - Latin-American Workshop on Dynamic Networks*, page 00531761], Buenos Aires, Argentina, 2010. INRIA. [bib | .pdf]



:: IEEE ComSoc Argentina Open Webinar ::
27/11/2020 :: J. Ignacio Alvarez-Hamelin

- [36] Mariano G. Beiró, Jorge R. Busch, and J. Ignacio Alvarez-Hamelin. Snailvis: a paradigm to visualize complex networks. In 39 Jornadas Argentinas de Informática e Investigación Operativa-Argentine Symposium on Computing Technology (JAIIO-AST '10), pages 1682--1693, Buenos Aires, Argentina, 2010. SADIO. [bib | .pdf]
- [37] Alfredo Ortega, Víctor A. Bettachini, Diego F. Grosz, and J. Ignacio Alvarez-Hamelin. Altas velocidades de transferencia en fibra óptica utilizando FPGAs de bajo costo. In Diego Brenji, editor, *Congreso de Microelectrónica Aplicada 2010*, pages 126--129, San Justo, 2010. Universidad Nacional de la Matanza (UNLaM). [bib | .pdf]
- [38] José I. Orlicki, J. Ignacio Alvarez-Hamelin, and Pablo I. Fierens. *Scalable Faceted Ranking in Tagging Systems*, volume 45 of *Lecture Notes in Business Information Processing*. Springer Berlin Heidelberg, 2010. 10.1007/978-3-642-12436-5_21. [bib | .pdf]
- [39] Alfredo A. Ortega, Victor A. Bettachini, José Ignacio Alvarez-Hamelin, and Diego F. Grosz. A CDMA Secure Optical Access Network. *arXiv e-print*, abs/0912.5324, Dec 2009. [bib | http]
- [40] José I. Orlicki, Pablo I. Fierens, and J. Ignacio Alvarez-Hamelin. Faceted Ranking In Collaborative Tagging Systems: Efficient Algorithms for Ranking Users based on a Set of Tags. In INSTICC Press, editor, *WEBIST 2009: Proceedings of the 5th International Conference on Web Information Systems and Technologies*, pages 626--633, Lisboa, Portugal, 2009. INSTICC Press. [bib | .pdf]
- [41] Mariano G. Beiró, J. Ignacio Alvarez-Hamelin, and Jorge R. Busch. A low complexity visualization tool that helps to perform complex systems analysis. *New J. Phys.*, 10(12):125003, 2008. [bib | http]
- [42] J. Ignacio Alvarez-Hamelin, Luca Dall'Asta, Alain Barrat, and Alessandro Vespignani. K-core decomposition of Internet graphs: hierarchies, self-similarity and measurement biases. *Networks and Heterogeneous Media*, 3(2):371--293, 2008. [bib | .pdf]
- [43] J. Ignacio Alvarez-Hamelin and Jorge R. Busch. Edge connectivity in graphs: an expansion theorem. In In-Mat 2008: Proceedings of the 4th Congreso Internacional de Matemática Aplicada a Ingeniería y Enseñanza de Matemática en Ingeniería, volume Matemática Aplicada, pages 2:1--13, Buenos Aires, Argentina, 2008. Universidad de Buenos Aires. [bib | .pdf]
- [44] Alain Barrat, Luca Dall'Asta, J. Ignacio Alvarez-Hamelin, and Alessandro Vespignani. *The large scale structure of the Internet*. World Scientific, 2007. [bib]
- [45] J. Ignacio Alvarez-Hamelin and Andrea Puglisi. The dynamical collision network in granular gases. *Phys. Rev. E*, 75:051302, 2007. [bib | .pdf]
- [46] José Ignacio Alvarez-Hamelin. Taxonomía de los Modelos de Topología de Internet. In *Mecánica Computacional, Interdisciplinary Mathematical Methods*, volume XXV, pages 2597--2612. CIMEC, 2006. [bib | http]
- [47] Luca Dall'Asta, J. Ignacio Alvarez-Hamelin, Alain Barrat, Alexei Vázquez, and Alessandro Vespignani. Exploring networks with traceroute-like probes: Theory and simulations. *Theor. Comput. Sci.*, 355(1):6--24, 2006. [bib | .pdf]
- [48] J. Ignacio Alvarez-Hamelin, A.C. Viana, and M.D. de Amorim. DHT-based Functionalities Using Hypercubes. In K. Al Agha, editor, *International Federation for Information Processing (IFIP), Ad-Hoc Networking*, volume 212, pages 157--176, Boston, 2006. Springer. [bib | .pdf]
- [49] J. Ignacio Alvarez-Hamelin, Luca Dall'Asta, Alain Barrat, and Alessandro Vespignani. Large scale networks fingerprinting and visualization using the k -core decomposition. In Y. Weiss, B. Schölkopf, and J. Platt, editors, *Advances in Neural Information Processing Systems 18*, pages 41--50, Cambridge, MA, 2006. MIT Press. [bib | .pdf]
- [50] Ignacio Alvarez-Hamelin, Marco Gaertler, Robert Görke, and Dorothea Wagner. Halfmoon - A new Paradigm for Complex Network Visualization. Technical Report TR-2005-29, Faculty of Informatics, Universität Karlsruhe (TH), 2005. [bib | http]
- [51] José Ignacio Alvarez-Hamelin, Luca Dall'Asta, Alain Barrat, and Alessandro Vespignani. k -core decomposition: a tool for the analysis of large scale Internet graphs. *CoRR*, cs/0511007, 2005. [bib | http]
- [52] Luca Dall'Asta, José Ignacio Alvarez-Hamelin, Alain Barrat, Alexei Vázquez, and Alessandro Vespignani. Statistical theory of Internet exploration. *Phys. Rev. E*, 71:036135, 2005. [bib | .pdf]
- [53] Luca Dall'Asta, José Ignacio Alvarez-Hamelin, Alain Barrat, Alexei Vázquez, and Alessandro Vespignani. How accurate are traceroute-like Internet mappings? In *7ème rencontres francophones sur les Aspects Algorithmiques des Télécommunications (AlgoTel '05)*, pages 31--34. INRIA, 2005. [bib]



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