



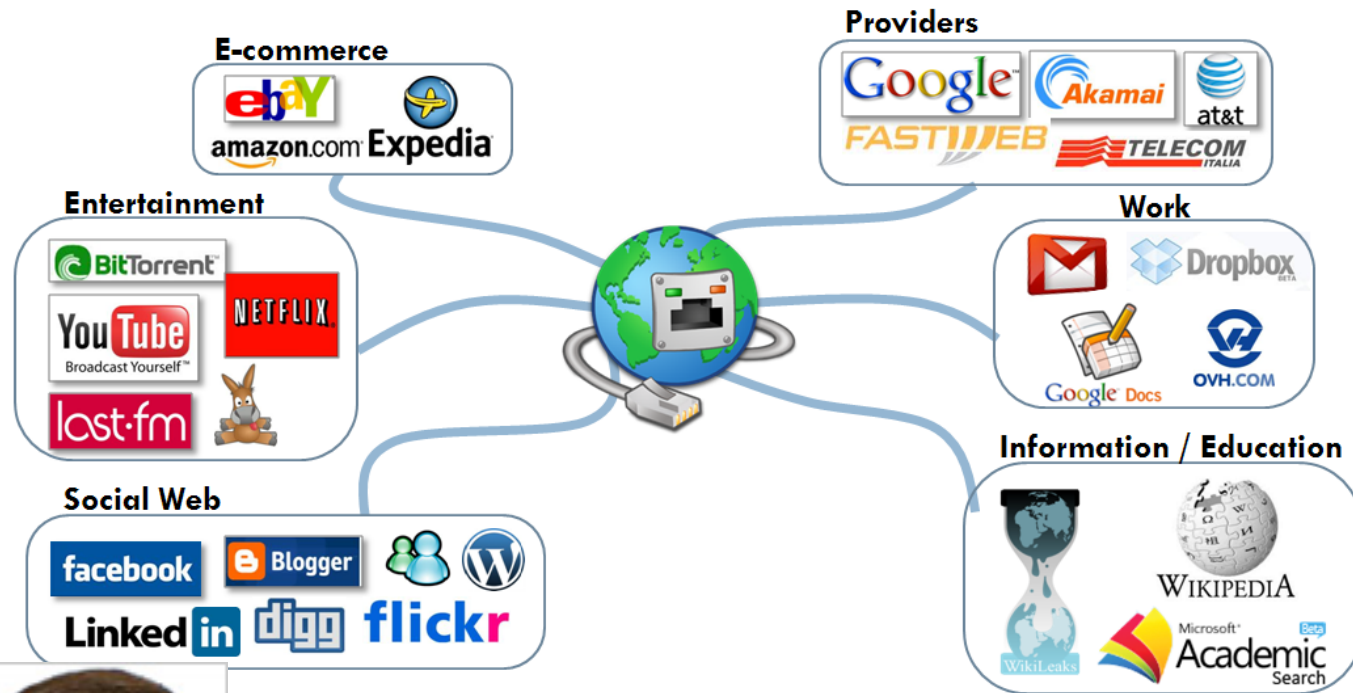
mPlane@SMART workshop

Barcelona, April 22, 2015

The mPlane community

- Many Academic and research institutions come from the Traffic Monitoring Analysis (TMA) COST Action:
 - PoliTo, ETH, ENST, Eurecom, UniLiege, FTW, NEC
- Some others were part of previous EU projects:
 - **PRISM**: FTW, ETH
 - **NapaWine**: PoliTo, ENST, NetVisor, NEC
 - **DEMONS**: FTW, ETHZ, NEC, TID
 - ...
- A community of “measurement” experts

The nowadays Internet



*“The Internet is the first thing that humanity has built that humanity doesn't **understand**, the largest experiment in **anarchy** that we have ever had.”*

Eric Schmidt – ex Google Exec. Chairman

Network neutrality and measurements...

Marco Mellia
Politecnico di Torino



*I'm by far not a network neutrality expert...
... I may be a measurement expert...*

Network neutrality



- **Net neutrality** (also network neutrality, Internet neutrality, or net equality) **principle**:
 - ❑ **Internet service providers** and governments should **treat all data** on the Internet **equally**
 - ❑ **No discrimination** or charging differentially by user, content, site, platform, application, type of attached equipment, or mode of communication

Example of measurements from the ISP point of view

Something **ISPs** “watch”



Something we observe

SUBNET

173.194.18

173.194.19

173.194.2

173.194.20

173.194.208

173.194.5

173.194.6

173.194.62

173.194.9

208.117.236

208.117.248

208.117.250

208.117.252

208.117.254

74.125.105

74.125.13

74.125.14

74.125.216

74.125.218

74.125.4

74.125.99

You Tube

Something we observe

SUBNET	NAME with AIRPORT code
173.194.18	fra02s08.c.youtube.com
173.194.19	fra02s15.c.youtube.com
173.194.2	mil01s12.c.youtube.com
173.194.20	par08s06.c.youtube.com
173.194.208	par08s06.c.youtube.com
173.194.5	lhr14s08.c.youtube.com
173.194.6	fra07s13.c.youtube.com
173.194.62	fra07s19.c.youtube.com
173.194.9	par03s06.c.youtube.com
208.117.236	par03x04.c.youtube.com
208.117.248	mia02s11.c.youtube.com
208.117.250	ams09x06.c.youtube.com
208.117.252	dfw06x02.c.youtube.com
208.117.254	fra07x03.c.youtube.com
74.125.105	lhr22s16.c.youtube.com
74.125.13	zrh04s03.c.youtube.com
74.125.14	mil02s01.c.youtube.com
74.125.216	bru02t11.c.youtube.com
74.125.218	fra07t13.c.youtube.com
74.125.4	lhr22s11.c.youtube.com
74.125.99	fra07s03.c.youtube.com

You



Something we observe

		5-May	
SUBNET	NAME with AIRPORT code	#flow	Tru avg
173.194.18	fra02s08.c.youtube.com	-1	-1
173.194.19	fra02s15.c.youtube.com	-1	-1
173.194.2	mil01s12.c.youtube.com	17054	333.46
173.194.20	par08s06.c.youtube.com	-1	-1
173.194.208	par08s06.c.youtube.com	-1	-1
173.194.5	lhr14s08.c.youtube.com	449	819.57
173.194.6	fra07s13.c.youtube.com	-1	-1
173.194.62	fra07s19.c.youtube.com	-1	-1
173.194.9	par03s06.c.youtube.com	-1	-1
208.117.236	par03x04.c.youtube.com	179	164.18
208.117.248	mia02s11.c.youtube.com	-1	-1
208.117.250	ams09x06.c.youtube.com	41430	679
208.117.252	dfw06x02.c.youtube.com	-1	-1
208.117.254	fra07x03.c.youtube.com	838	667.29
74.125.105	lhr22s16.c.youtube.com	1829	551.78
74.125.13	zrh04s03.c.youtube.com	719	074.15
74.125.14	mil02s01.c.youtube.com	48366	234.82
74.125.216	bru02t11.c.youtube.com	-1	-1
74.125.218	fra07t13.c.youtube.com	8697	355.33
74.125.4	lhr22s11.c.youtube.com	1496	846.25
74.125.99	fra07s03.c.youtube.com	-1	-1

YouTube

Something we observe

SUBNET	NAME with AIRPORT code	5-May		6-May	
		#flow	Tru avg	#flow	Tru avg
173.194.18	fra02s08.c.youtube.com	-1	-1	-1	-1
173.194.19	fra02s15.c.youtube.com	-1	-1	-1	-1
173.194.2	mil01s12.c.youtube.com	17054	1333.46	15470	1276.31
173.194.20	par08s06.c.youtube.com	-1	-1	-1	-1
173.194.208	par08s06.c.youtube.com	-1	-1	-1	-1
173.194.5	lhr14s08.c.youtube.com	449	1819.57	283	1658.45
173.194.6	fra07s13.c.youtube.com	-1	-1	-1	-1
173.194.62	fra07s19.c.youtube.com	-1	-1	-1	-1
173.194.9	par03s06.c.youtube.com	-1	-1	-1	-1
208.117.236	par03x04.c.youtube.com	179	164.18	4250	540.16
208.117.248	mia02s11.c.youtube.com	-1	-1	77	552
208.117.250	ams09x06.c.youtube.com	41430	679	49437	656.39
208.117.252	dfw06x02.c.youtube.com	-1	-1	51	285.63
208.117.254	fra07x03.c.youtube.com	838	667.29	2130	852.53
74.125.105	lhr22s16.c.youtube.com	1829	1551.78	1655	1185.94
74.125.13	zrh04s03.c.youtube.com	719	1074.15	499	2264.09
74.125.14	mil02s01.c.youtube.com	48366	1234.82	37968	1253.01
74.125.216	bru02t11.c.youtube.com	-1	-1	-1	-1
74.125.218	fra07t13.c.youtube.com	8697	1355.33	12579	1338.71
74.125.4	lhr22s11.c.youtube.com	1496	1846.25	2488	1034.78
74.125.99	fra07s03.c.youtube.com	-1	-1	-1	-1

YouTube

Something we observe

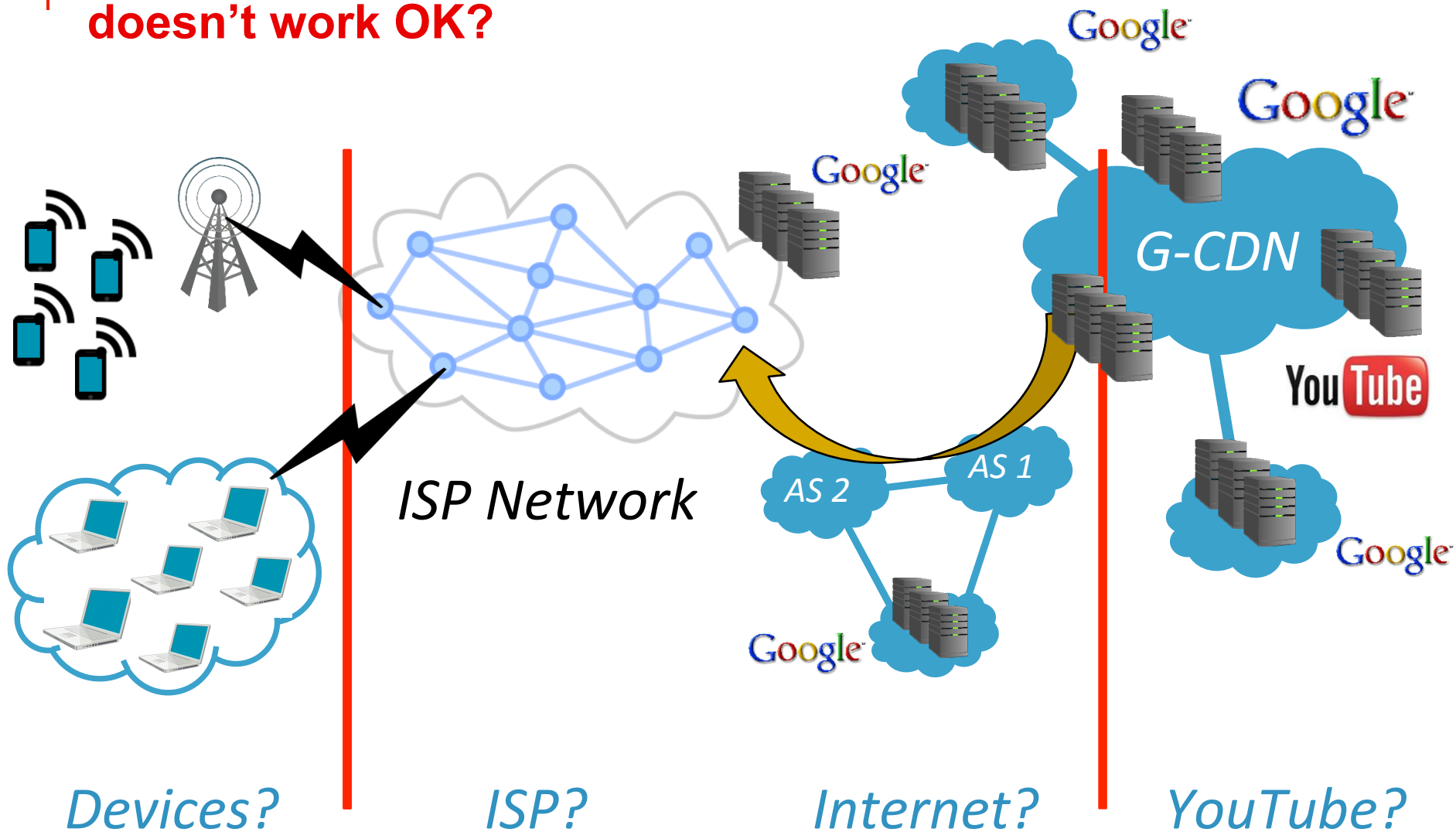
SUBNET	NAME with AIRPORT code	5-May		6-May		7-May	
		#flow	Tru avg	#flow	Tru avg	#flow	Tru avg
173.194.18	fra02s08.c.youtube.com	-1	-1	-1	-1	-1	-1
173.194.19	fra02s15.c.youtube.com	-1	-1	-1	-1	-1	-1
173.194.2	mil01s12.c.youtube.com	17054	1333.46	15470	1276.31	13655	1259.63
173.194.20	par08s06.c.youtube.com	-1	-1	-1	-1	-1	-1
173.194.208	par08s06.c.youtube.com	-1	-1	-1	-1	-1	-1
173.194.5	lhr14s08.c.youtube.com	449	1819.57	283	1658.45	-1	-1
173.194.6	fra07s13.c.youtube.com	-1	-1	-1	-1	-1	-1
173.194.62	fra07s19.c.youtube.com	-1	-1	-1	-1	-1	-1
173.194.9	par03s06.c.youtube.com	-1	-1	-1	-1	-1	-1
208.117.236	par03x04.c.youtube.com	179	164.18	4250	540.16	957	496.91
208.117.248	mia02s11.c.youtube.com	-1	-1	77	552	-1	-1
208.117.250	ams09x06.c.youtube.com	41430	679	49437	656.39	57675	653.81
208.117.252	dfw06x02.c.youtube.com	-1	-1	51	285.63	-1	-1
208.117.254	fra07x03.c.youtube.com	838	667.29	2130	852.53	-1	-1
74.125.105	lhr22s16.c.youtube.com	1829	1551.78	1655	1185.94	3957	942.47
74.125.13	zrh04s03.c.youtube.com	719	1074.15	499	2264.09	82	1302.03
74.125.14	mil02s01.c.youtube.com	48366	1234.82	37968	1253.01	37182	1162.85
74.125.216	bru02t11.c.youtube.com	-1	-1	-1	-1	-1	-1
74.125.218	fra07t13.c.youtube.com	8697	1355.33	12579	1338.71	8560	1239
74.125.4	lhr22s11.c.youtube.com	1496	1846.25	2488	1034.78	4146	1363.63
74.125.99	fra07s03.c.youtube.com	-1	-1	-1	-1	-1	-1

you

Something we observe



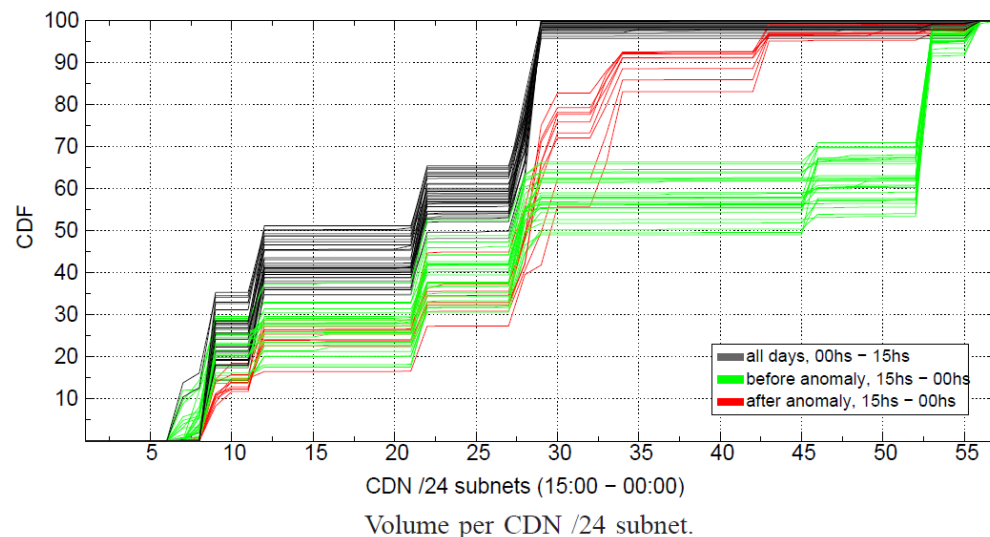
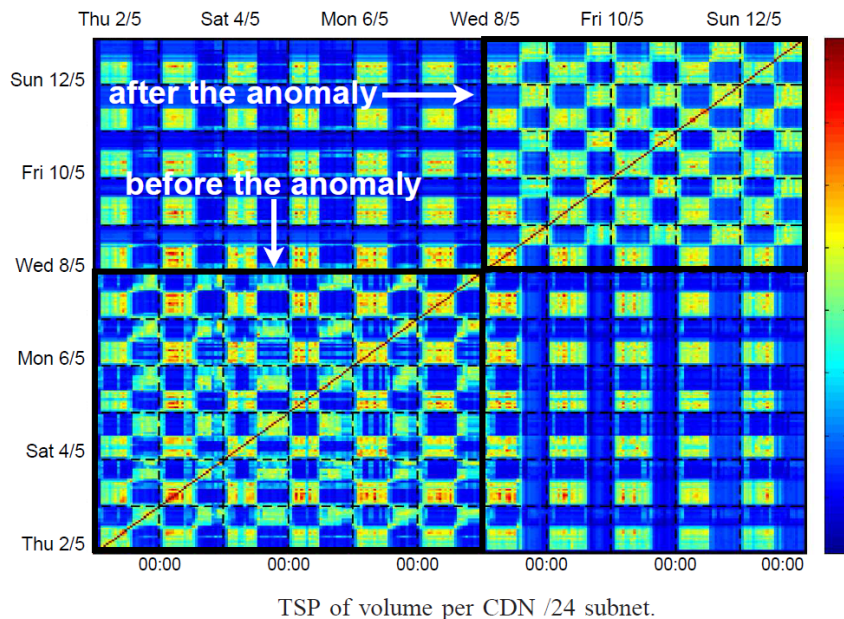
Who to blame when YouTube doesn't work OK?



Diagnosis #1

change in the cache-selection policy?

YES!



Temporal Similarity Plot (TSP)

- For every time-bin: compute distribution of volume across all /24 Google CDN subnets
- Distribution compared with custom Kullback-Leibler metric
- Comparisons results plotted on heatmap

Traffic distribution across /24 subnets

Conclusion

A different server selection policy is deployed exactly on the same day when the anomaly starts occurring!

Diagnosis #2

given that change... who is to blame: new servers or path?



Diagnosis #3

is there a correlation between increased RTT and throughput?

NO

Diagnosis #4

....

YES/NO

Conclusion

The **origin of the anomaly** is the **cache selection** done by **Google**

Network neutrality



- **Net neutrality** (also network neutrality, Internet neutrality, or net equality) **principle**:
 - ❑ **Internet service providers** and governments should **treat all data** on the Internet **equally**
 - ❑ **No discrimination** or charging differentially by user, content, site, platform, application, type of attached equipment, or mode of communication

In the previous case, the ISP has no role...
... it is a victim (as the user)

Network neutrality

- **The network has never been neutral**
 - Ethernet is not neutral
 - WiFi is not neutral
 - TCP is not neutral
 - BGP is not neutral
 - ADSL is not neutral
 - ...
- The network has been **designed to be NOT NEUTRAL**

How can we measure the “neutrality”?

What about applications?

iClarified



News



Tutorials



Answers



Wizards



YouTube Drops Support for the 2nd Generation Apple TV, iOS 6 Devices and Lower

f Like

8

t Tweet

30

Pint

1

in Share

g+1

5



Posted 9 hours ago by iClarified | Please help us and submit a translation by clicking [here](#) | 3874 views

Google has announced that YouTube will no longer support the second generation Apple TV and iOS devices that are running iOS 6 or lower.

So my daughter cannot watch youtube on her iPad?

April
older.

What about applications?

●●●● TIM 12:01 100%
corriere.it

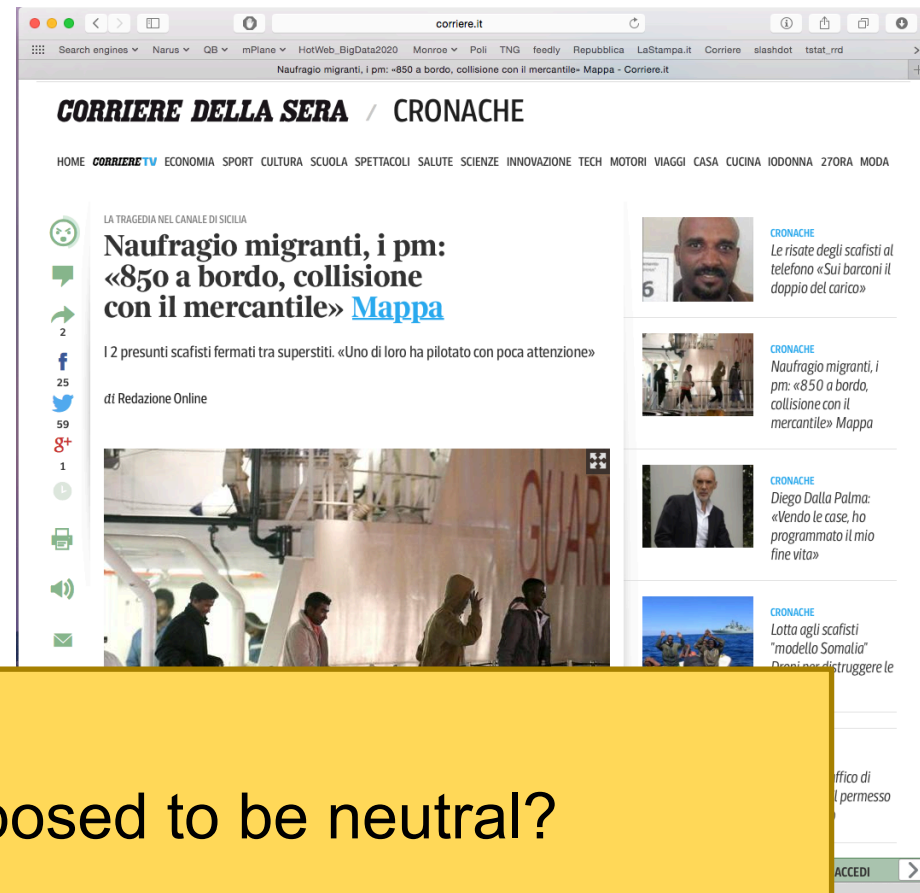
Sei già abbonato?
Inserisci il tuo numero di cellulare o effettua il login con la tua mail e password e prosegui nella lettura.

Non sei ancora abbonato?
Inserisci il numero di telefono, riceverai un SMS di conferma per attivare l'offerta e leggere tutta l'informazione di Corriere della Sera sul tuo smartphone.
La prima settimana è GRATIS!

TIM

Numero

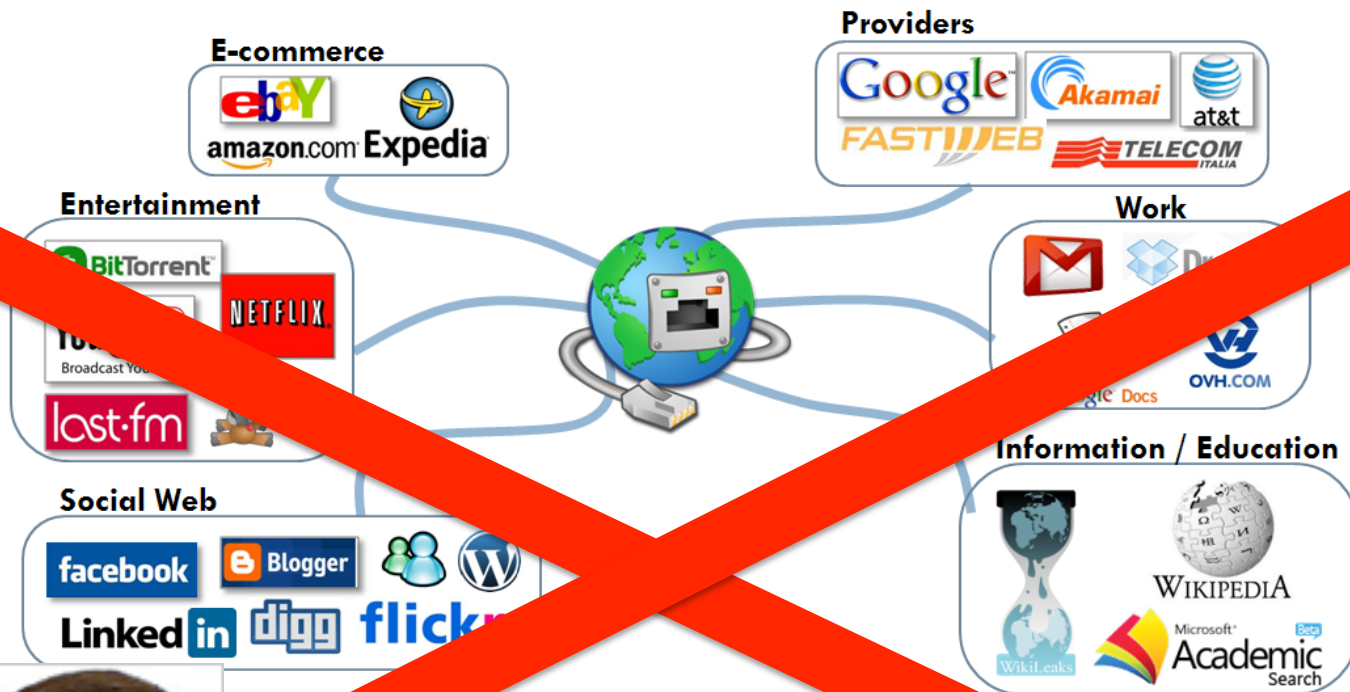
INVIA



Are applications supposed to be neutral?

And speaking about my
daughter...

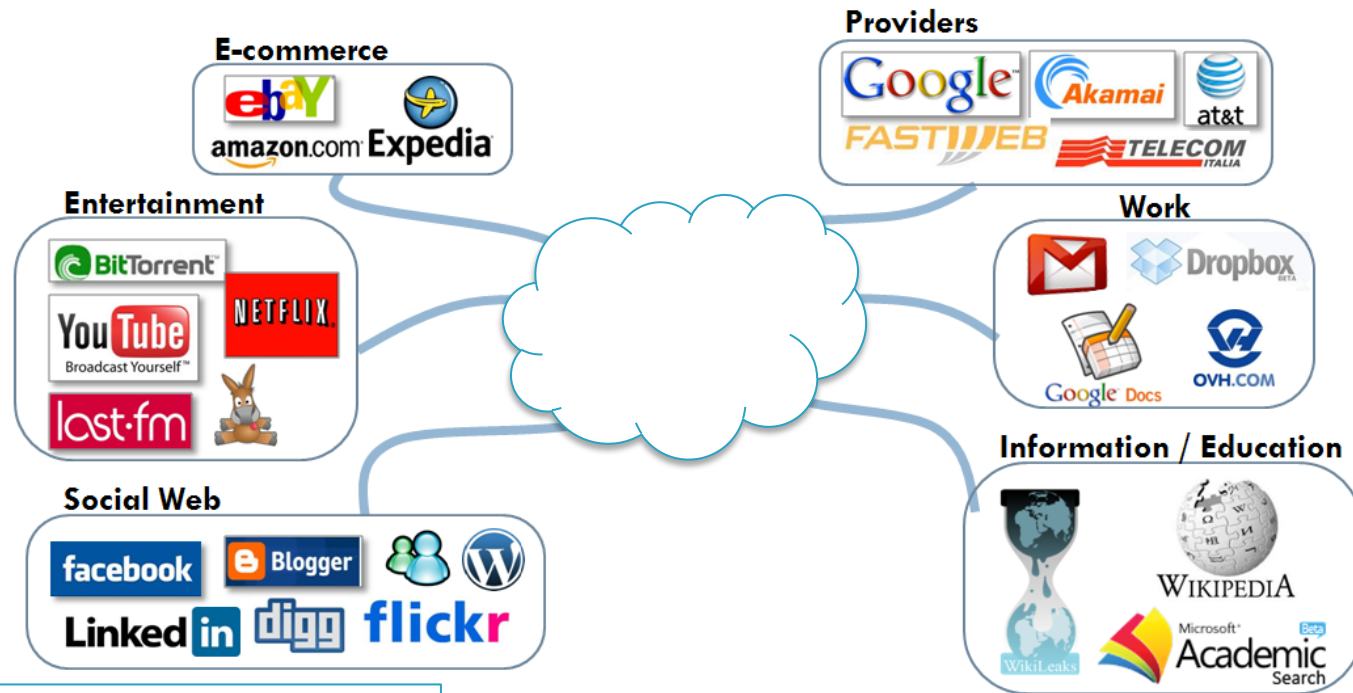
The nowadays Internet



*The Internet is the first thing that humanity has built that humanity doesn't **understand**. It's the largest experiment in **anarchy** that we have ever had."*

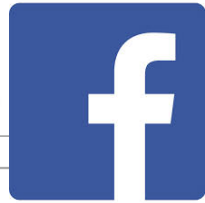
Eric Schmidt – ex Google Exec. Chairman

The nowadays Internet



If you ask my daughter...
“What is the Internet?”...

Use?



... most of those are so called “third-party sites” - aka tracking services...

Tracking services

- **233** out of the top-500 hostnames contacted by users are tracking service
- **196** of this 233 are contacted also using **HTTPS**
 - To protect my daughter's privacy?
 - Or to protect their business?
- First tracker contacted within **1 second** for 78% of users
- 71% of services embed at **least one tracker**

Honestly, I'm not worried about network neutrality...
I'm very worried about my daughter's privacy...

Perguntas
Fragen Domande Galdera
Otázky
Questions
Spørsmål Pertanyaan kysymykset
Frågor Spørsmål Cwestiynau
вопросы Preguntas Sorular
Въпроси
Vragen
Pytania