

#### Traffic Localization for DHT-based BitTorrent networks

Moritz Steiner and Matteo Varvello

## OUTLINE

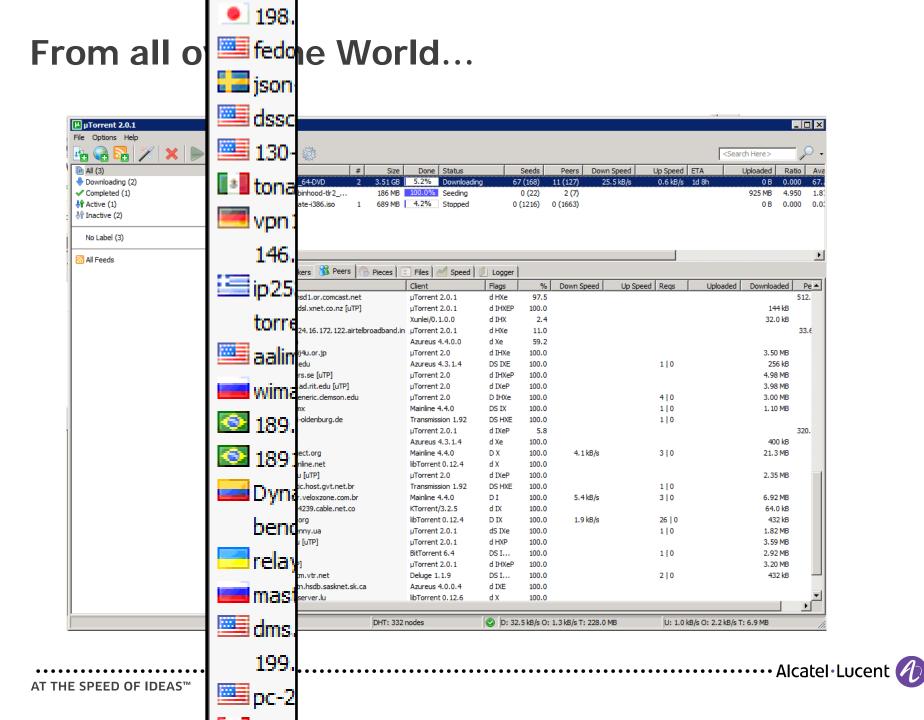
- Motivation
- DHT Traffic Localization
- DHT Traffic Localization in Action!
- Evaluation
- Conclusion



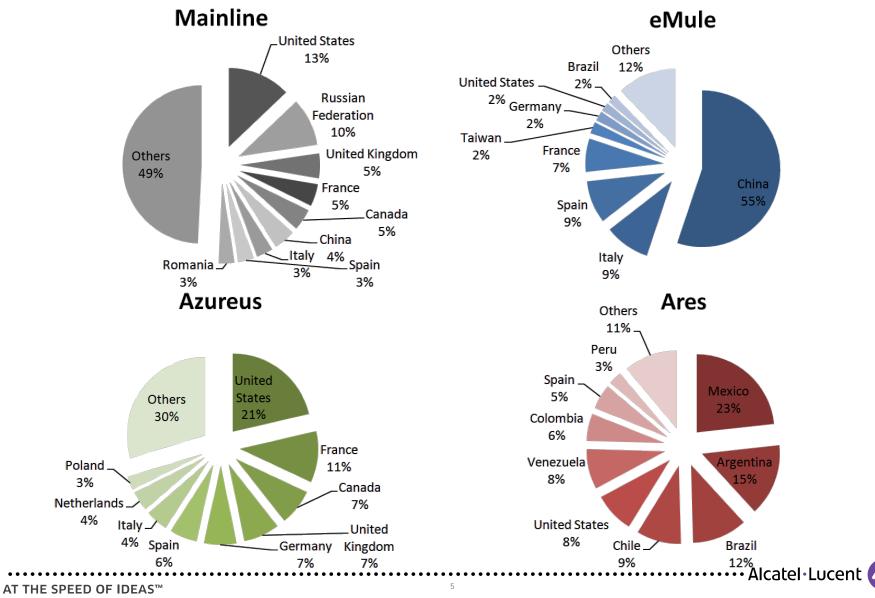
# **Motivation**



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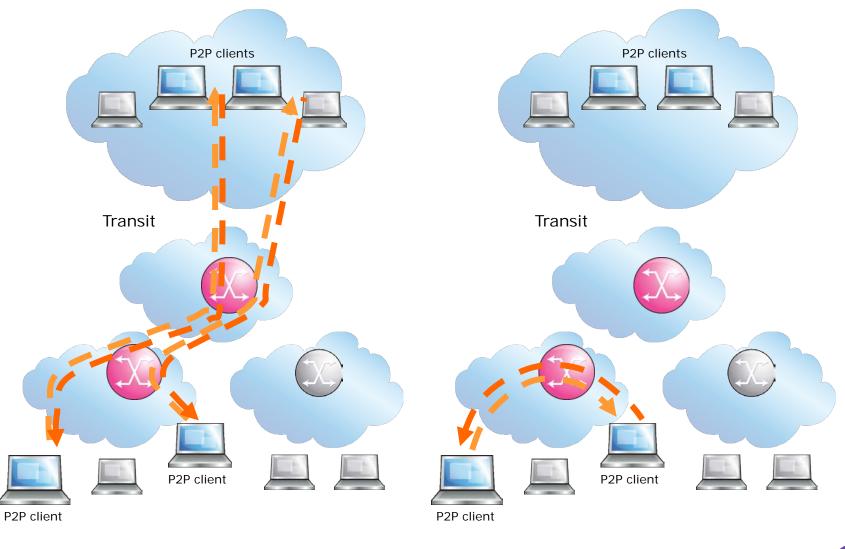


### **Geographic Distribution of Peers**



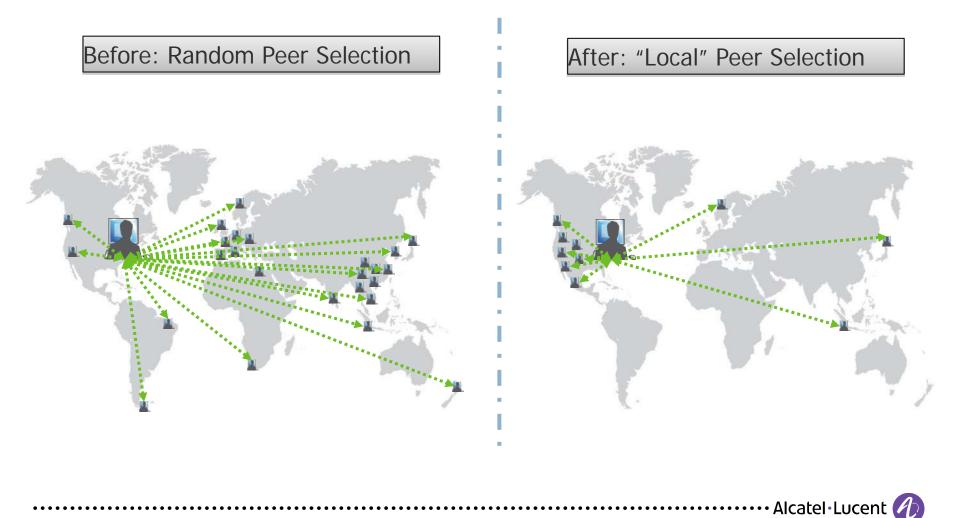
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### **P2P Traffic Localization**





#### **Random vs. Localized Peer Selection**



#### **Approaches to Localization**

- Client based
- Client Network collaboration
- Network based

#### **Trackers disappear – DHT takes over**

#### German Police Shut Down Private Torrent Tracker

#### March 30, 2009 by Yonah

Filed under: Announcements & Events, File-Sharing Programs, Networks & Services, Legal P2P News & Issues

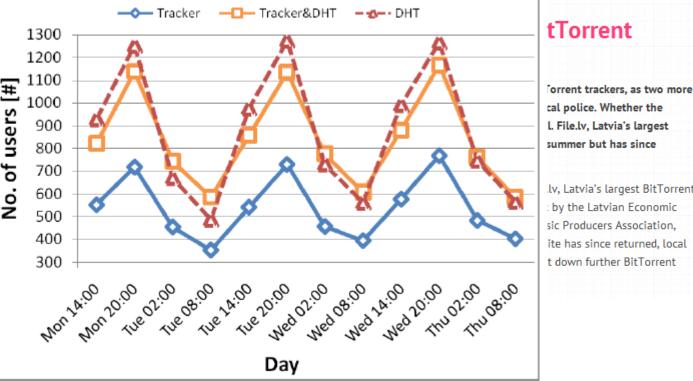
The battle against P2P file sharing has a lot of facets - w on the abstract ground of law the repeat file sharers have reasons to rejoice (as the European Parliament dismiss the notion of 'three strikes' policy), on the concrete groun the piracy combat authorities engage in rapid raids to car the pirates red-handed. In one such raid German authori have terminated a private BitTorrent tracker this week and confiscated lots of PCs, HDDs, DVDs, CDs and money.



IFPI, Italian po By Jacqui Cheng | Last upd

#### Police shuts down Portuguese Trackers

This blog post talks about the news that the Portuguese Police shut down three Portuguese BitTorrent trackers. The whole issue arised many coments in the media and in the blogosphere. All my comments in this post are based on the press releases from four entities, PJ, FEVIP, ASAE and AFP, and the statements they've been giving about this issue (that I had access to, not everything). Also, I'm afraid I'm not using the correct English legal terms in so sorry. Also, I'm not saving here that specially at this level.



summer but has since lv, Latvia's largest BitTorrent by the Latvian Economic sic Producers Association.

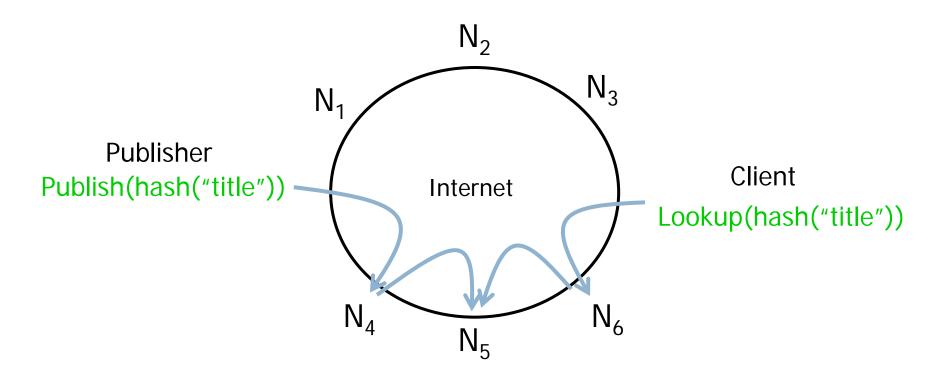
A popular torrent tracker in many closed up shop today, nanding the international music trade group in th another victory against P2P. Colombo-BT.org now points to a page that says, "Access denied in execution of an Italian Court Authority injunction." The shutdown came after action was taken by the Guardia di Finanza, an Italian police force that operates under the Italian Armed Forces. Unsurprisingly, the IFPI applauded the move and took it as a sign of progress against piracy online.

## **DHT Traffic Localization**



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#### What is a DHT?

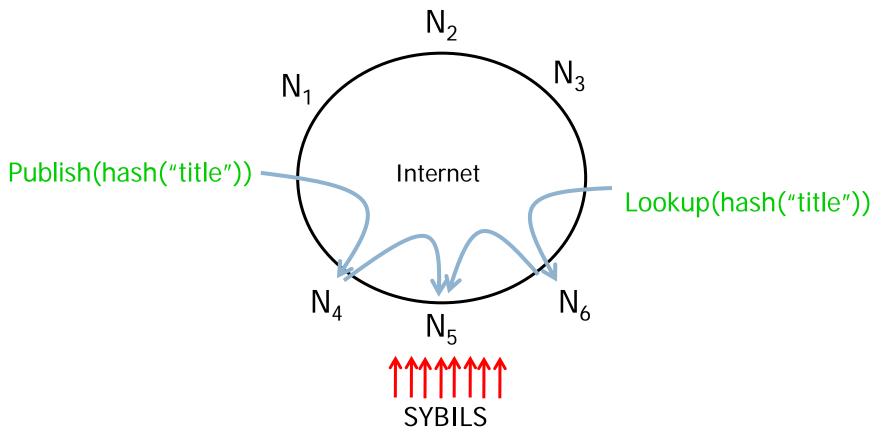


- A distributed database for publishing and searching information

  - Each peer and each object is identified by an info-hash
    Use object info-hash to decide on which peer to store information



#### How to control a DHT?

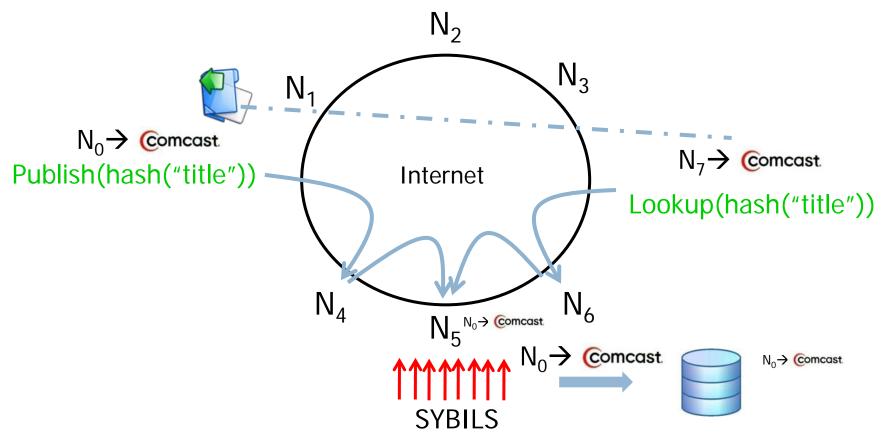


- Intercept all the announces for a file
- Intercept all queries for a file

AT THE SPEED OF IDEAS™



#### How to localize P2P traffic using the DHT?

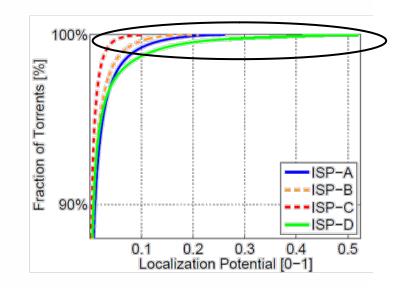


- Build a database <peer, ISP> by intercepting all announces for a file
- Localized responses: request from Comcast response with peers from Comcast



### Which files should we localize?

- Ideally, all files
  - Resource consumption scales linearly with the number of files to localize
- We only focus on **popular** files for two reasons:
  - It is infeasible to monitor all files available in a DHT
  - Localizing each file is unnecessary



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## **Traffic Localization in Action!**



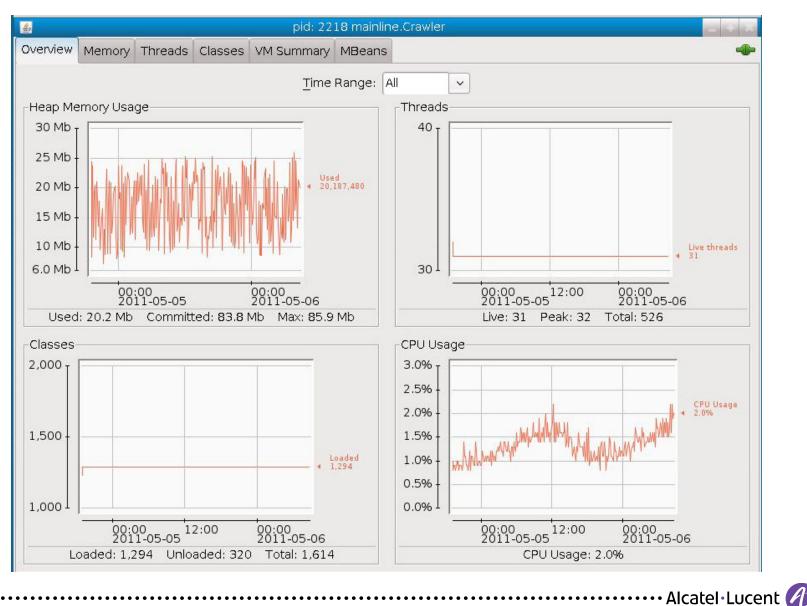
.........

### 1) Choose a popular file - thepiratebay.org/top/all

http://thepiratebay.org/	top/all				Þ
	orrents   Recent Torrents   TV shows   Music   Top 100 Pirate Search ons  Games  Other All		RETTE.		
(a	DON'T BLEACH Single mom discovers 1 simple trick to turn yellow teeth white Find Out How Now	Don't Let the Dentist Fool Yo Single mom discovers 1 simple trick to turn yellow teeth white	e		
Туре	Name	View: Single / Double	SE	LE	
Video (Movies)	The Twilight Saga Eclipse TS XVID - IMAGINE 통해 약 흓 Uploaded 07-02 19:22, Size 1.41 GiB, ULed by IwannaFan2		17002	16237	
Video (Movies)	Hot Tub Time Machine (2010) R5 XviD-MAX ₮ क़ ऀ འ 🖀 ឝ़ Uploaded 06-08 12:52, Size 1.36 GiB, ULed by extremezone		11233	4891	
Video (Movies)	The Karate Kid DVDRiP R6 XViD-KiNGDOM (Kingdom-Release) ▼ n ସ ▲ A Uploaded 07-01 07:38, Size 980.88 MiB, ULed by hiest		8353	7304	
Video (Movies)	Green Zone (2010) DVDRip XviD-MAX ᅗक़ ऀ འ   Uploaded 06-09 02:43, Size 1.37 GiB, ULed by extremezone		11226	3534	
Video (Movies)	The A Team 2010 TS XViD - IMAGiNE ᅗक़ 역 🛯 🚔 Uploaded 06-12 07:23, Size 1.39 GiB, ULed by raymondhome		8547	4794	
Video (Movies)	Shes Out of My League (2010) DVDRip XviD-MAX 중 🛱 🤜 🖴 Uploaded 06-04 17:10, Size 1.26 GiB, ULed by extremezone		10126	2930	
Video (Movies)	The Book of Eli (2010) DVDRip XviD-MAX 홍휴 역 🛯 😤 Uploaded 05-18 20:40, Size 1.26 GiB, ULed by extremezone		10410	2256	
Audio (Music)	Eminem-Recovery-(Retail)-2010-[NoFS] 중 🏚 🤜 🖴 Uploaded 06-08 15:12, Size 177.19 MiB, ULed by nos1977		10623	1431	
Video (Movies)	Toy.Story.3.2010.CAM.XviD-PrisM 장휴 역 🛯 🐥 Uploaded 06-19 14:55, Size 1.22 GiB, ULed by raymondhome		8146	3700	
Video (TV shows)	True.Blood.S03E03.HDTV.XviD-NoTV ▼ 配 ♥ ♣ Uploaded 06-28 14:10, Size 550.29 MiB, ULed by Anonymous		10668	1173	

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#### 2) Start the Localization Mechanism



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#### DEMO TIME

- 1. Connect to a windows machine at my place
  - Verizon FIOS
  - Utorrent
- 2. Download a content item being localized using the presented approach.
- 3. Observe
  - from which peers the client downloads from
  - the interaction with the sybils

3) Dover	plaad laaallyd	
HuTorrent 2.0.4	c-76-121-124-131.hsd1.wa.comcast.net [uTP]	
File Options Help	c-71-57-185-226.hsd1.fl.comcast.net [uTP]	
	c-67-190-165-89.hsd1.co.comcast.net [uTP]	own Speed U
✓ Completed (0)	c-71-192-168-206.hsd1.ma.comcast.net [uTP]	
No Label (1)	c-69-181-134-154.hsd1.ca.comcast.net	Down Speed
	c-67-167-4-224.hsd1.il.comcast.net [uTP]	379.7 kB/s 169.9 kB/s
	c-67-173-38-84.hsd1.il.comcast.net [uTP]	144.9 kB/s 112.7 kB/s 107.2 kB/s
	c-24-22-97-31.hsd1.or.comcast.net [uTP]	85.2 kB/s 79.0 kB/s
	c-75-70-194-138.hsd1.co.comcast.net [uTP]	76.7 kB/s 56.9 kB/s 55.0 kB/s
	c-68-44-162-162.hsd1.nj.comcast.net [uTP]	44.4 kB/s 41.1 kB/s
	c-71-203-46-97.hsd1.fl.comcast.net [uTP]	27.5 kB/s 24.5 kB/s 23.3 kB/s
	c-69-140-147-141.hsd1.dc.comcast.net [uTP]	21.6 kB/s 18.9 kB/s
	c-76-24-144-223.hsd1.ma.comcast.net [uTP]	17.4 kB/s 9.0 kB/s 8.2 kB/s
	c-71-230-82-221.hsd1.pa.comcast.net [uTP]	7.6 kB/s 5.9 kB/s
	c-76-99-16-143.hsd1.pa.comcast.net [uTP]	5.7 kB/s 4.8 kB/s 3.3 kB/s
	c-69-247-184-225.hsd1.la.comcast.net	2.4 kB/s 2.4 kB/s 2.4 kB/s
	c-67-189-67-62.hsd1.or.comcast.net [uTP]	1.9 kB/s 1.7 kB/s
	c-71-205-126-191.hsd1.mi.comcast.net [uTP]	1.2 kB/s 1.0 kB/s ng) 💽 D:
	c-68-82-165-106.hsd1.pa.comcast.net [uTP]	••••••••••
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wn Speed	Up Speed	ETA	Uploaded
1.5 MB/s	19.6 kB/s	7m 2s	48.0 kB

Down Speed	Up Speed	Reqs	Uploaded
379.7 kB/s	0.6 kB/s	71   0	
169.9 kB/s	0.2 kB/s	41   0	
144.9 kB/s	0.5 kB/s	35   0	
112.7 kB/s	0.3 kB/s	24   0	
107.2 kB/s	0.1 kB/s	29   0	
85.2 kB/s	0.2 kB/s	23   0	
79.0 kB/s	0.2 kB/s	17   0	
76.7 kB/s	0.2 kB/s	16   0	
56.9 kB/s	0.3 kB/s	17   0	
55.0 kB/s	0.2 kB/s	16   0	
44.4 kB/s	0.1 kB/s	21   0	
41.1 kB/s	0.3 kB/s	12 0	
27.5 kB/s	0.4 kB/s	10   0	
24.5 kB/s		15 0	
23.3 kB/s	0.2 kB/s	8 0	
21.6 kB/s	0.1 kB/s	17   0	
18.9 kB/s	0.2 kB/s	7 0	
17.4 kB/s		5 0	
9.0 kB/s		20   0	
8.2 kB/s	0.2 kB/s	4 0	
7.6 kB/s	0.2 kB/s	4 0	
5.9 kB/s		17   0	
5.7 kB/s	0.2 kB/s	3 0	
4.8 kB/s	0.2 kB/s	4 0	
3.3 kB/s		15   0	
2.4 kB/s	0.4 kB/s	3 0	
2.4 kB/s		3 0	
1.9 kB/s	0.1 kB/s	3 0	
1.7 kB/s	0.3 kB/s	2 0	
1.2 kB/s	0.5 kB/s	2 0	
1.0 kB/s	0.3 kB/s	11   0	
ng) 🥥	D: 1.5 MB/s O:	59.0 kB/s	T: 96.5 MB
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#### The Sybils control the content

D. +	Time	Source	Destination	Protocol	Info		
	3 5.504641	192.108.1.10	192.11.19.2	900		Destination port: 4	
	4 5.552394	192.11.19.2	192.168.1.10	UDP		Destination port: 2	
	5 5.552656	192.168.1.10	192.11.19.2	UDP		Destination port: 4	
	6 5.602966	192.11.19.2	192.168.1.10	UDP		Destination port: 2	
	7 5.603153	192.168.1.10	192.11.19.2	UDP		Destination port: 4	
	8 5.650895	192.11.19.2	192.168.1.10	UDP		Destination port: 2	
	9 5.651141	192.168.1.10	192.11.19.2	UDP		Destination port: 4	
	0 5.697484	192.11.19.2	192.168.1.10	UDP		Destination port: 2	
	1 5.697728	192.168.1.10	192.11.19.2	UDP		Destination port: 4	
	2 5.746730	192.11.19.2	192.168.1.10	UDP		Destination port: 2	
	3 5.746937	192.168.1.10	192.11.19.2	UDP		Destination port: 4	
	4 5.801294	192.11.19.2	192.168.1.10	UDP	Source port: 49413	Destination port: 2	
	5 5.801546	192.168.1.10	192.11.19.2	UDP		Destination port: 4	
	6 5.851896	192.11.19.2	192.168.1.10	UDP		Destination port: 2	
	7 35.015617	192.168.1.10	192.11.19.2	UDP		Destination port: 4	
	8 35.015677	192.168.1.10	192.11.19.2	UDP		Destination port: 4	
	9 35.015708	192.168.1.10	192.11.19.2	UDP		Destination port: 4	
	0 35.062017	192 11.19.2	192.168.1.10	UDP		Destination port:	
	1 35.063339 2 35.063355	192.11.19.2 192.11.19.2	192.168.1.10 192.168.1.10	UDP UDP	Source port: 49407	Destination port: 2 Destination port: 2	
Inte User	rnet Protoco		0:16:03:23:28:47), Dst: (192.168.1.10), Dst: 19 34 (25834), Dst Port: 4	2.11.19.2	(192.11.19.2)	b:10:dc)	
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Inte User Data 00 0 10 0 20 1 30 3 40 8 50 5	rnet Protoco Datagram Pro (154 bytes) 00 1f 33 bb 1 00 b6 cf de 0 13 02 64 ea c 3a 69 64 32 3 3a cc cb 12 f 5 68 61 73 6	l, src: 192.168.1.10 otocol, src Port: 258 00 00 80 11 d5 98 00 30 80 2 d5 8b 00 3a 8d 9b 89 34 00 3a 8d 9b 89 34 00 3a 4a 0 55 27	(192.168.1.10), Dst: 19 34 (25834), Dst Port: 4 of .XZBM be rti25	2.11.19.2 9404 (494) <b></b>	KCB.4:p e5:toke	20 20 2n	
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## **Evaluation**



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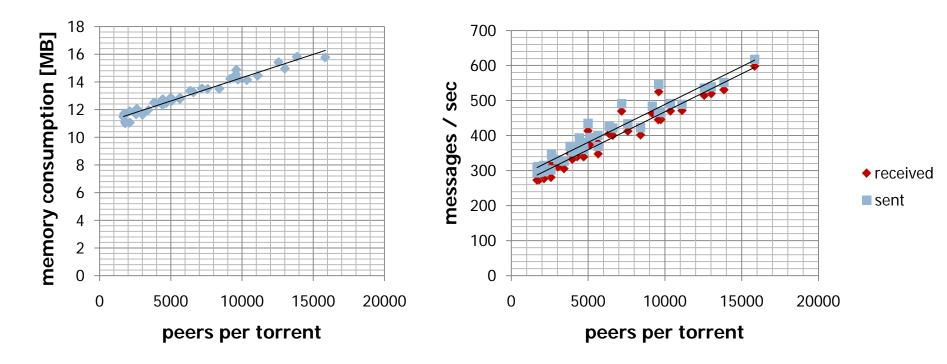
### **Evaluation – Methodology**

- Select torrents to localize (use PirateBay)
  - Run the sybils
- Instrument a Transmission, Utorrent and BitComet client to repetitively download the selected torrents
  - Download time is bound
  - One day, one week, one month periods
  - No client-to-tracker communication
- We run the instrumented clients on Private machines connected to the Internet with
  - Cable
  - Fiber

- DSL

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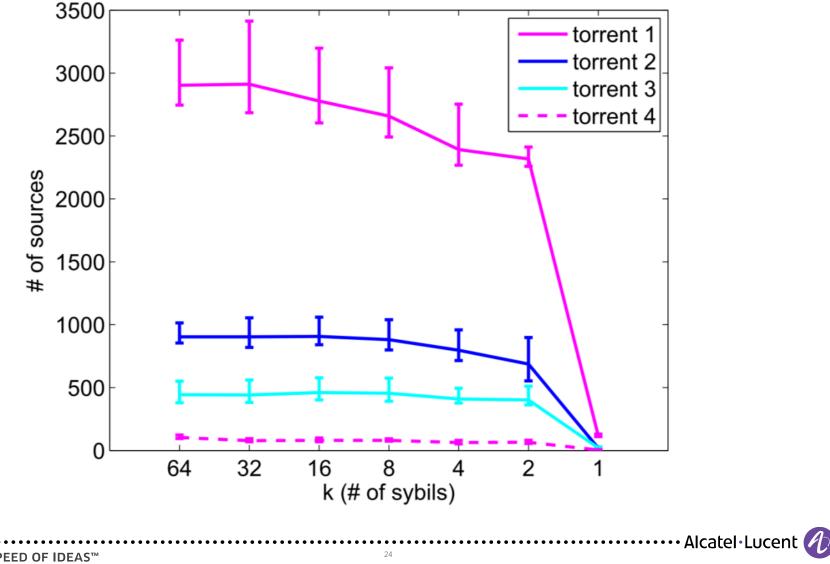
#### **Evaluation –** *Resource Consumption*



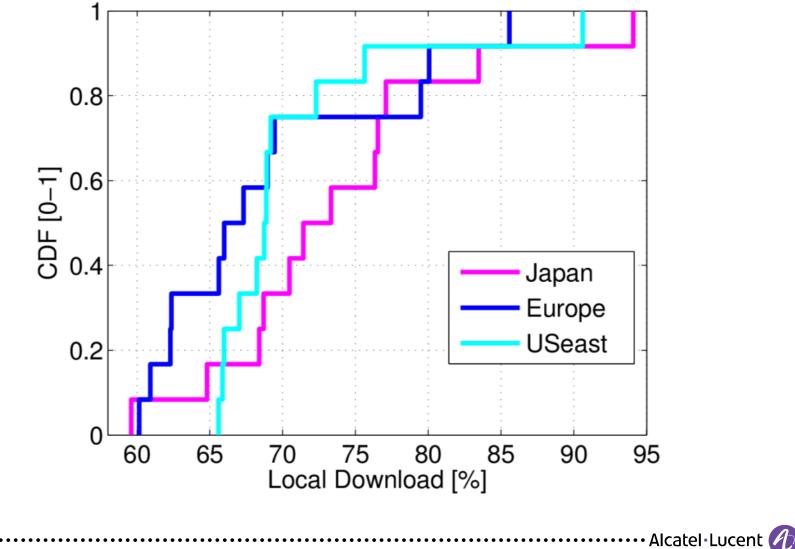
- Resource consumption linearly grows with the number of peers per torrent
- Number of message per second is the critical resource
  - ca. 20k / sec using a small linux server in our lab
  - ca. 10k / sec using a "high IO" amazon ec2 VM

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#### Server Side Evaluation – Nr of Sybils



#### Server Side Evaluation – Running from the Cloud

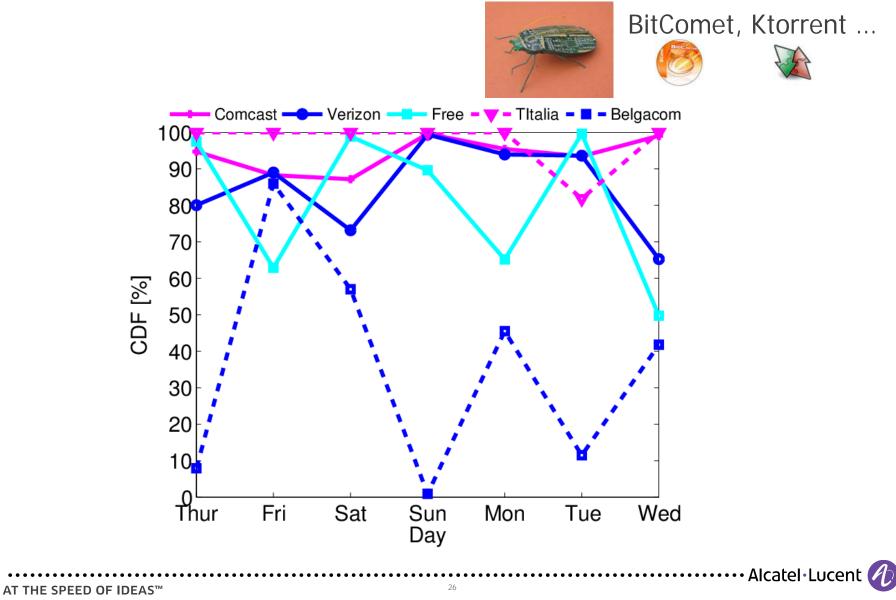


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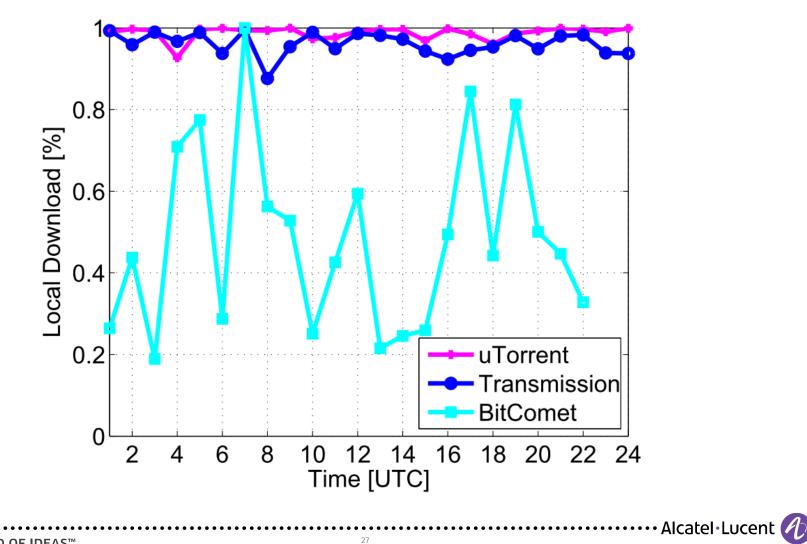
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#### **Evaluation –** *Traffic Localization*

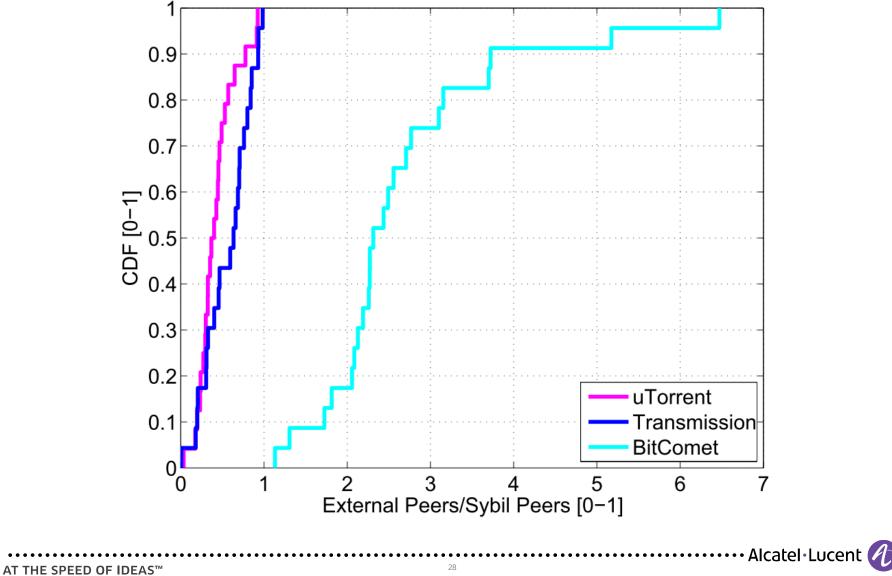


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#### **Evaluation –** *Impact of the Client*

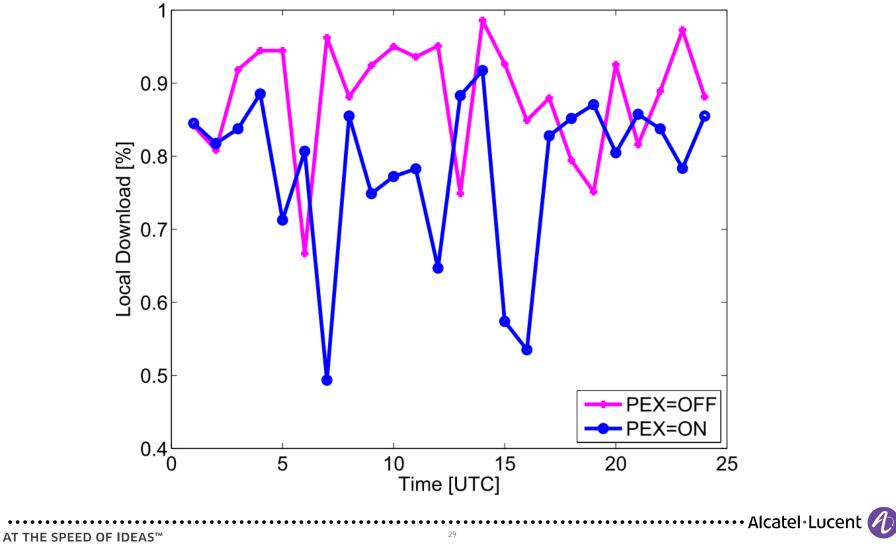


#### **Evaluation –** *Competition Sybils vs. Other Peers*



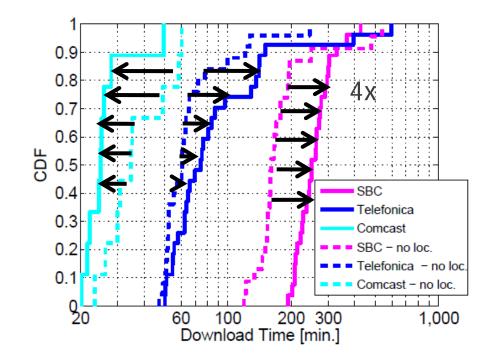
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#### **Evaluation –** *Impact of PEX*



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#### **Evaluation –** *Download Speed Analysis*



- CAUSES
  - Different local popularity of F
  - Peers located at Telefonica have low upload rate and cannot contribute much

to the swarm



# Conclusions



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#### Conclusion

- Today, the role of the trackers is distributed among peers via a Distributed Hash Table (DHT)
  - Existing solutions for BitTorrent traffic localization leveraging central trackers will become soon ineffective
- We design, prototype, and preliminary evaluate the first traffic localization mechanism for DHT-based BitTorrent networks
  - Resource utilization scales with the # of peers per torrents.
  - Can run on any machine with connection to the Internet.
  - Issues with flawed protocol implementations.
  - Works very well for popular torrents in fast networks.



#### **Questions?**





#### What is a sybil attack?

- Sybils A single entity can join a P2P network many times with many distinct logical identities (nodeIDs)
- Eclipse attack Eclipse a file with info-hash F from a P2P network
- How? Insert in a DHT several sybils with nodeIDs close to F
  - Crawl the surrounding zone of F, Z, to learn about the peers in Z
  - Send HELLO messages to each peer in Z from the sybils
    - Each peer in Z believes the sybils are the closest peers to F
    - Announce and search requests for **F** falling into **Z** are routed to one of the sybils