Protecting privacy in social media via controlling exposure

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CS 60017
Autumn 2019

Last time we talked about…

- Anonymity: one aspect of privacy
  - What happens if you give users anonymity?
  - They become more disinhibited
  - Case study on Whisper / 4chan /b/
  - Important for internet culture

Now a few systems on how to better control privacy in social media

- Recall Exposure control
  - Extension of access control
  - Users care about the exposure of the content, i.e., the set of users who will eventually see a post
  - Users have an expectation about exposure
  - Possible privacy violation = If the actual exposure did not meet expected exposure

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- Two systems to control exposure
  - Strengthening access control in social media
  - Limiting data aggregators in social media

Strengthening access control in social media

- Key idea
  - We can control exposure if the users can easily and accurately specify the access control lists
  - Then the users who has access to these lists are always in user's expected exposure set

Understanding and Specifying Social Access control lists

(based on Mondal et al.'s SOUPS'14 paper)

Privacy in Online Social Networks (OSNs)

Prior to OSNs **(also called Online Social media sites or OSMS)**

- Users were largely **content consumers**

In OSNs

- Users expected to be **content creators and managers**

In sites like Facebook

- Must enumerate who is able to access every uploaded content
- Avg. 130 friends, 90 pieces of content every month per user
- Really difficult to get the privacy right for "cognitive burden"

Privacy sensitive content in OSMs

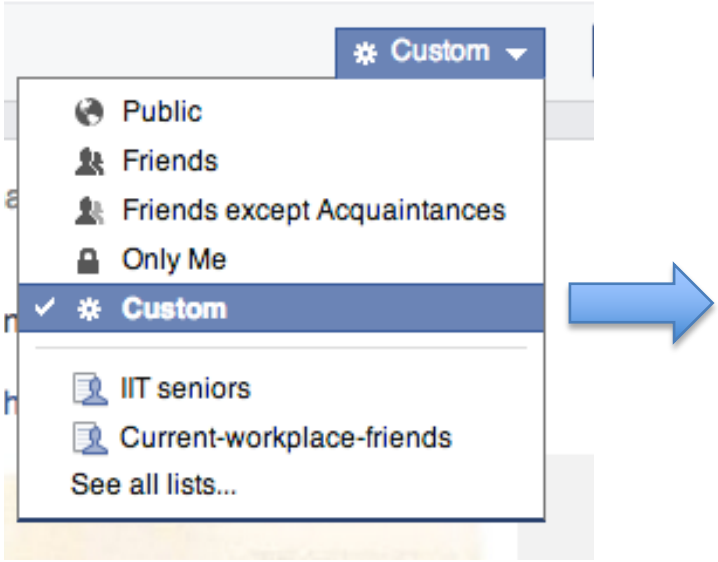
Non privacy sensitive content: all friends should be able to access

Privacy sensitive Content: only select friends should be able to access

How do users manage access currently?

Users specify **Social Access Control Lists** (SACLs)

SACLs: Share with a subset of friends



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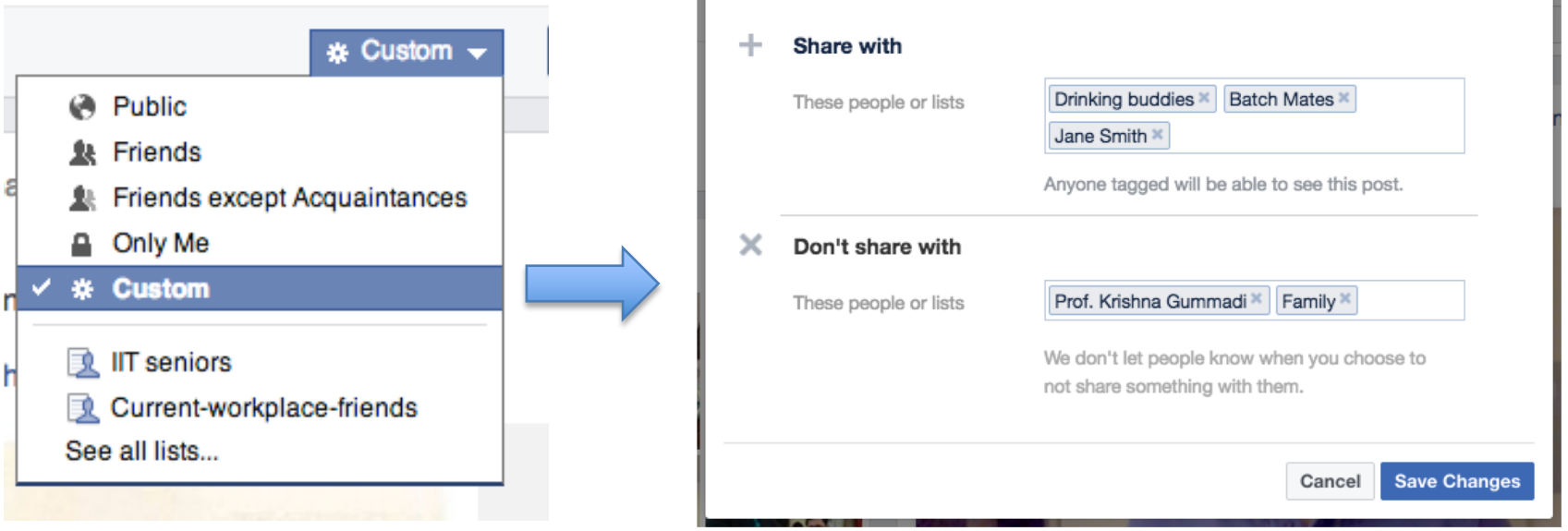

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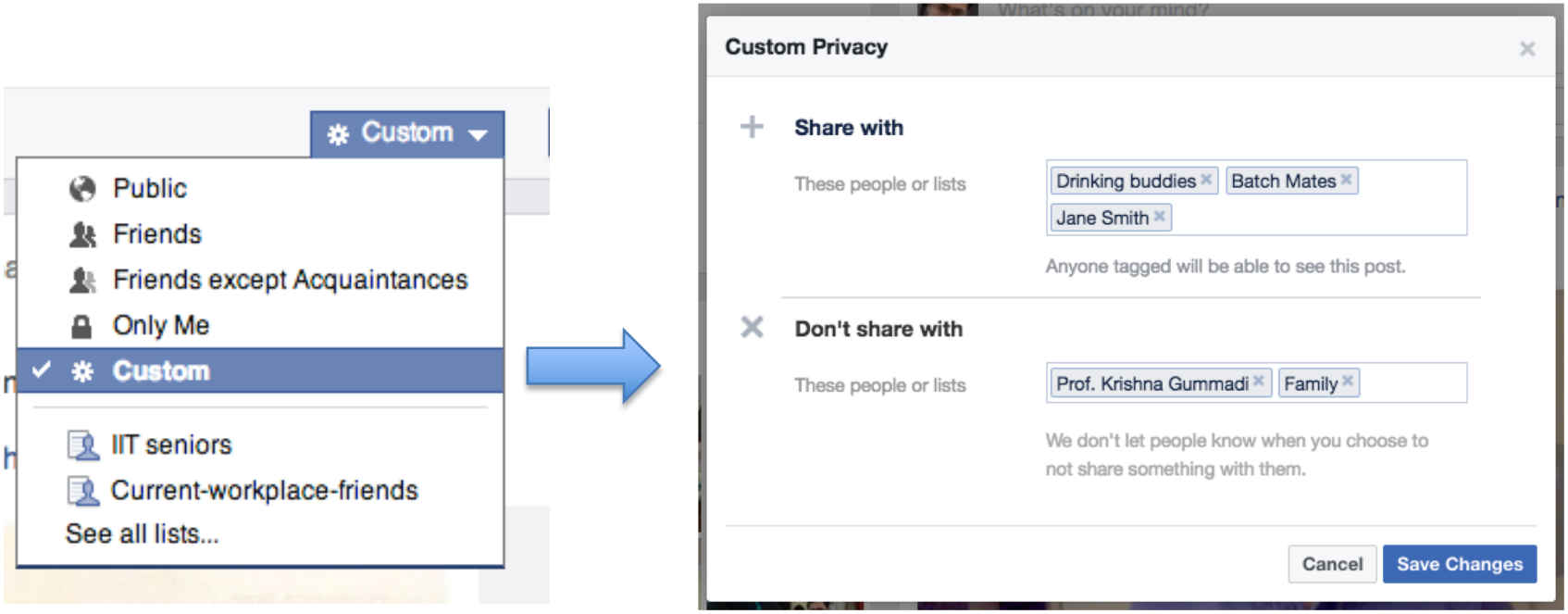

Each time users have to specify these SACLs manually!

State of the art for helping SACL specification

Provide users **automatically detected groups**

- **Network community** based group detection
- **User profile attribute** based group detection
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Assumption by existing work:

- **Automatically detected groups are similar to SACLs**

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Our goal is to better understand **real world SACL usage** & **simplify SACL specification**

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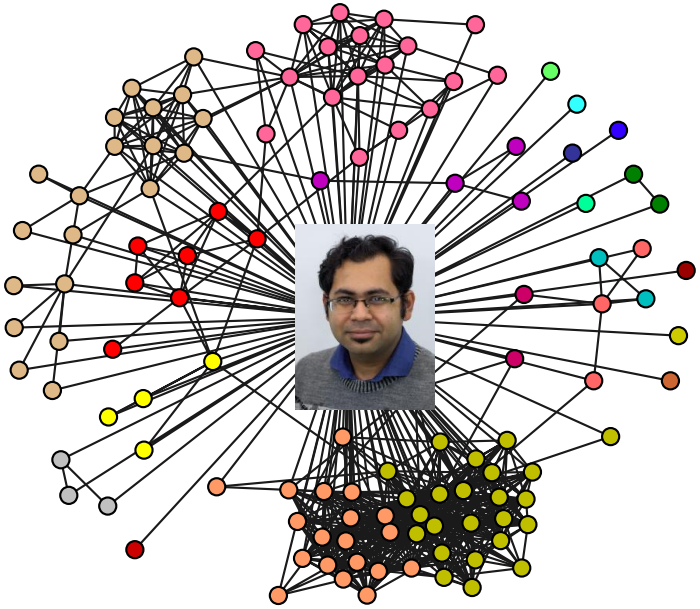

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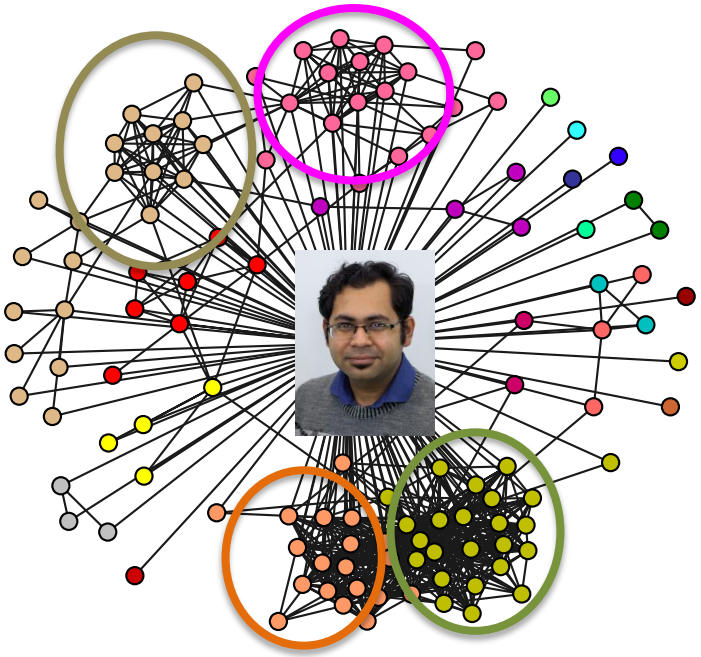

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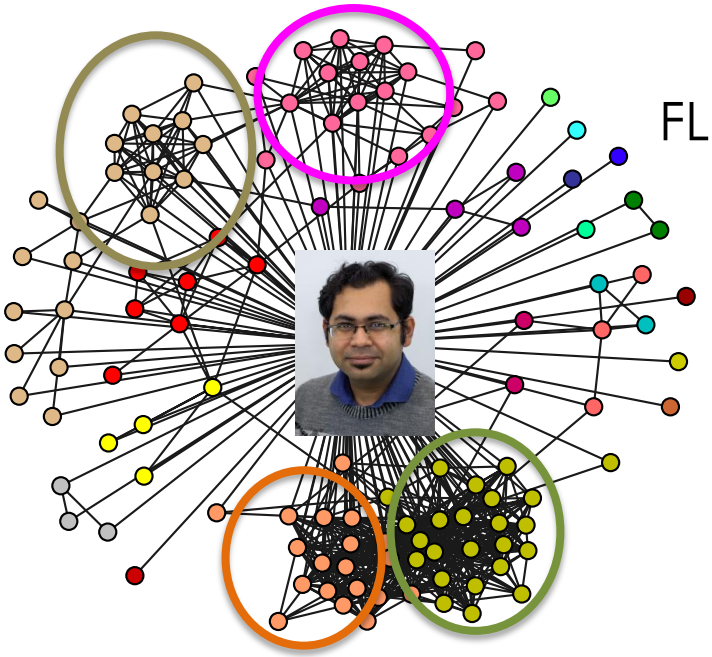

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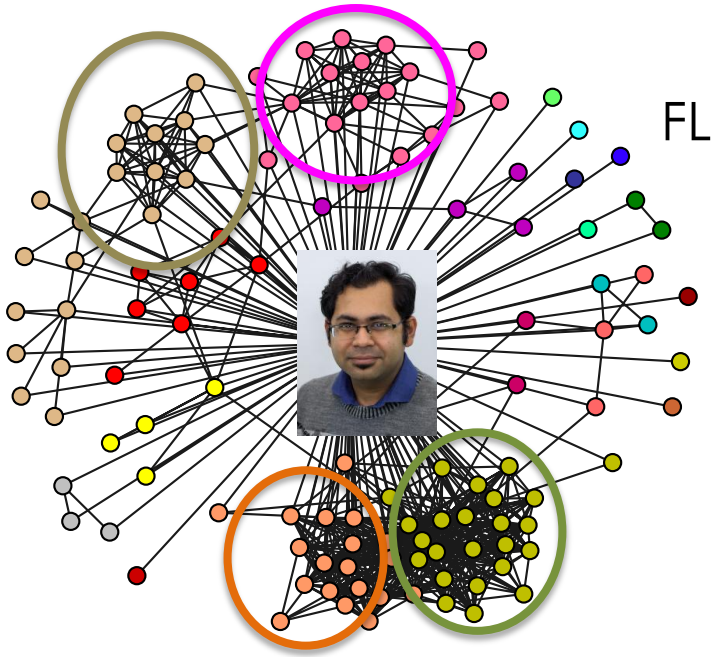

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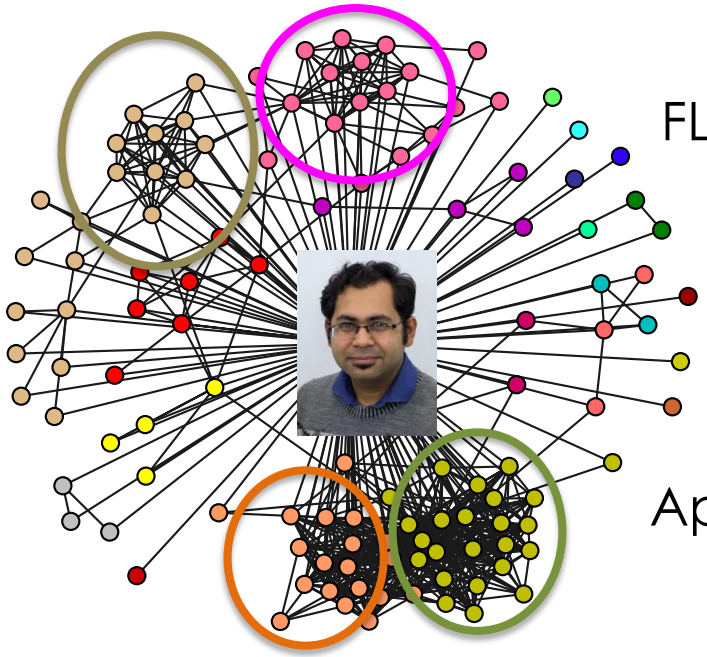

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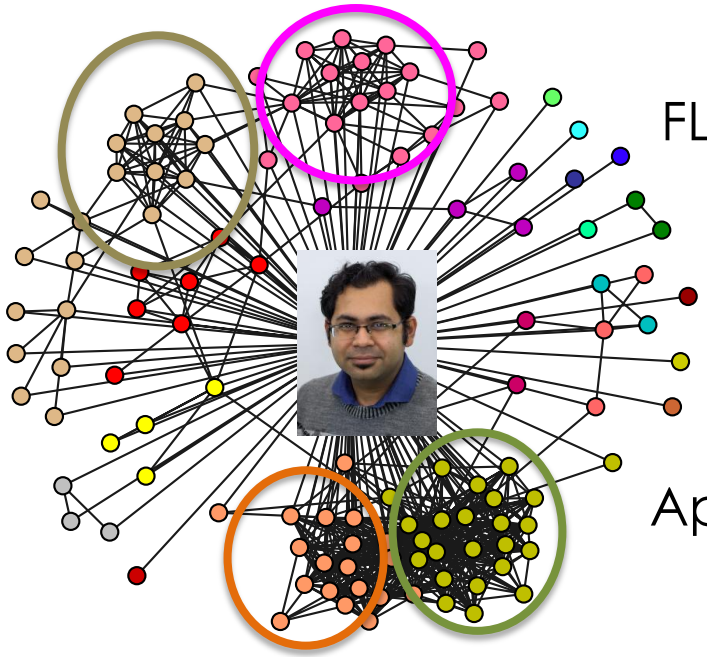

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1,200+ users have installed FLM in 2013 - 2014!

How to collect data from FLM users?

We asked consent from users to access their data

- **1,100+** users gave consent
- Collected a snapshot of all their profile and SACL data

First large scale dataset of real in-use SACLs

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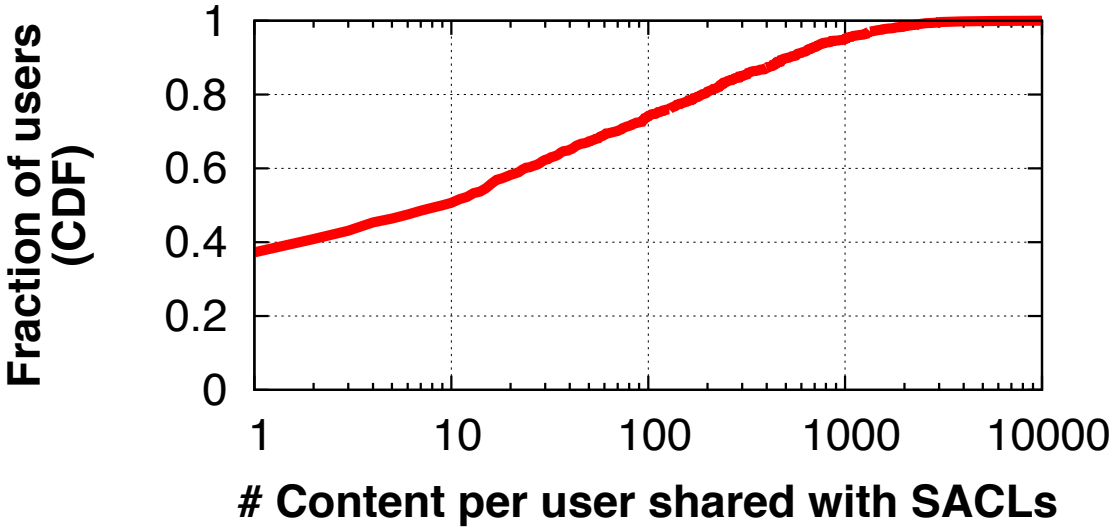

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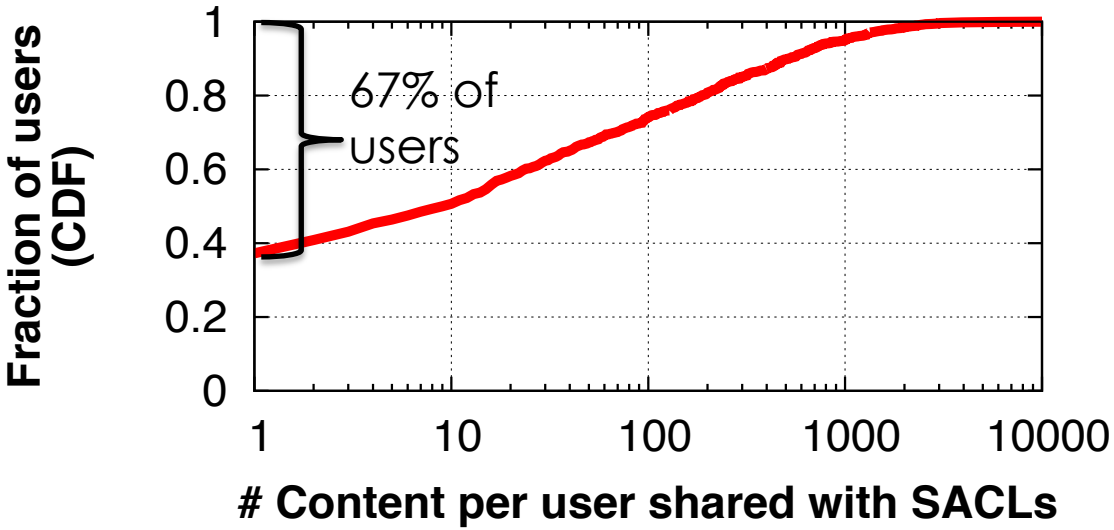

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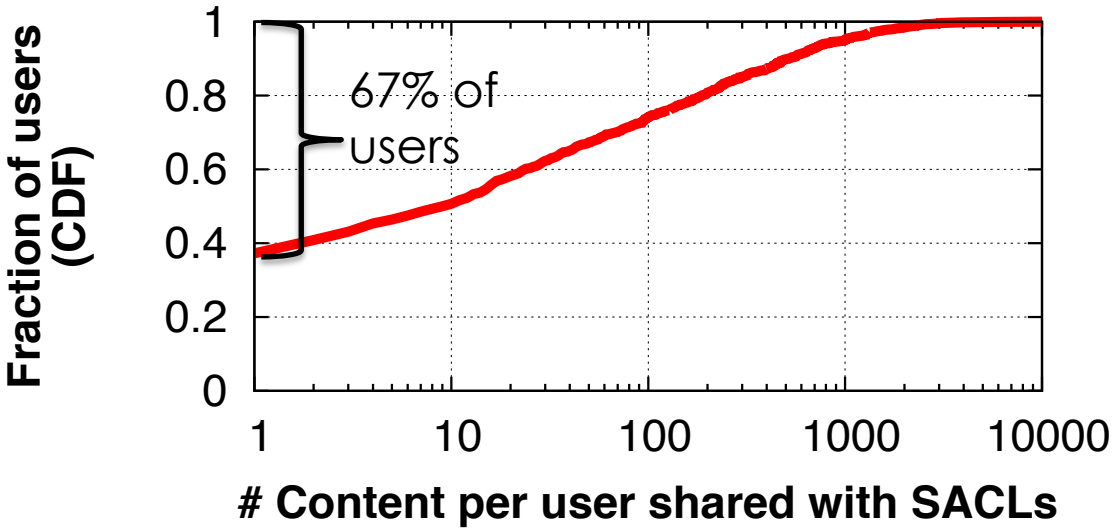

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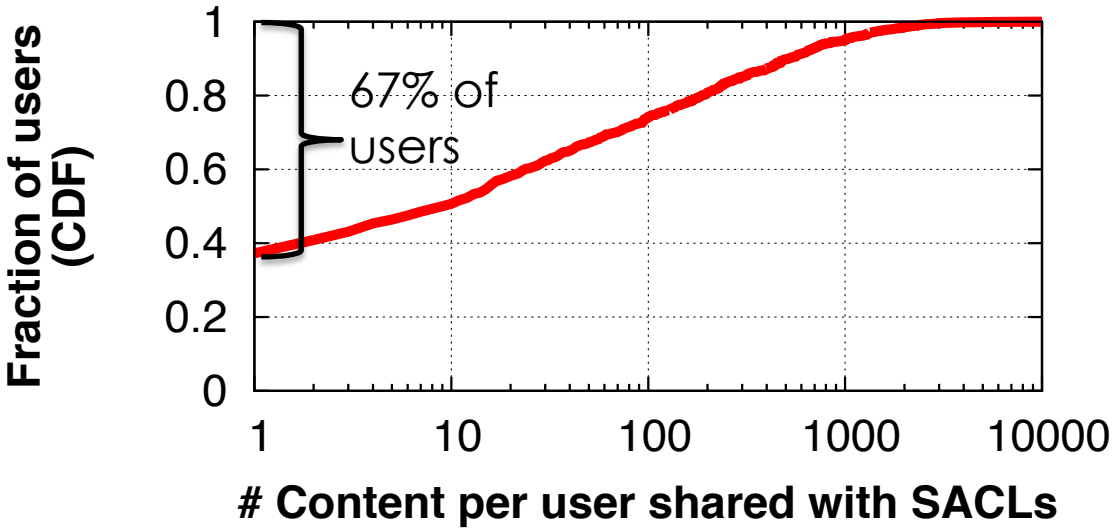

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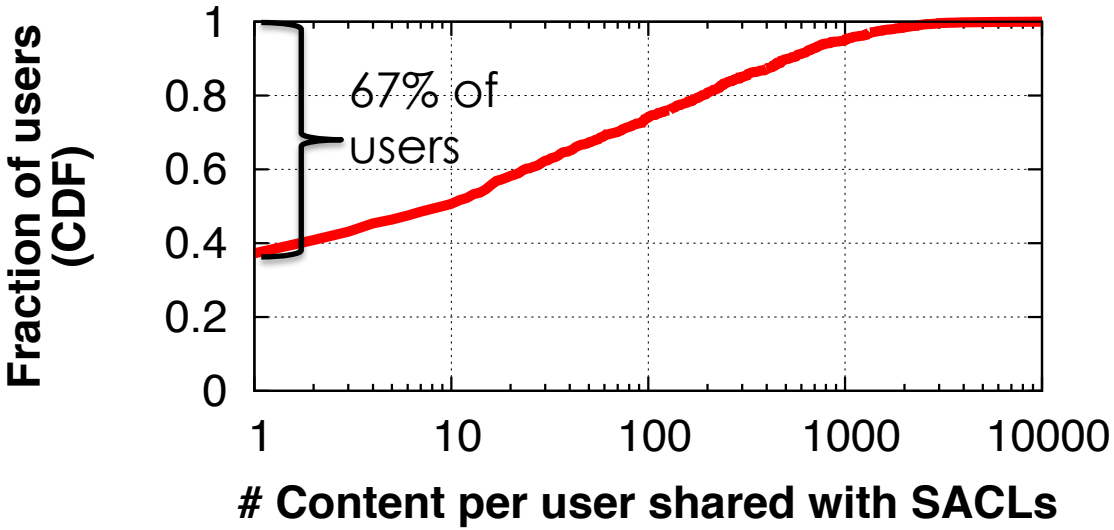

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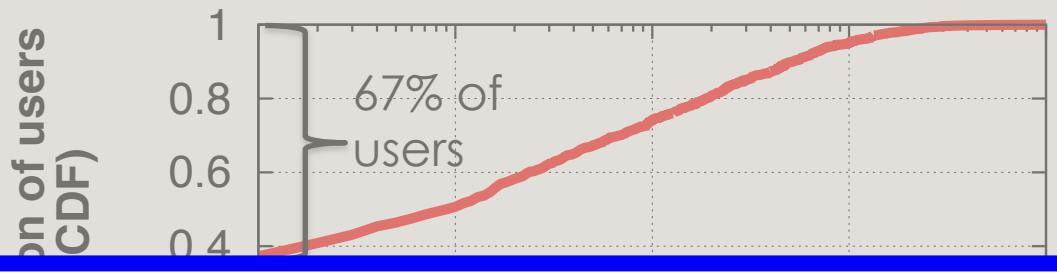

How can we design systems for reducing user overhead of specifying SACLs?

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Average user overhead = average #terms per content

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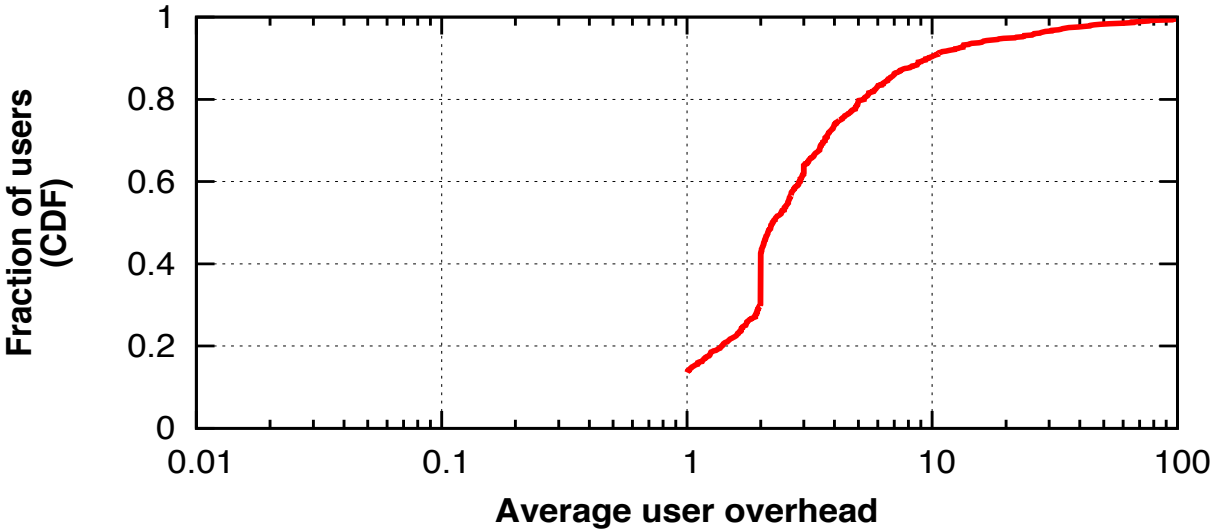

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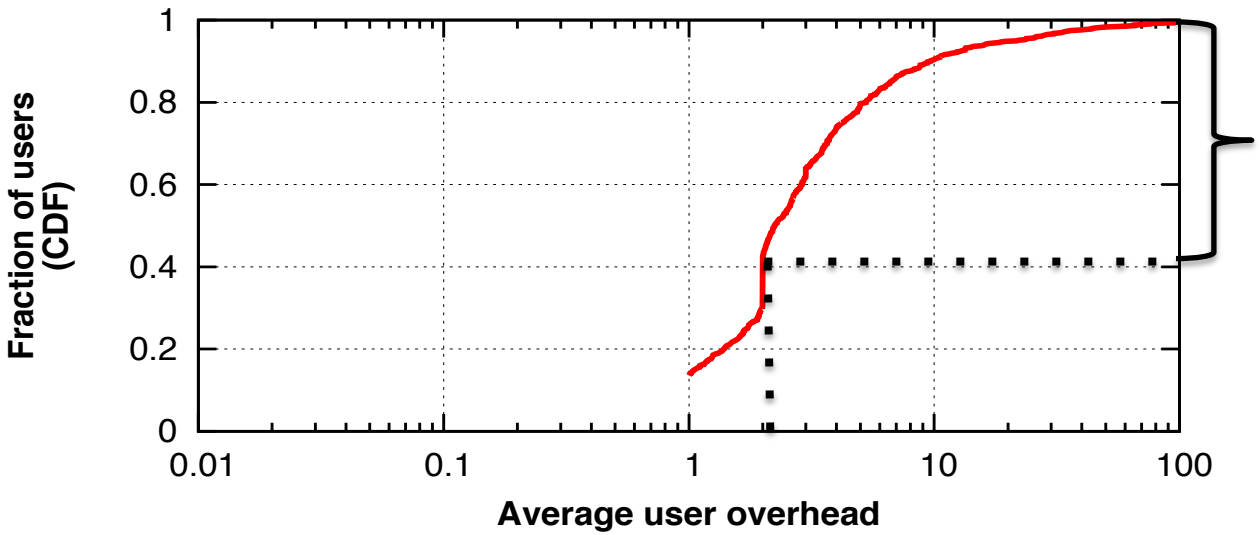

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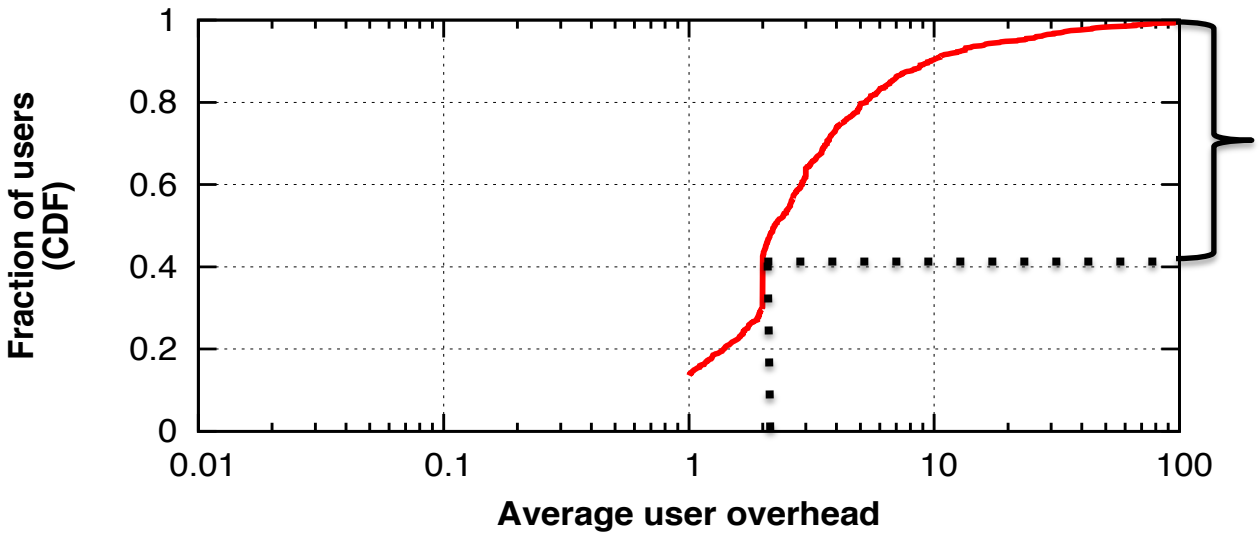

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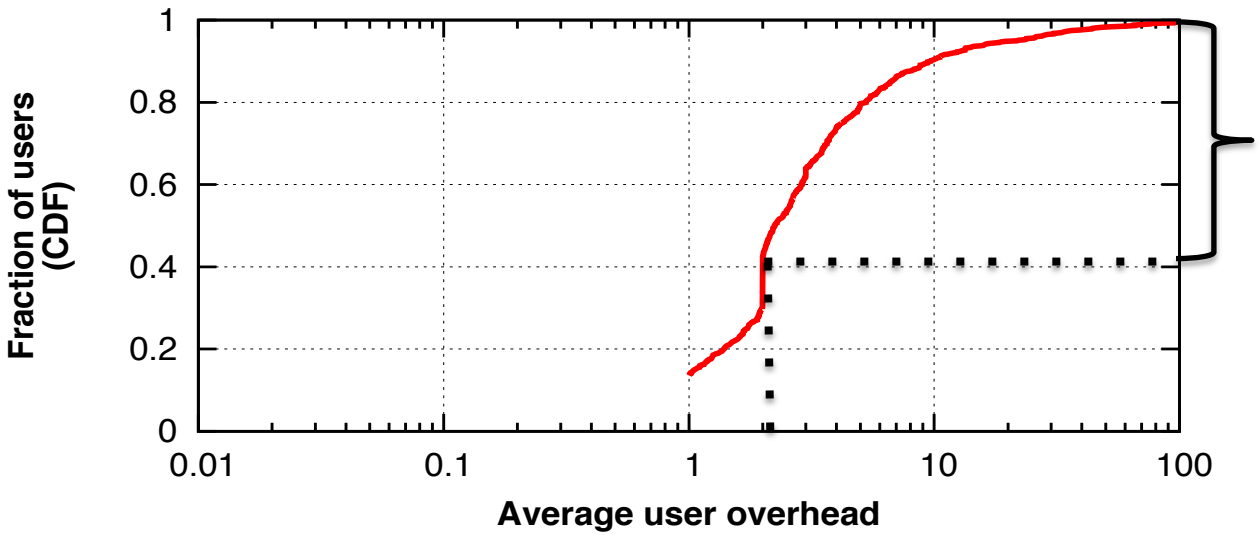

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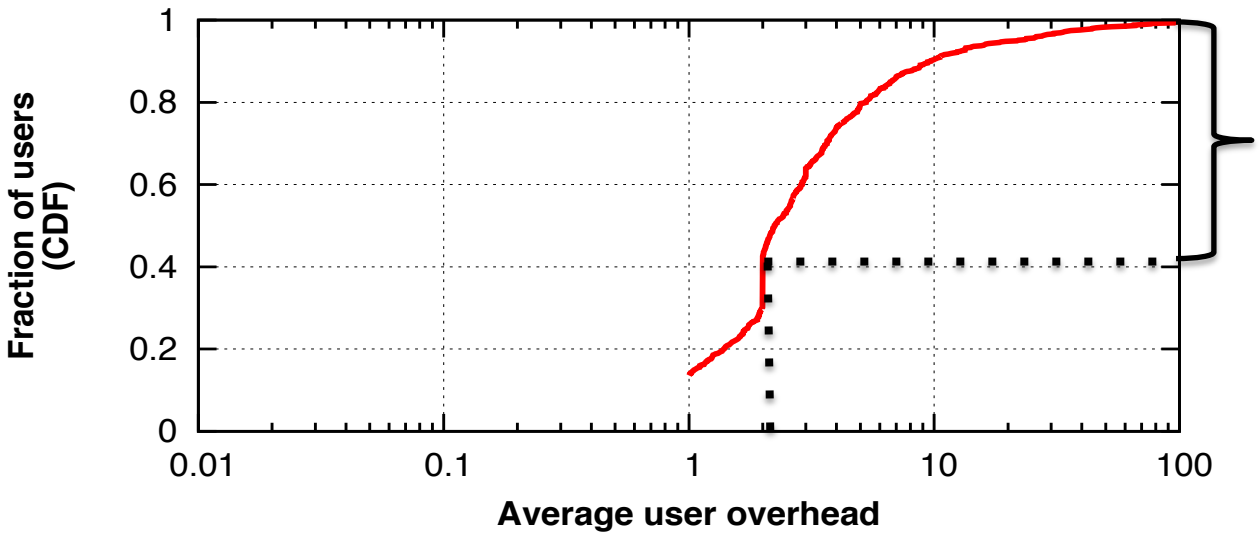

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Can we use automated groups to reduce this overhead?

Can we reduce overhead using automatically detected groups?

In the existing work there are three types of group detection for SACLs:

Based on network structure, user profile attributes, user activity

We tried all!

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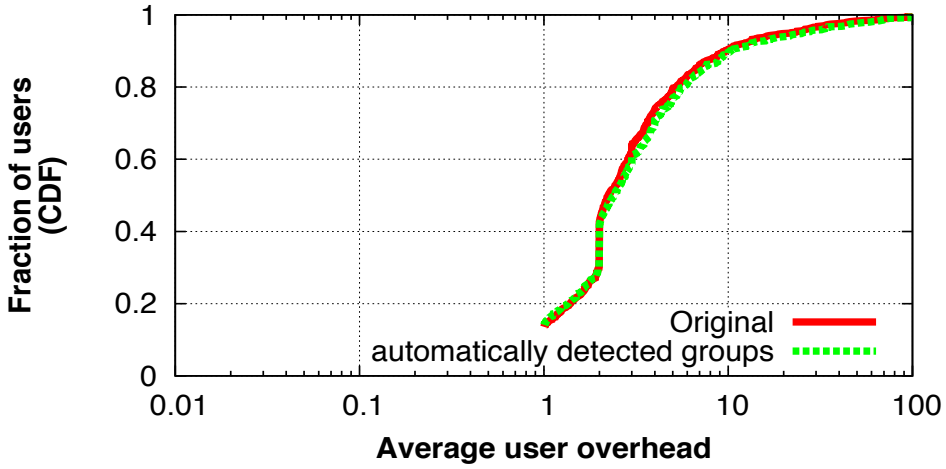

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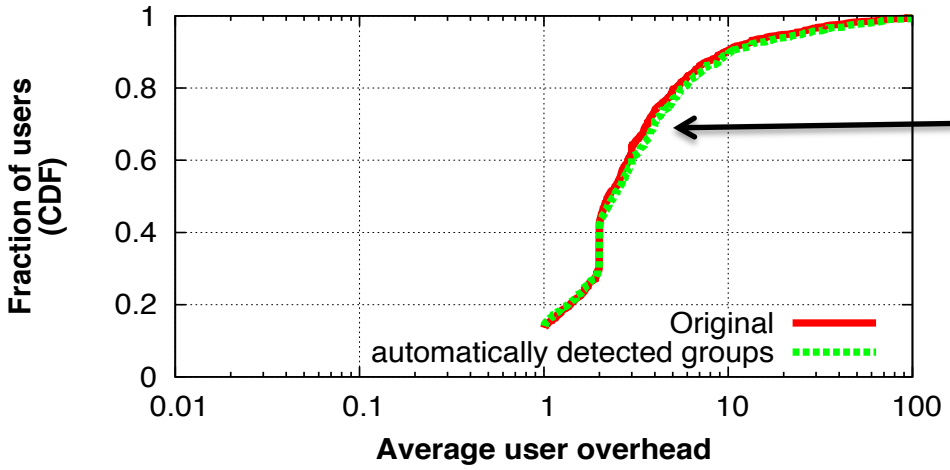

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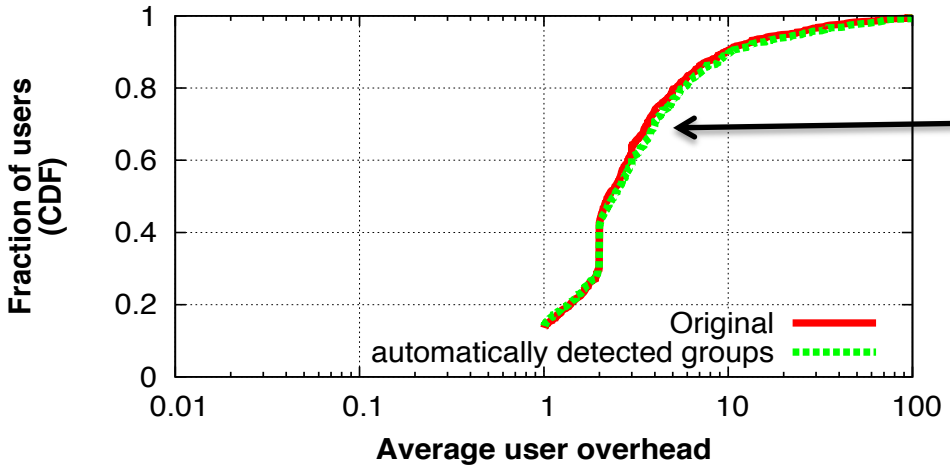

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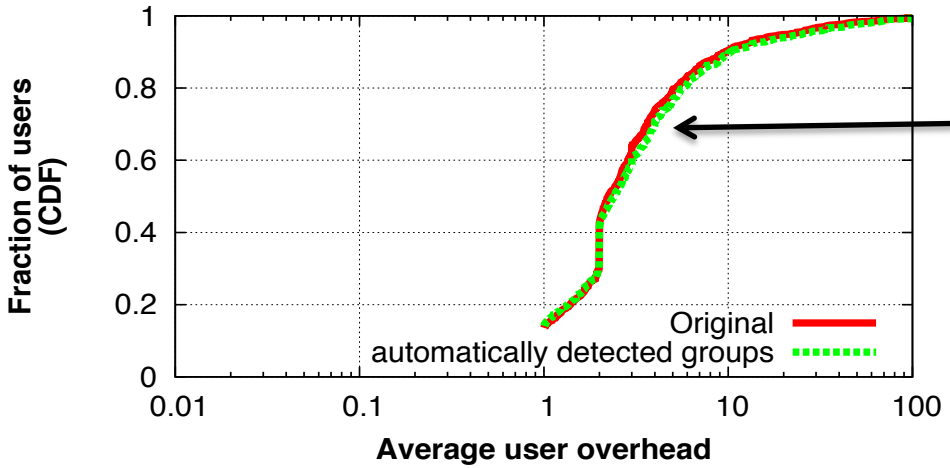

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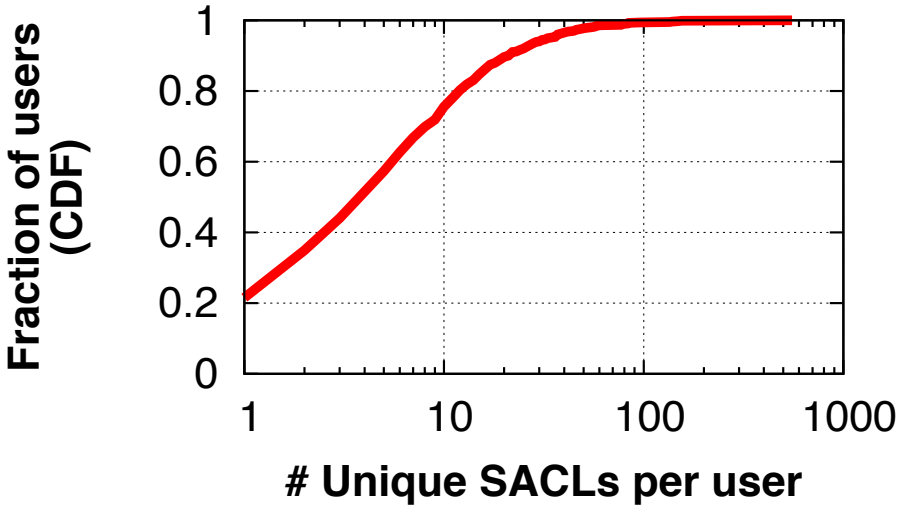
Is there any other way?

Insight via modelling user behavior: Users reuse SACLs repeatedly



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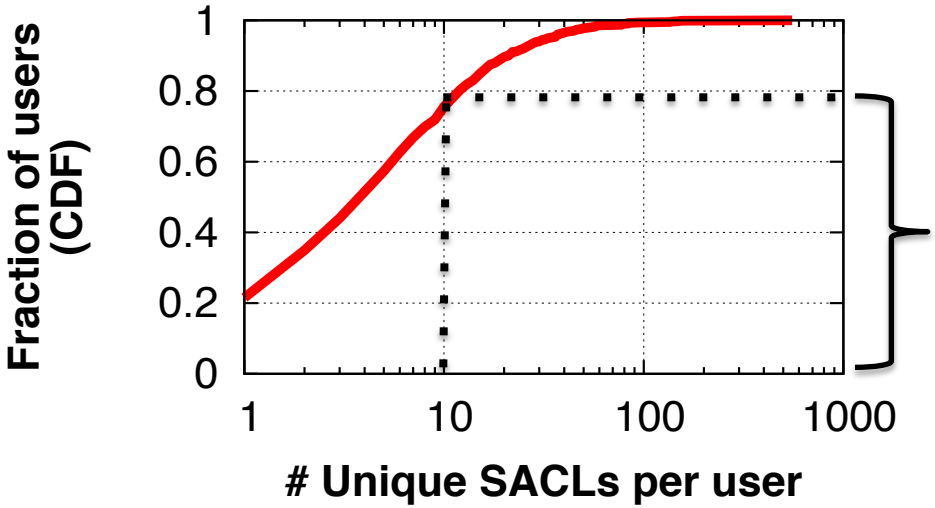

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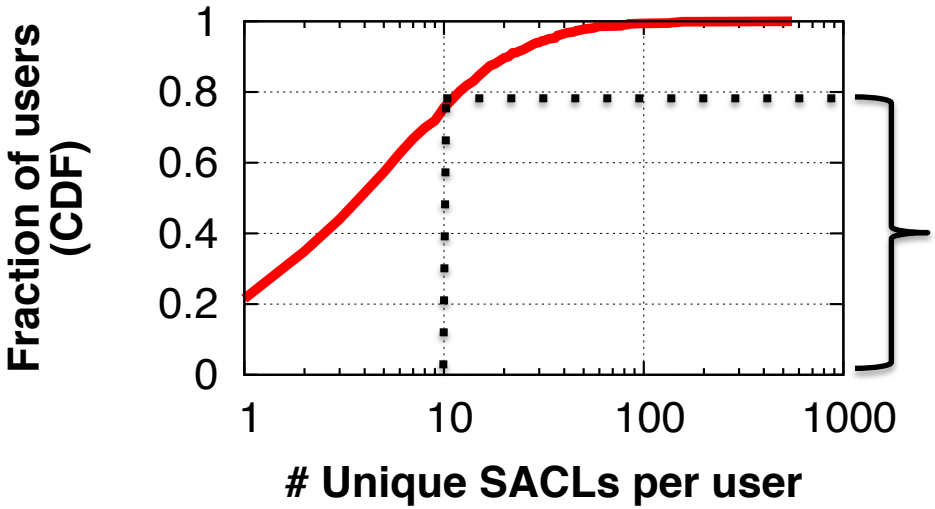

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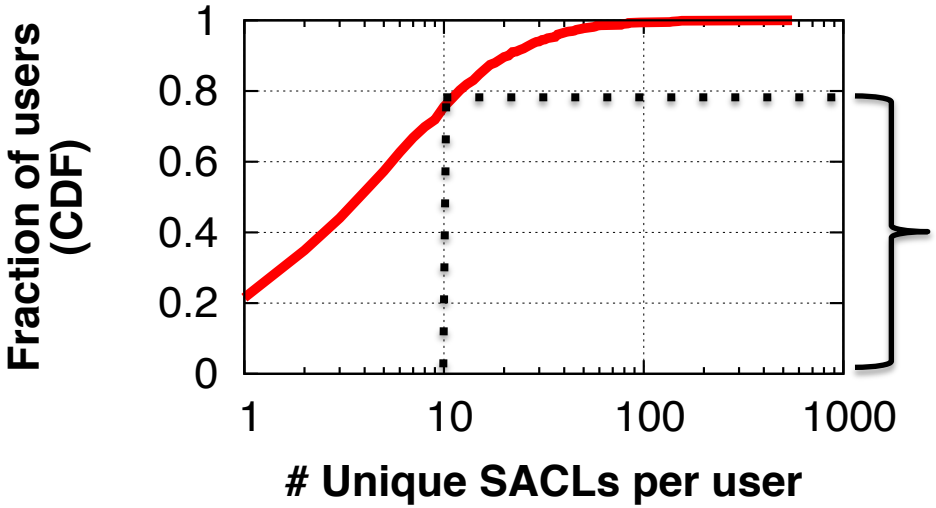

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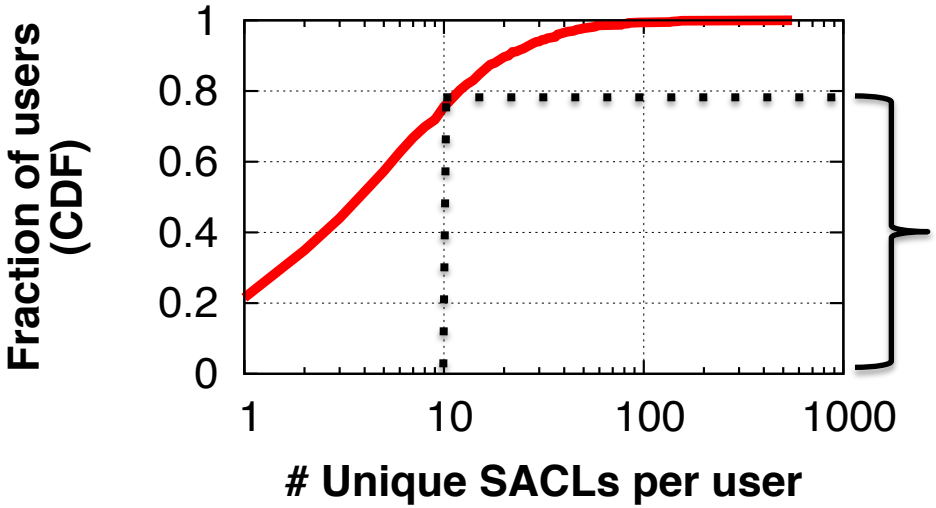

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Idea: How about **caching** a few of the past SACLs to reduce overhead?

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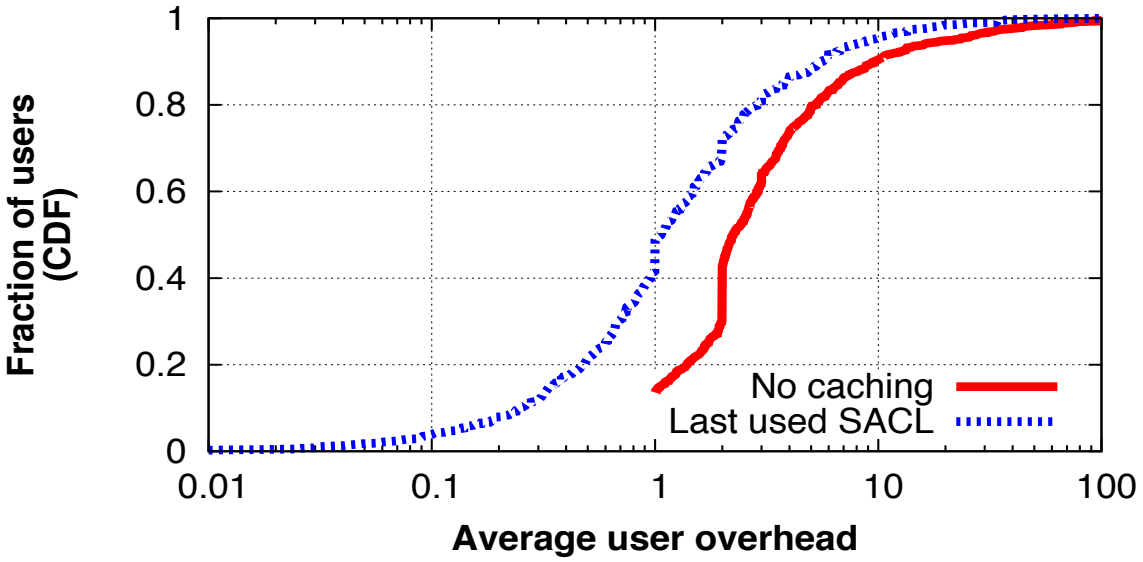

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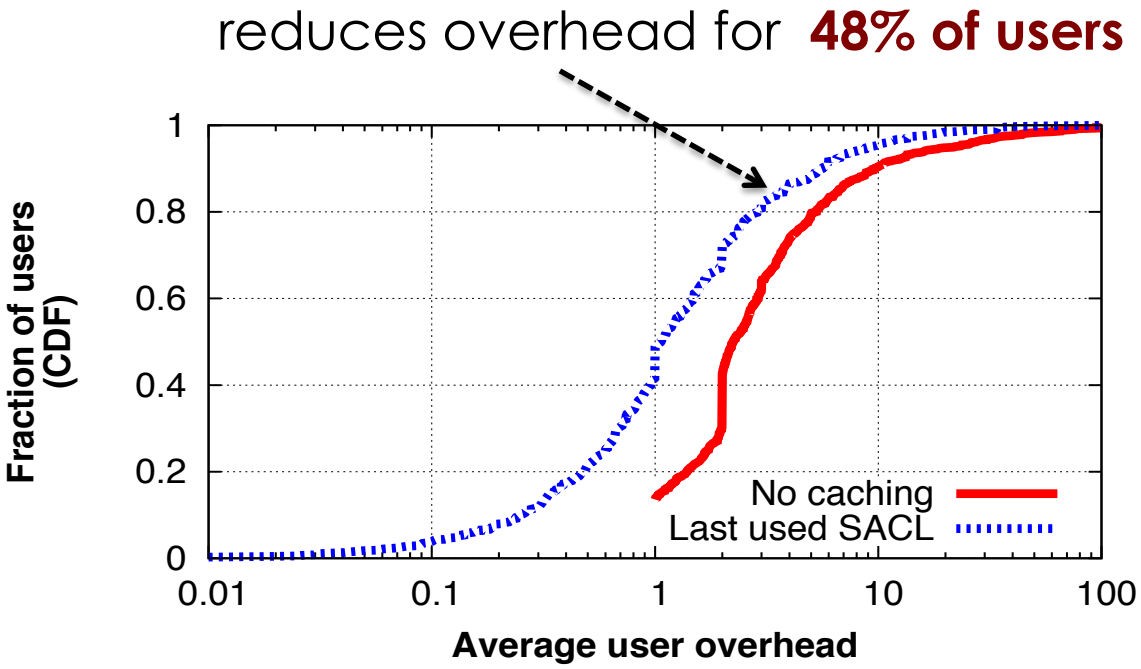

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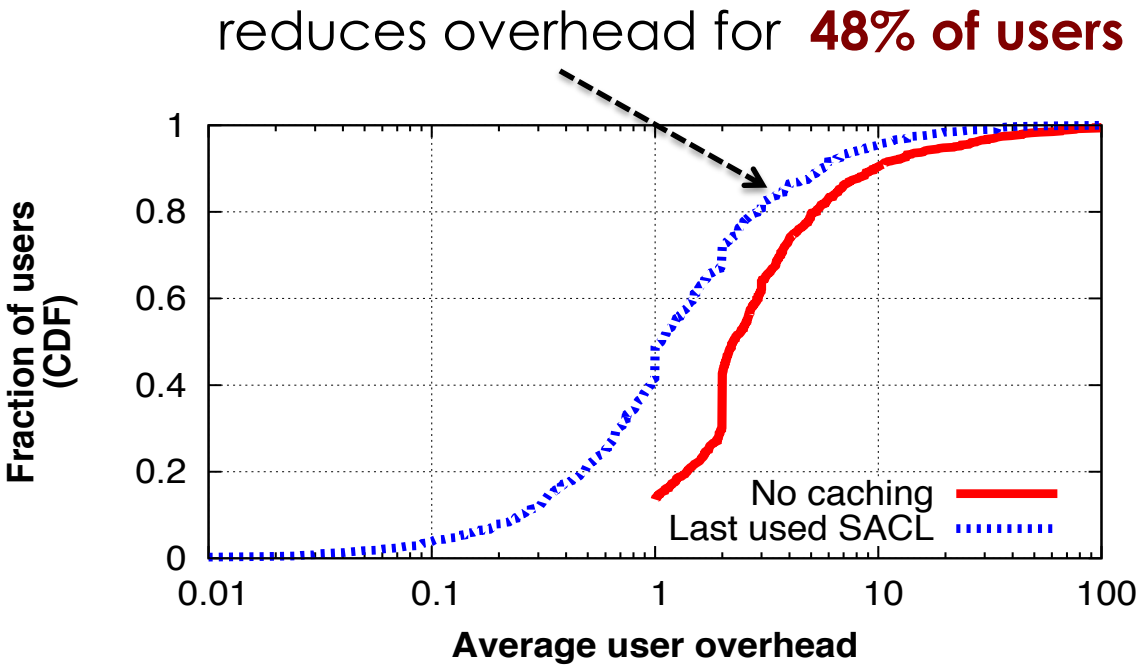

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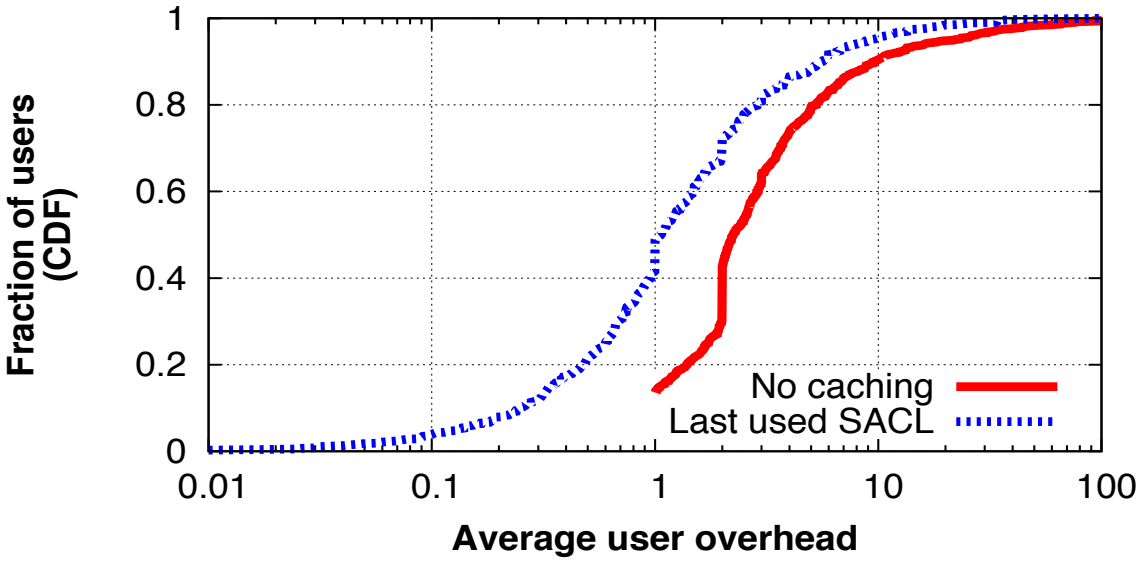

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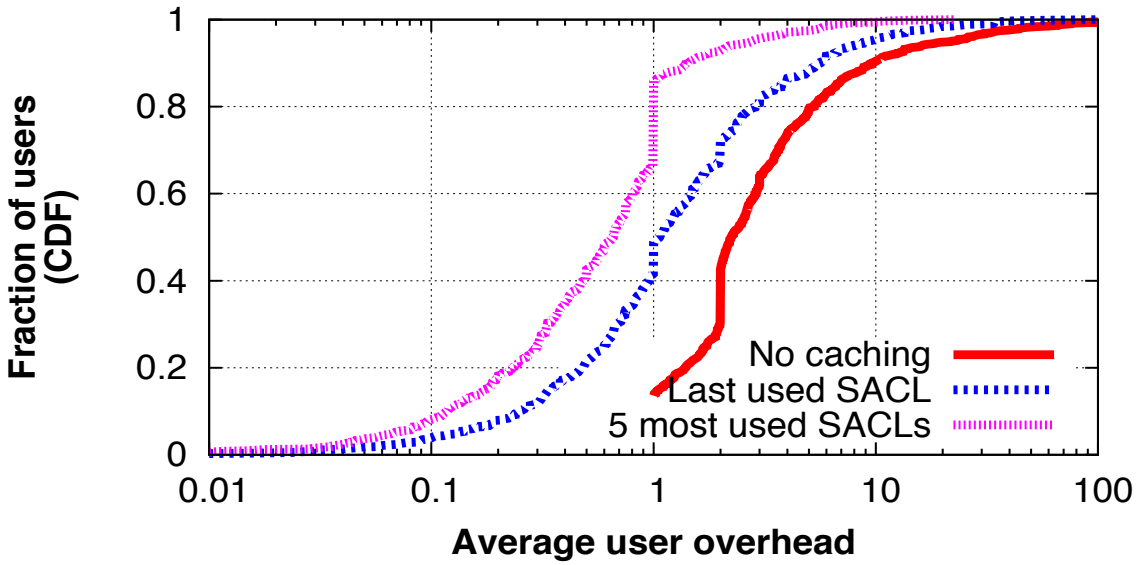

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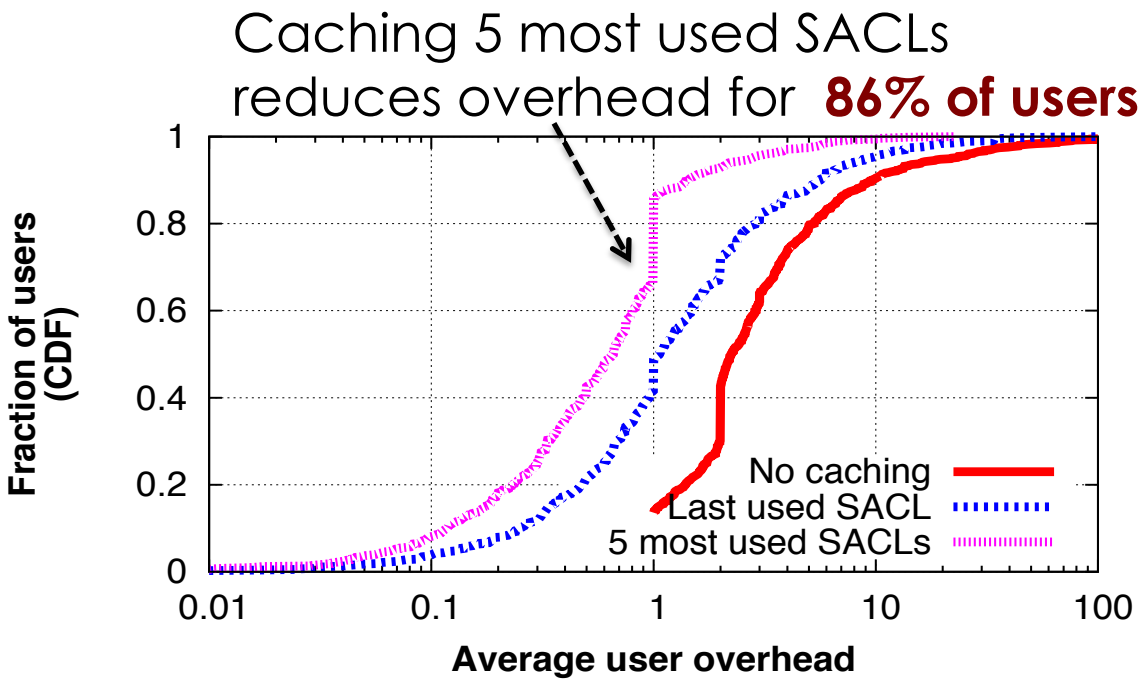

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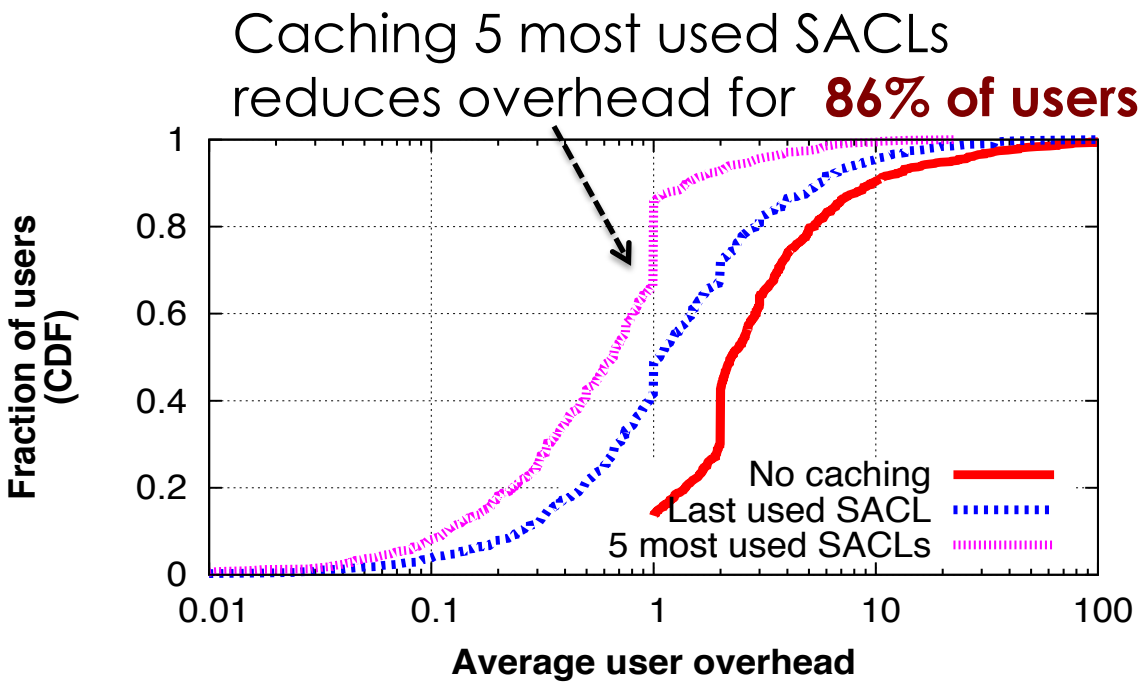

SACL specification overhead significantly reduces if we cache just a few SACLs!

Limiting third party crawlers (data aggregators) in social media

- Questions
  - Why are third party crawlers bad?
  - What do they do with the data?
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Why are third party crawlers bad?

Recap: Example of a third party crawler -- Spokeo

Service aggregating "public" data from web

Others get all of this data by searching Spokeo

After aggregation: Inferring non public data become easier

Users complained of privacy violation

Problem: Third party crawlers violate exposure

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In 2010, 171 M Facebook user's data published in torrent

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- User data is valuable asset to OSM operators
- OSM operators are blamed for misuse of user data [NYTimes '10]

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OSMs need to limit large-scale third party crawlers

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What can be done with aggregated data?

Sale the data to databrokers

- What are data brokers [from wiki]
  - …collects information about individuals from public records and private sources…

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  - The data are aggregated to create individual profiles
  - Profiles: age, race, gender, height, weight, marital status, religious affiliation, …, net worth, home ownership status, investment habits, product preferences, health-related interests

What do data brokers do with this data?

- The sell it (Duh!)
  - To marketers and ad companies
  - To government agencies
  - To background checkers
  - To anybody who can afford…

Facebook used to partner with data brokers

- Why? : For getting more data about users
  - Study: Auditing Offline Data Brokers via Facebook's Advertising Platform
  - Venkatadri et al., WWW 2019
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  - In a nutshell:
    - They targeted participants with Transparency Enhancing Ads (Treads)
    - Treads: embed the targeting parameter in the image so that users know what Facebook thinks their attributes are

Lastly: Some data brokers

Country	Partner	Attribute count	Targetable		Percent
			Overall	Partner	
U.S.	**All**	507	210M	190M	90.5%
	Acxiom	128	210M	160M	76.2%
	Datalogix	350	210M	160M	76.2%
	Others[5]	10	210M	150M	71.4%
	Experian	5	210M	140M	66.7%
	Epsilon	14	210M	130M	61.9%
Australia	**All**	58	16M	13M	81.3%
	Experian	34	16M	12M	75.0%
	Acxiom	24	16M	9.1M	56.9%
U.K.	**All**	139	39M	29M	74.4%
	Acxiom	103	39M	22M	56.4%
	Datalogix	19	39M	17M	43.6%
	Experian	17	39M	15M	38.5%
Germany	Acxiom	60	31M	20M	64.5%
France	Acxiom	21	32M	18M	56.3%
Brazil	Experian	20	120M	61M	50.8%
Japan	Acxiom	17	25M	12M	48.0%

Table 1: Coverage of different data brokers across countries with partner categories. We show the total number of broker attributes, the number of Facebook identities that are targetable (Overall), the number of these identities that have at least one attribute from that broker (Partner), and the resulting coverage. Countries with more than one broker have a row indicating the coverage of all the brokers together (All).

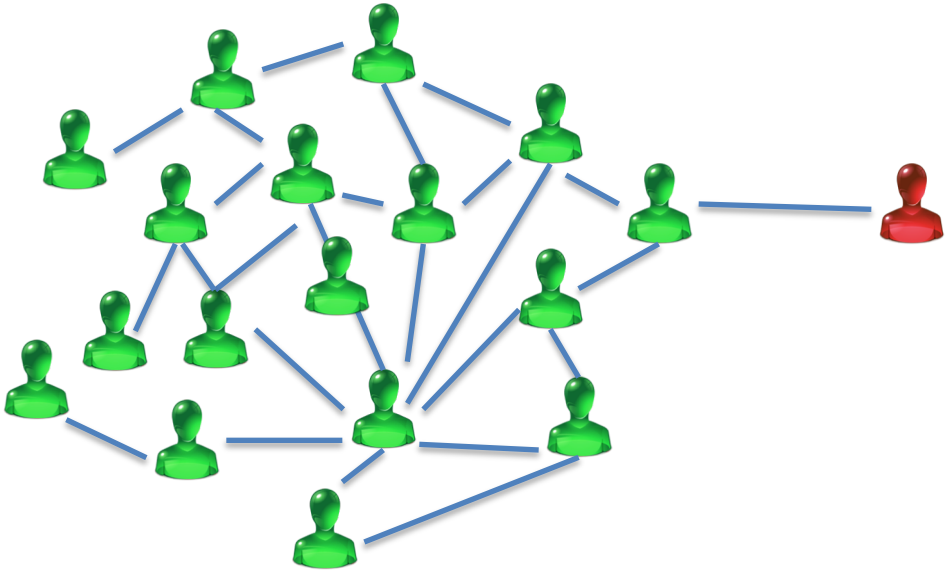
Source: Venkatadri et al., WWW 2019

How to stop the third party crawlers (who help data brokers)?

Existing solution: Simple rate-limiting

OSMs rate-limit on per-account or per IP address basis

Crawlers can defeat rate-limit using multiple accounts



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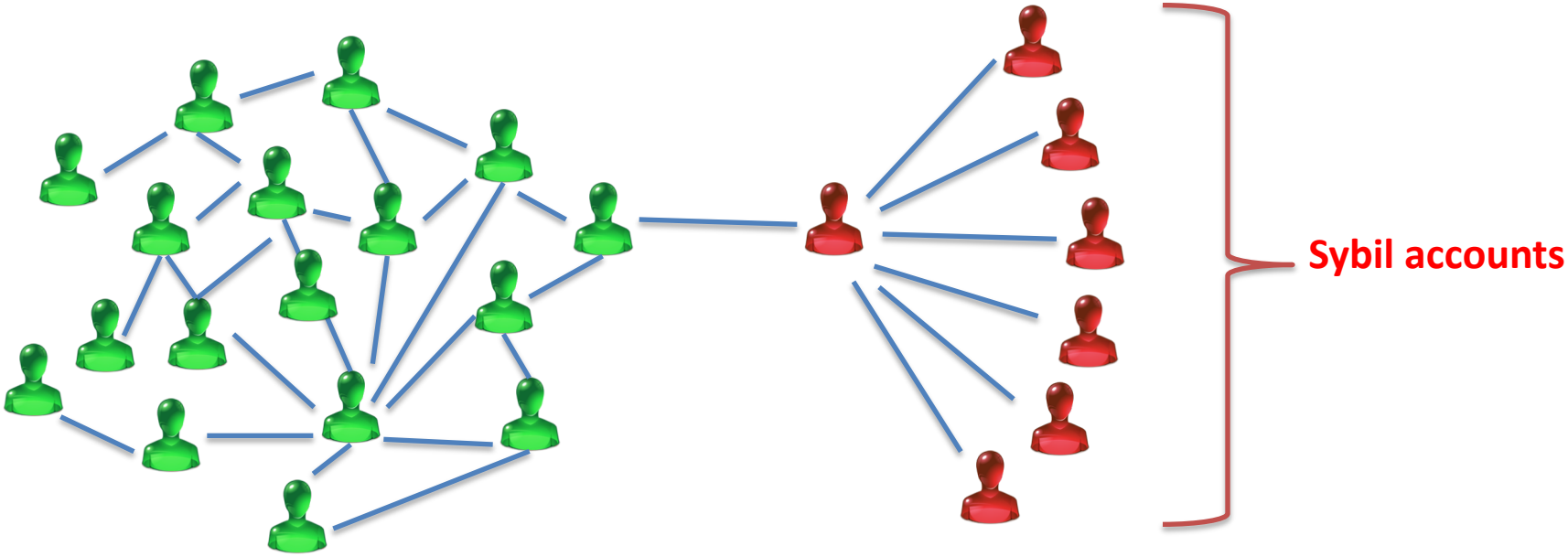

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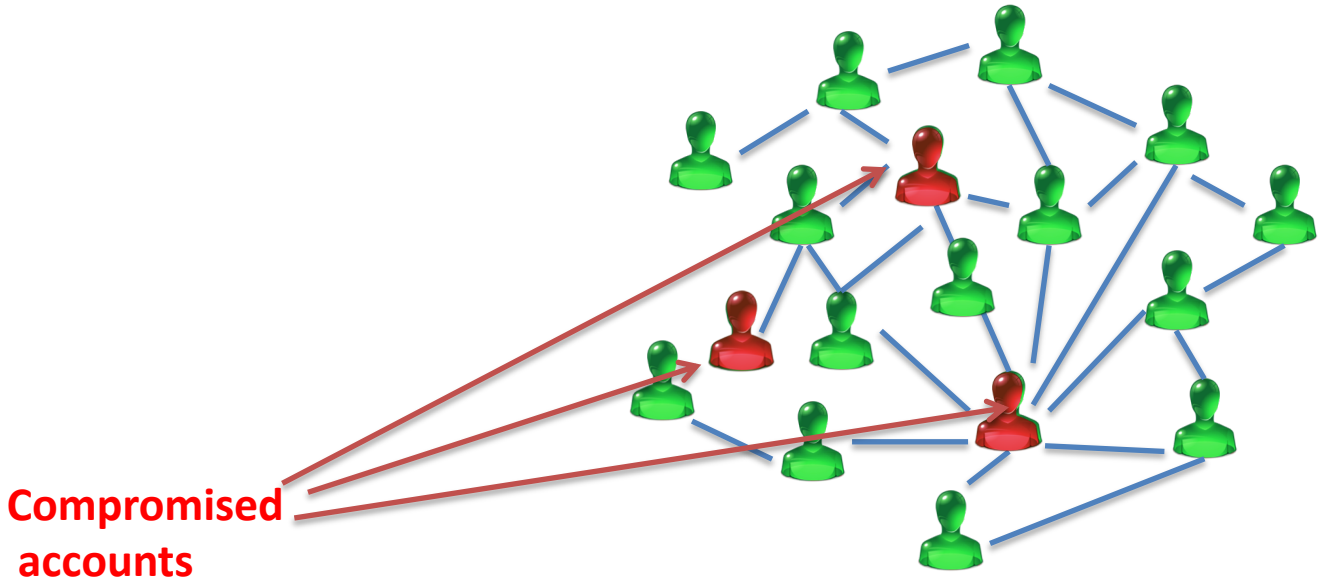


Our solution: Genie

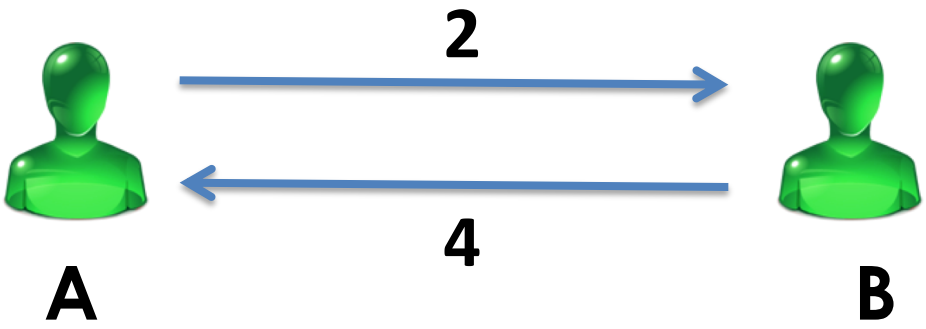
Intuition: Links to good users are harder to get than accounts

Replace user account based rate limiting with link based rate limiting

Credit Networks [EC '11]

Nodes trust each other by providing pair-wise credit

Credit is used to pay for the services received



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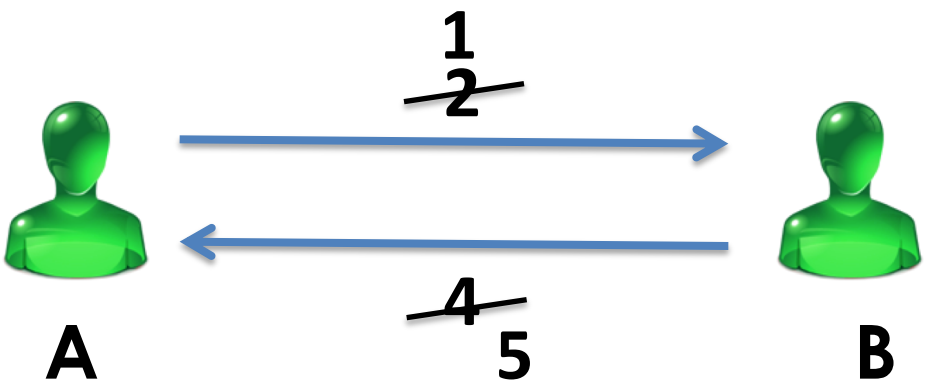

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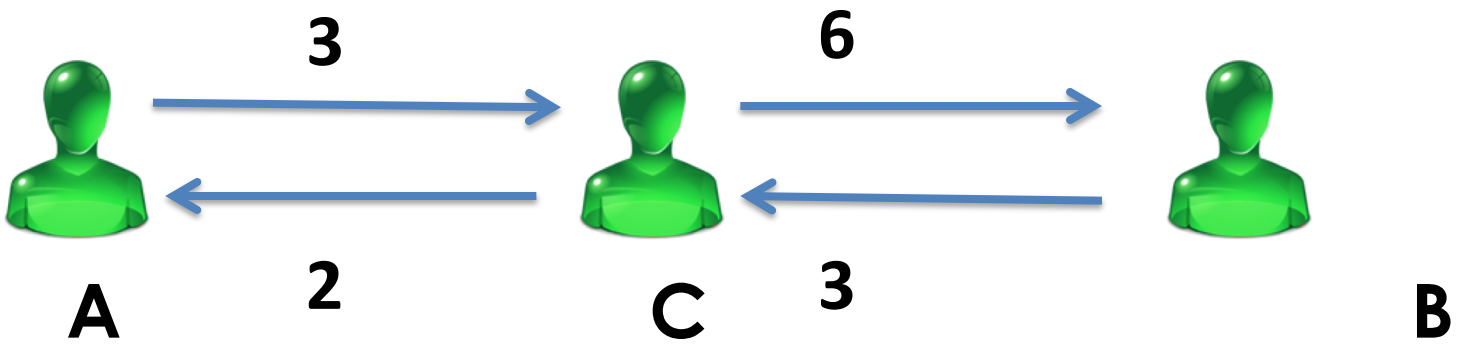

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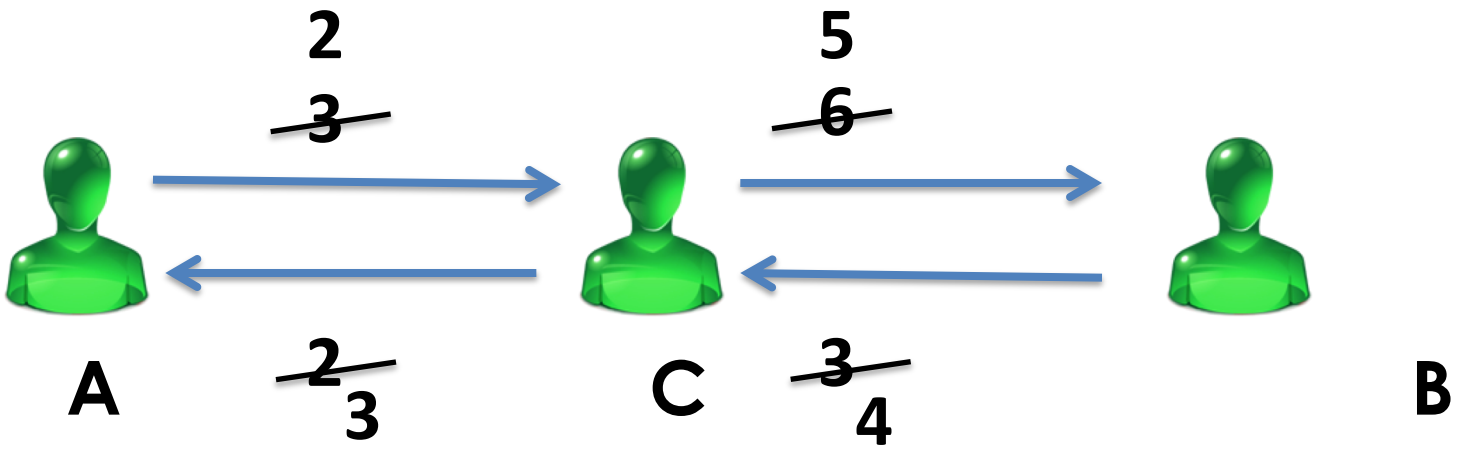

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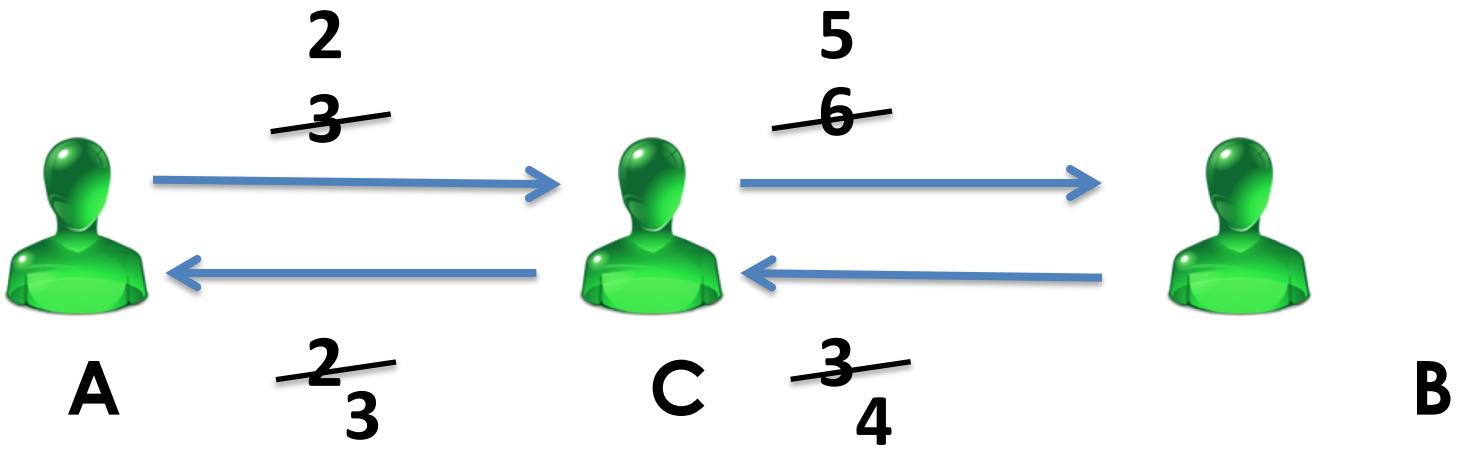


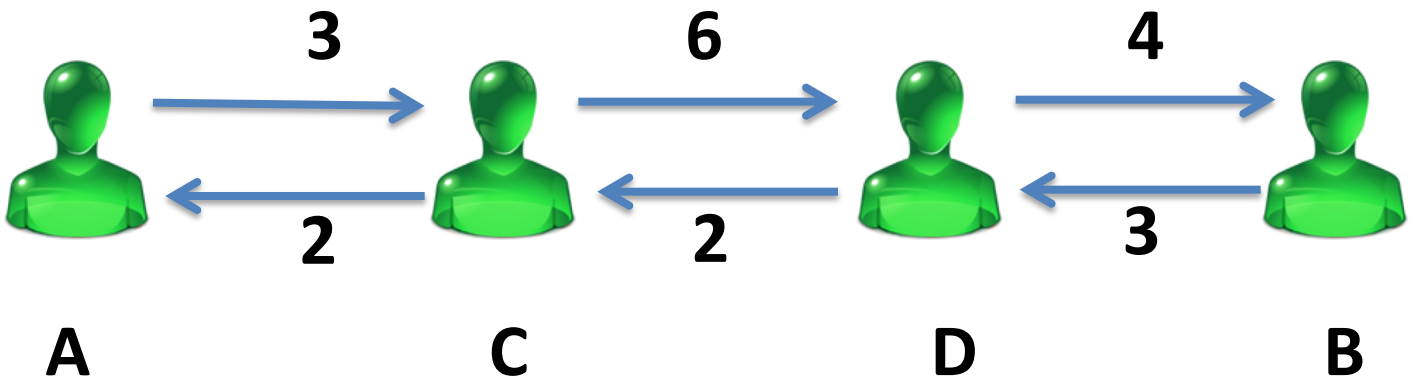
To obtain a service, find path(s) with sufficient credits

How can we map OSM to credit networks ?

OSM operator forms credit network from the social network

Operator assigns initial credit to the links

Credit deducted from links to view another user's profile



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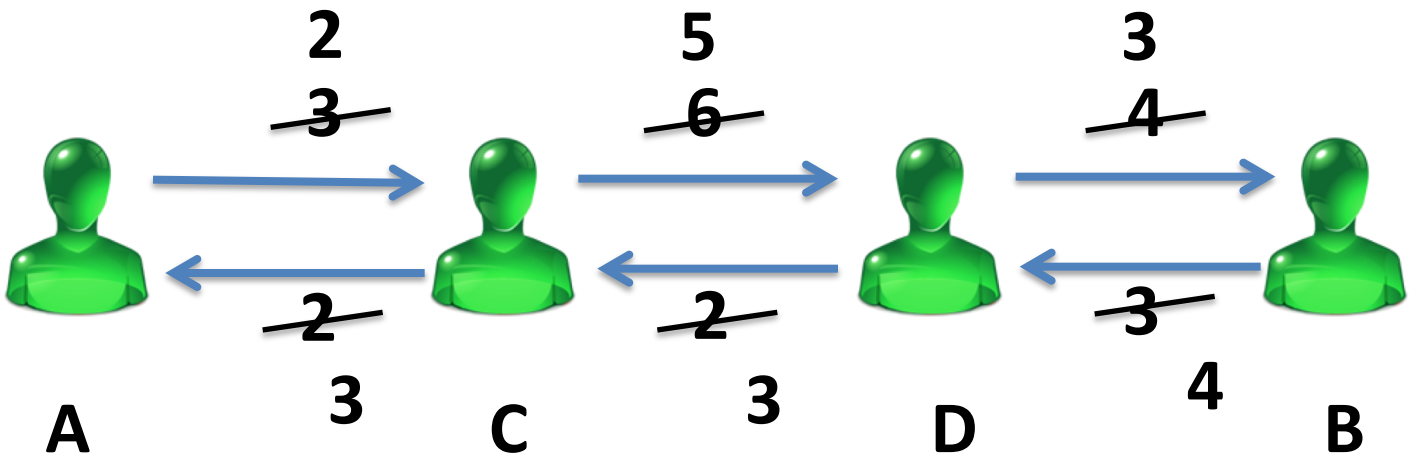

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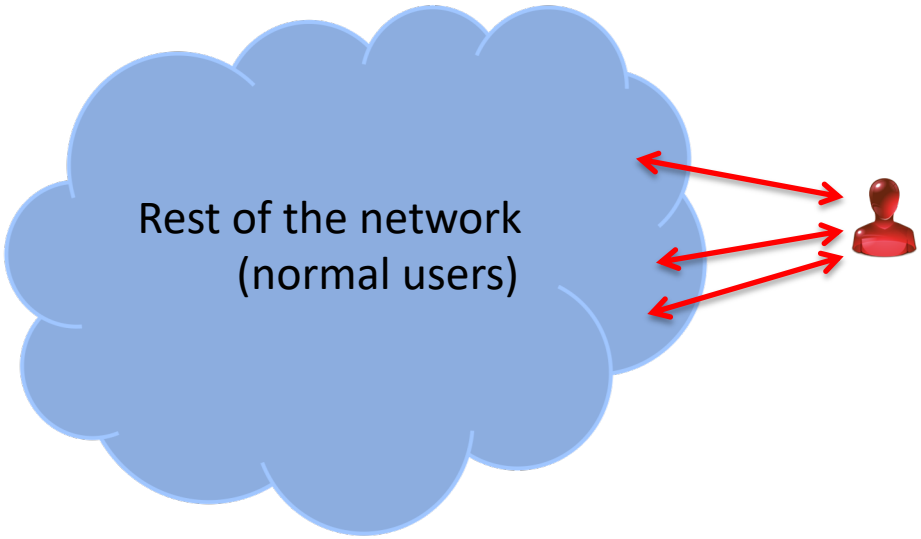

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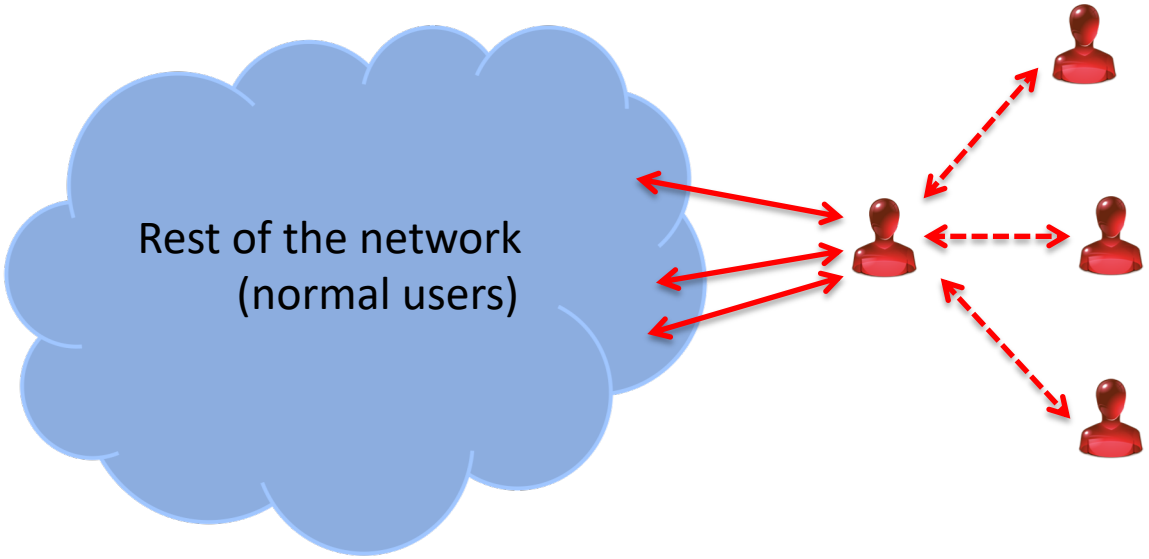

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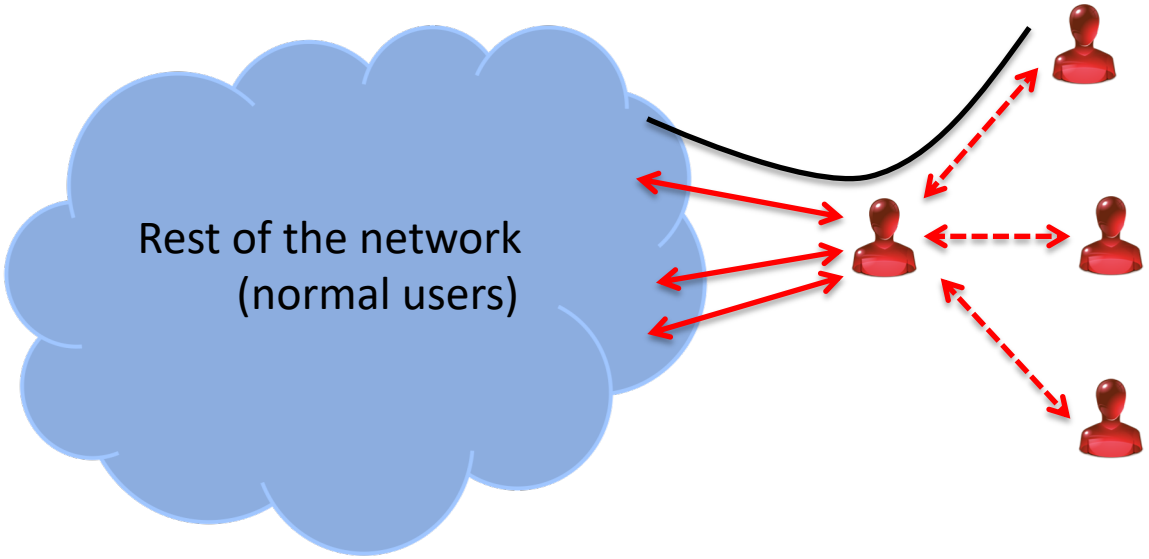

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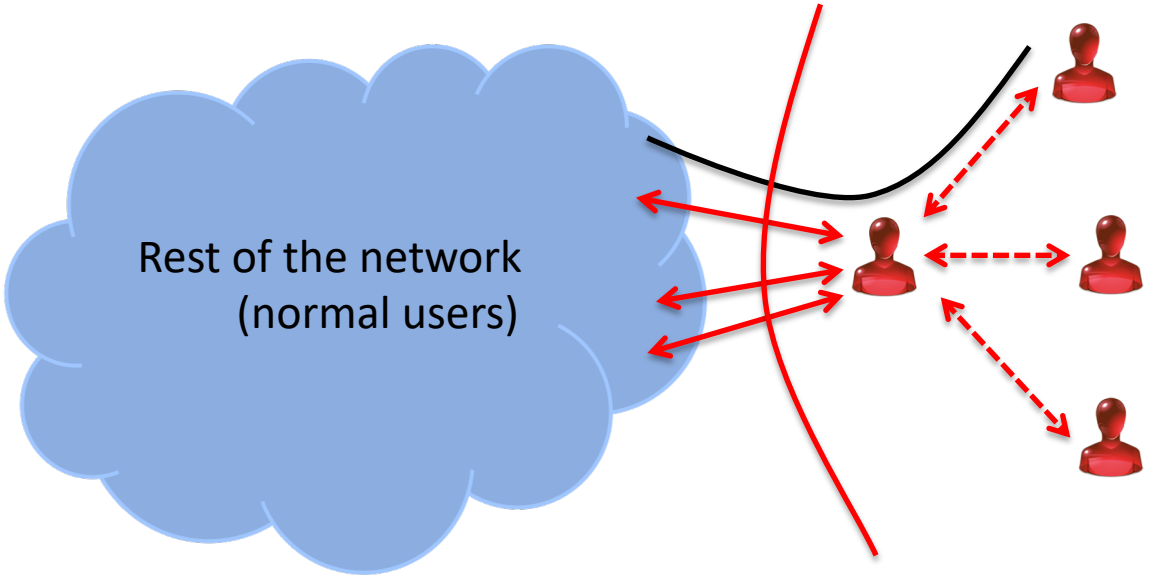

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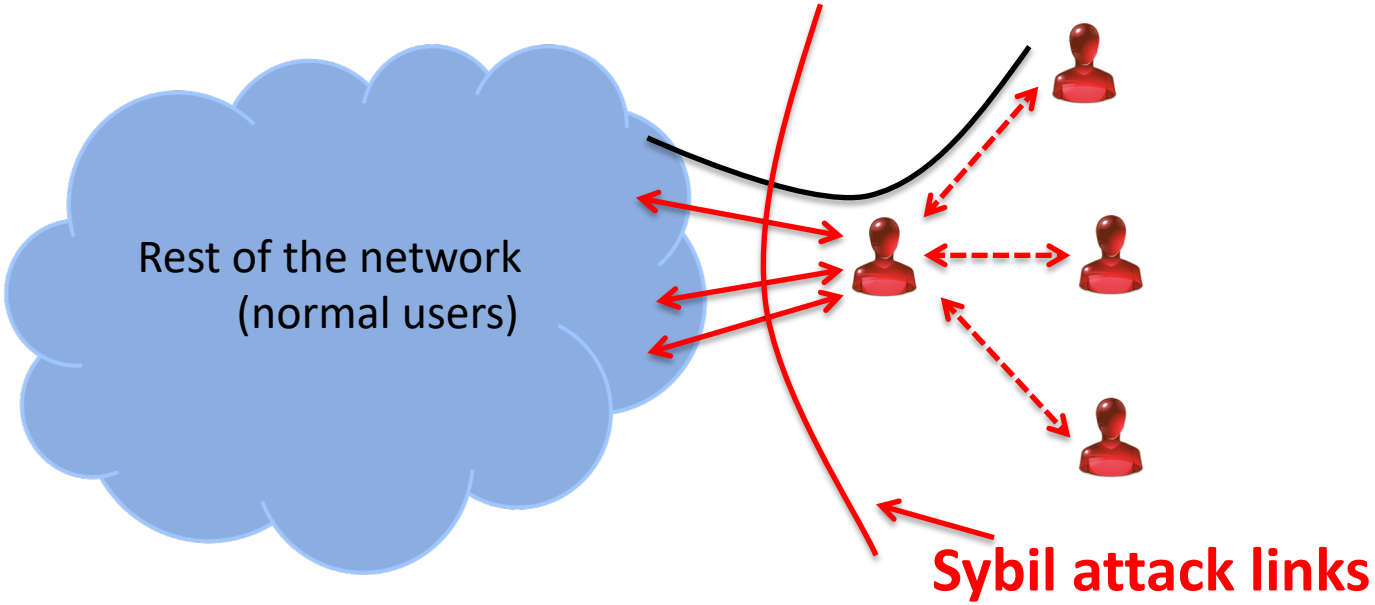

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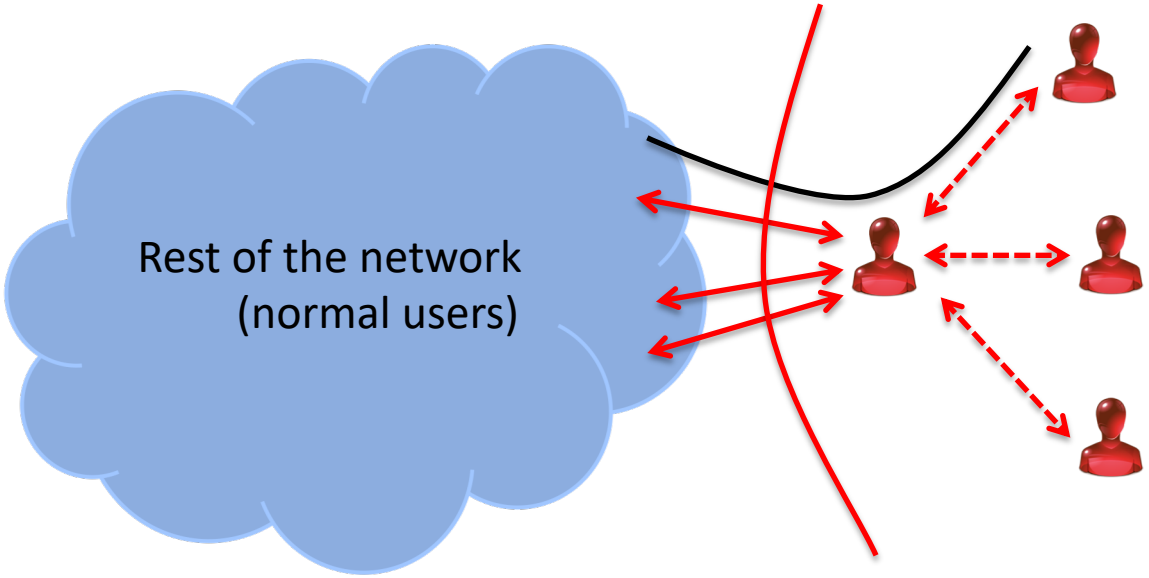

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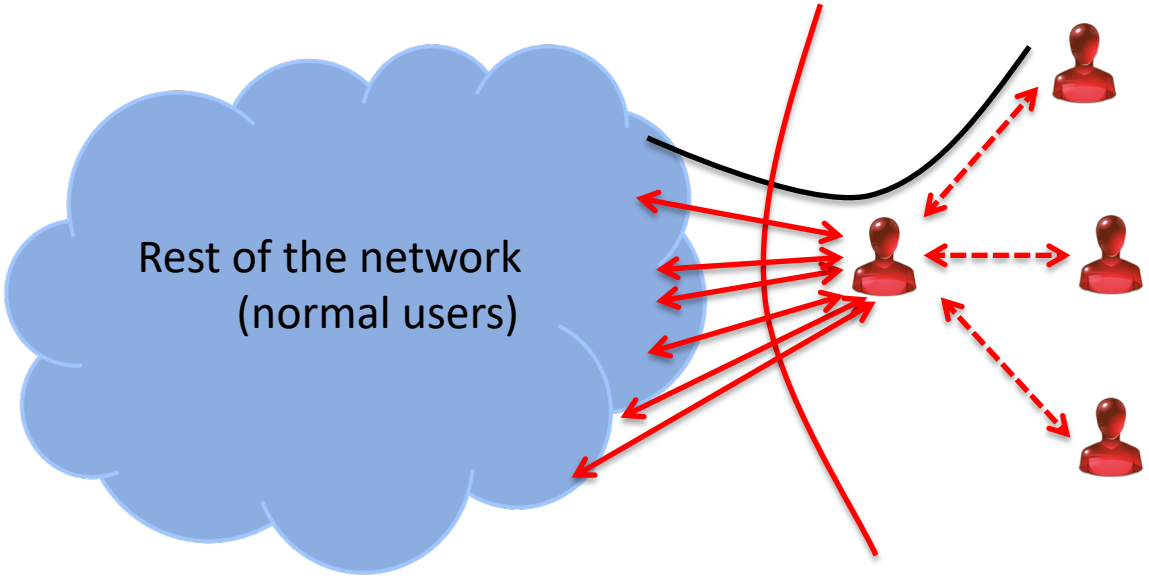

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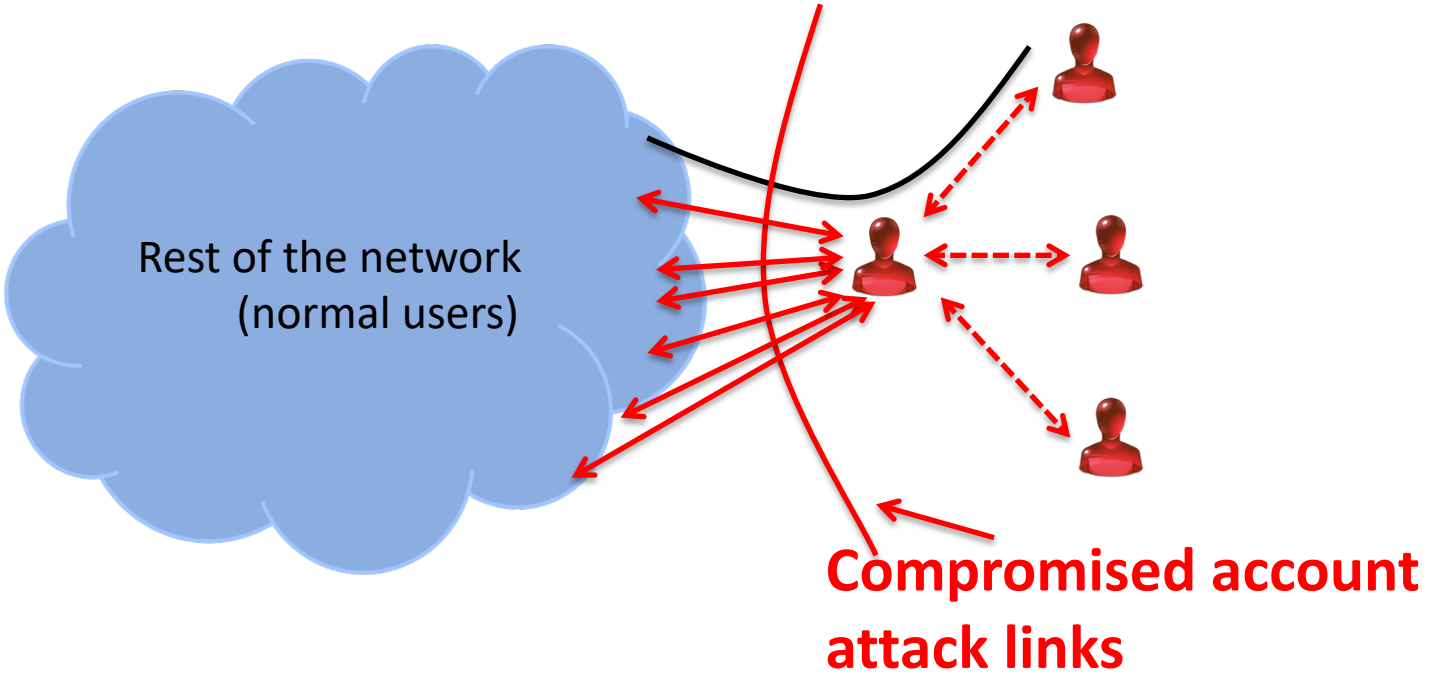

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Strengthening Genie against compromised accounts

Real-world data driven finding:

- More than 92% of the normal views are local (1 or 2 hop away)

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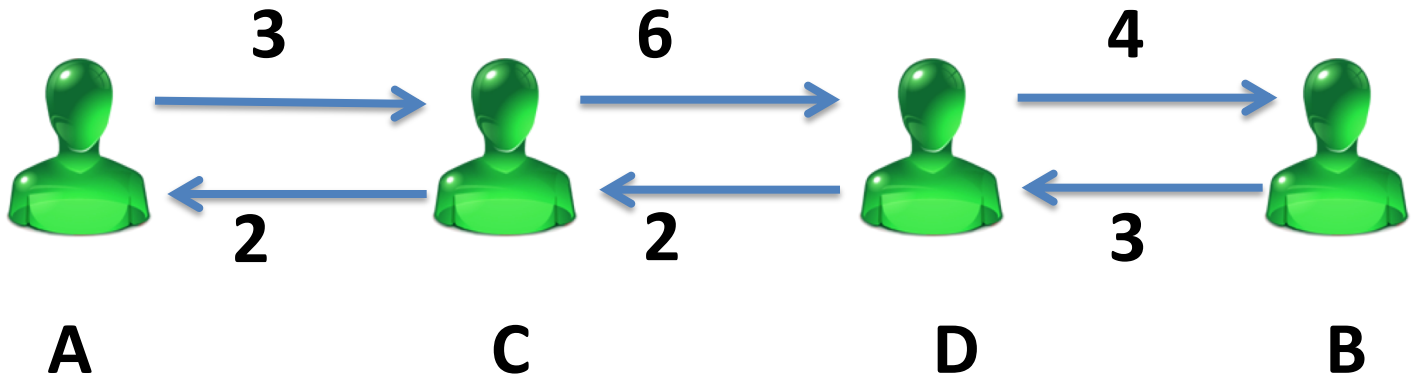

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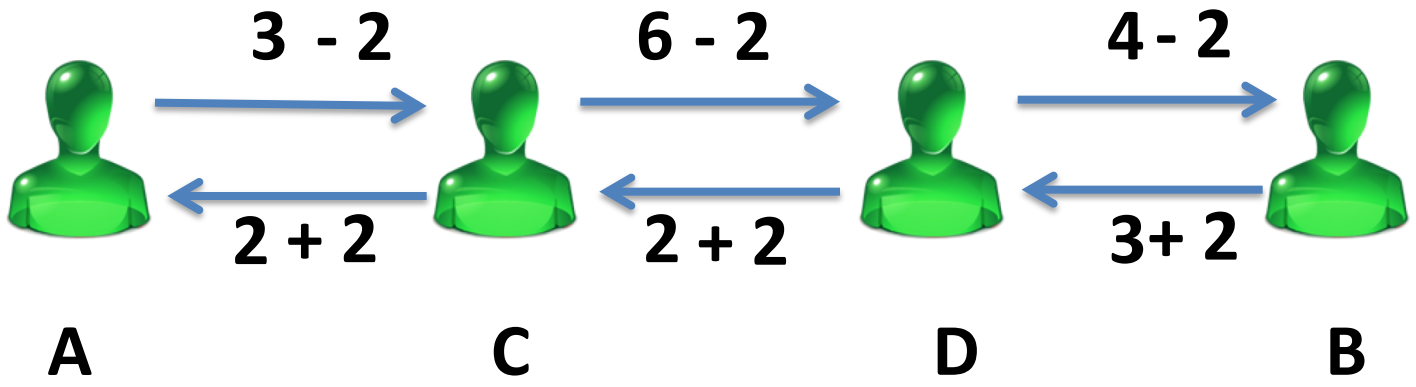

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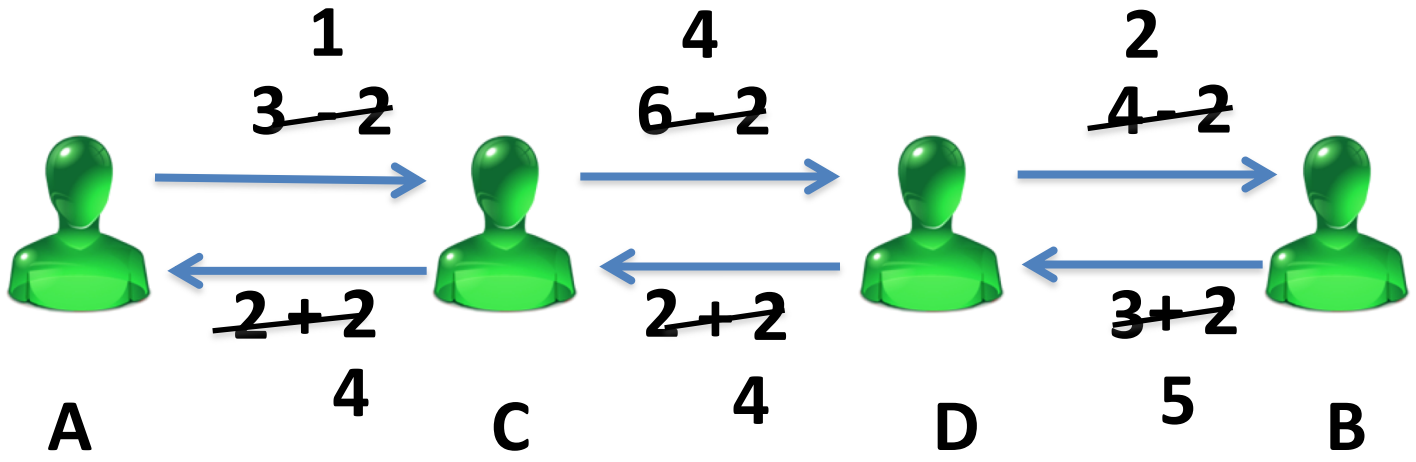

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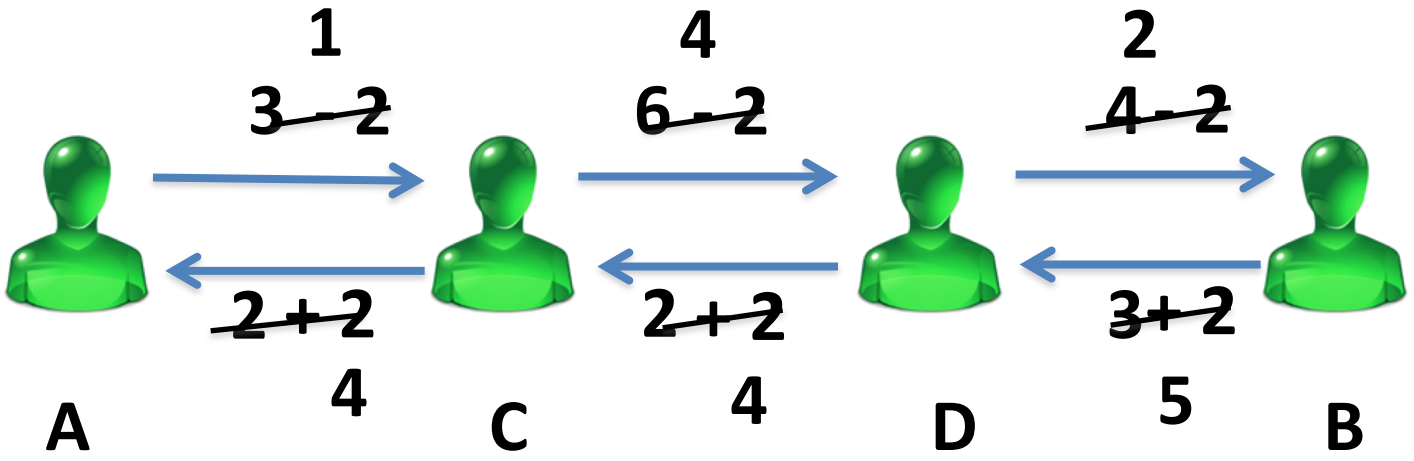
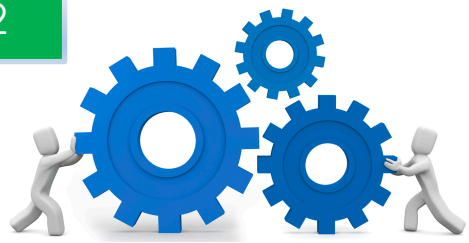


Rate of crawling decreases with increased path length

Genie evaluation

Genie simulator using **Canal** Library EuroSys'12

- Input: Social graph and user activity trace
- Output: allowed/flagged user activity



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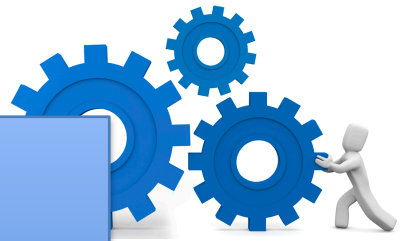
Make graph operations fast!

Less than millisecond latency for million node graphs



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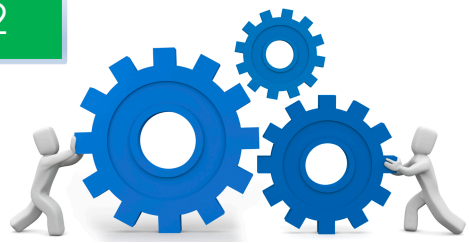

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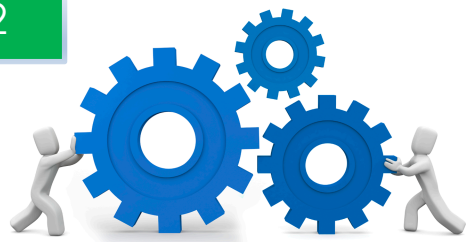

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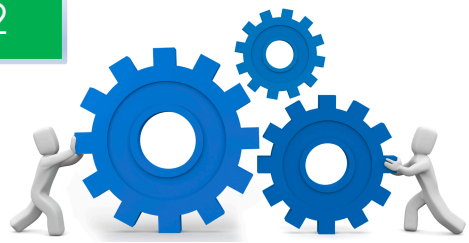

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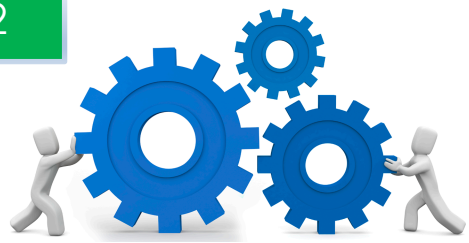

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Genie controls exposure by limiting third party crawlers