Virtual silos on the web

Exploring website clusters using hyperlinks and tracking code

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A collaboration with Mozilla

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Introduction

There is an increasing trend of recording, analyzing, and even selling users information and browsing behavior by third-party websites to companies.

Hypothesis: relationship between structural organisation of the Web and advertisement revenue model.

Goals

1. Detect trackers using the embedded scripts and placed cookies for roughly 5 million webpages.
2. Build a communication graph of webpages, trackers, and stakeholders.
3. Use community detection algorithms to find virtual silos on the web.
4. Analyse and compare the silos to gain insight into hypothesised relationship.

Seed URLs of pre-existing communities

- Need a starting point to get a list of websites.
- Using different communities, maximum diversity.
- Do the silos correspond to the communities?
- URLs gathered from `reddit.com`.

Crawling the pages

- Get domain of URL.
- Get all third-party scripts and cookies.
- Count internal/external links.
- *robots.txt* permissions.

Crawler results

- Data from roughly 355,000 URLs.
- 83,657 domains.
- jQuery not in top 50.

Crawler results

A few of the most frequently used script sources:

- `google-analytics.com/analytics.js`
- `platform.twitter.com/widgets.js`
- `securepubads.g.doubleclick.net/gampad/ads`
- `b.scorecardresearch.com/beacon.js`

Communication graphs

Three graphs:

- Hyperlink
- Tracking
- Total

Detect communities with Louvain Modularity Optimisation algorithm.

Communication graphs

Graph:	Communities	Modularity
Hyperlink	671	0.7
Tracking	4169	0.62
Total	435	0.64

Communication graphs

Calculate metrics of communities:

- size
- density
- degree
- connectivity

Calculated on induced graph so they can be compared meaningfully.


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haylingtoday.co.uk
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derryjournal.com
sussexexpress.co.uk
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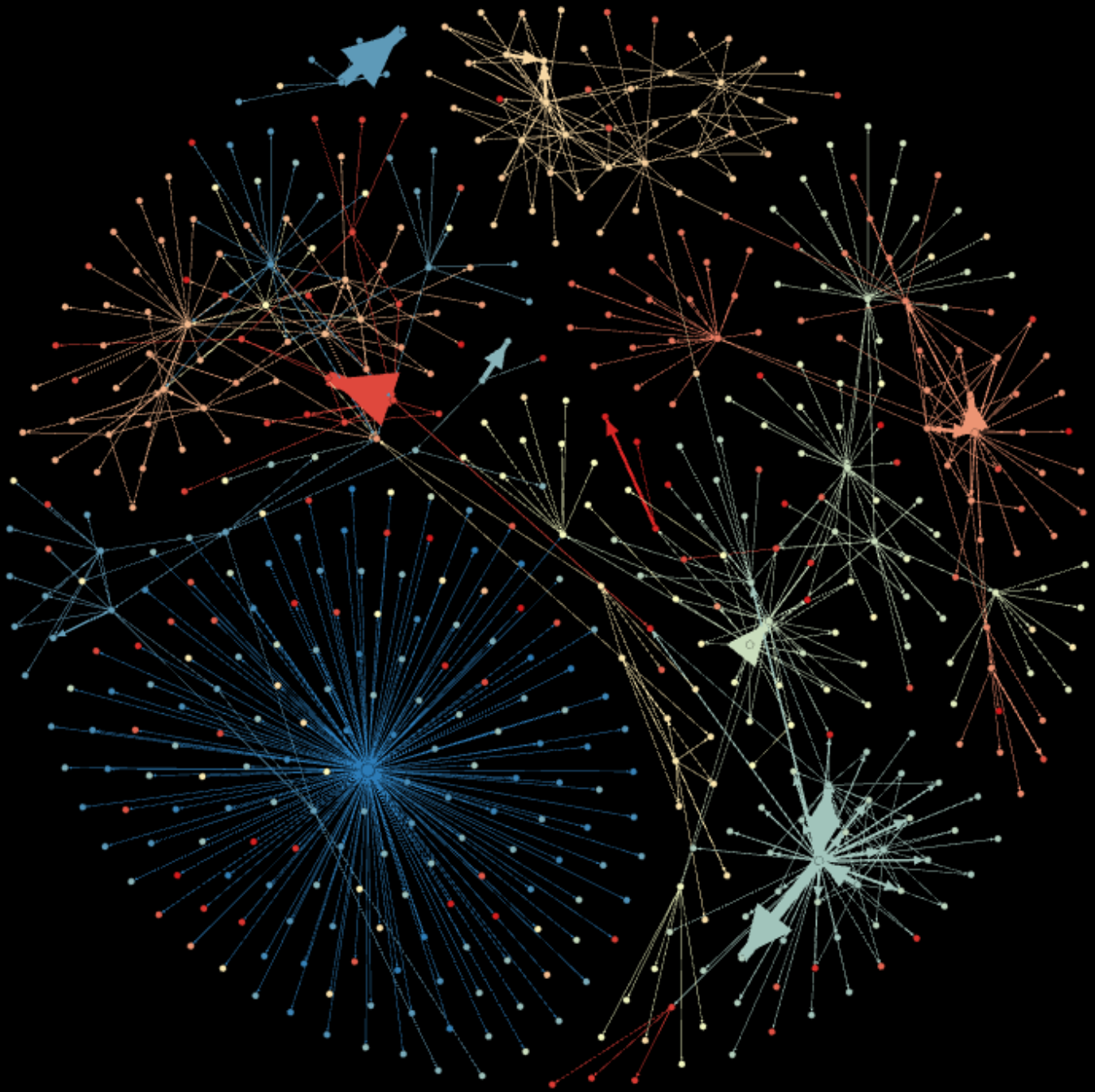

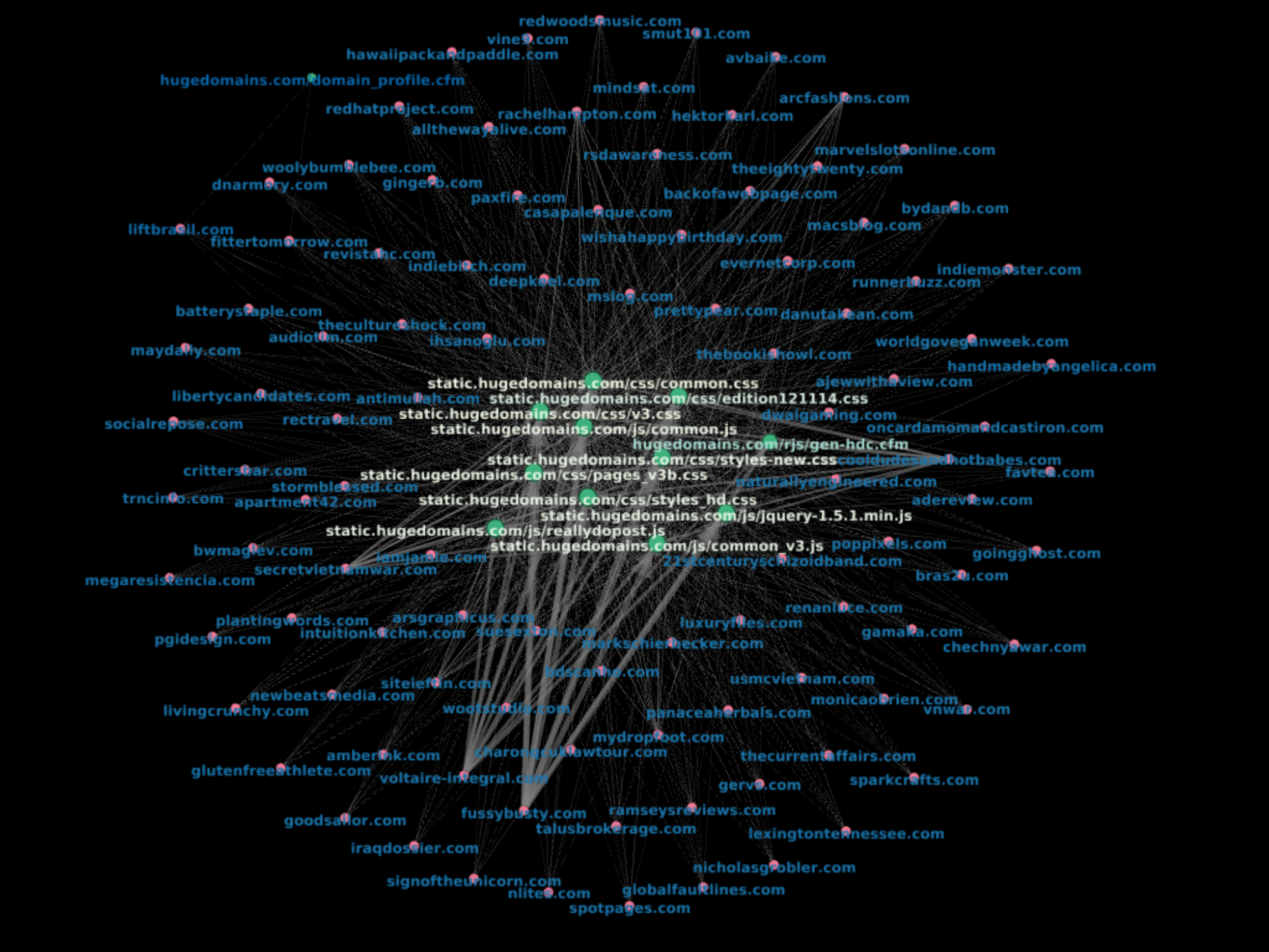
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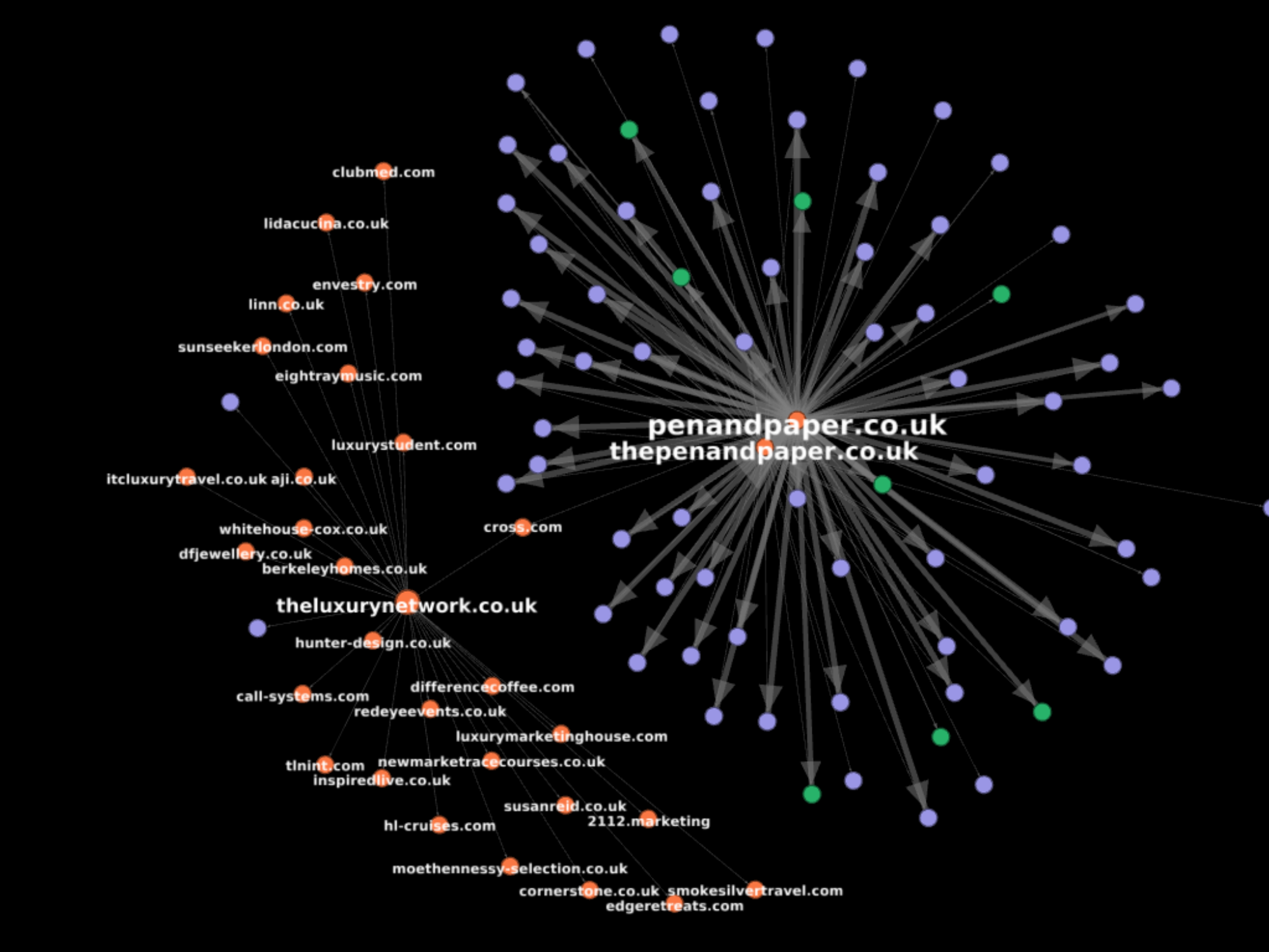
iraqdossier.com
nicholasgrobler.com
signoftheunicorn.com
nlites.com
globalfaultlines.com
spotpages.com

Total silos

Manually analysed twenty silos:

- Twelve contain exactly the same domains.
- Six silos were (part of) a bigger silo, now separate because of cookies/scripts. However, can also be identified by Louvain.
- One lost a domain because it uses popular cookies/scripts.
- The following silo only exists within the total communities, which is remarkable: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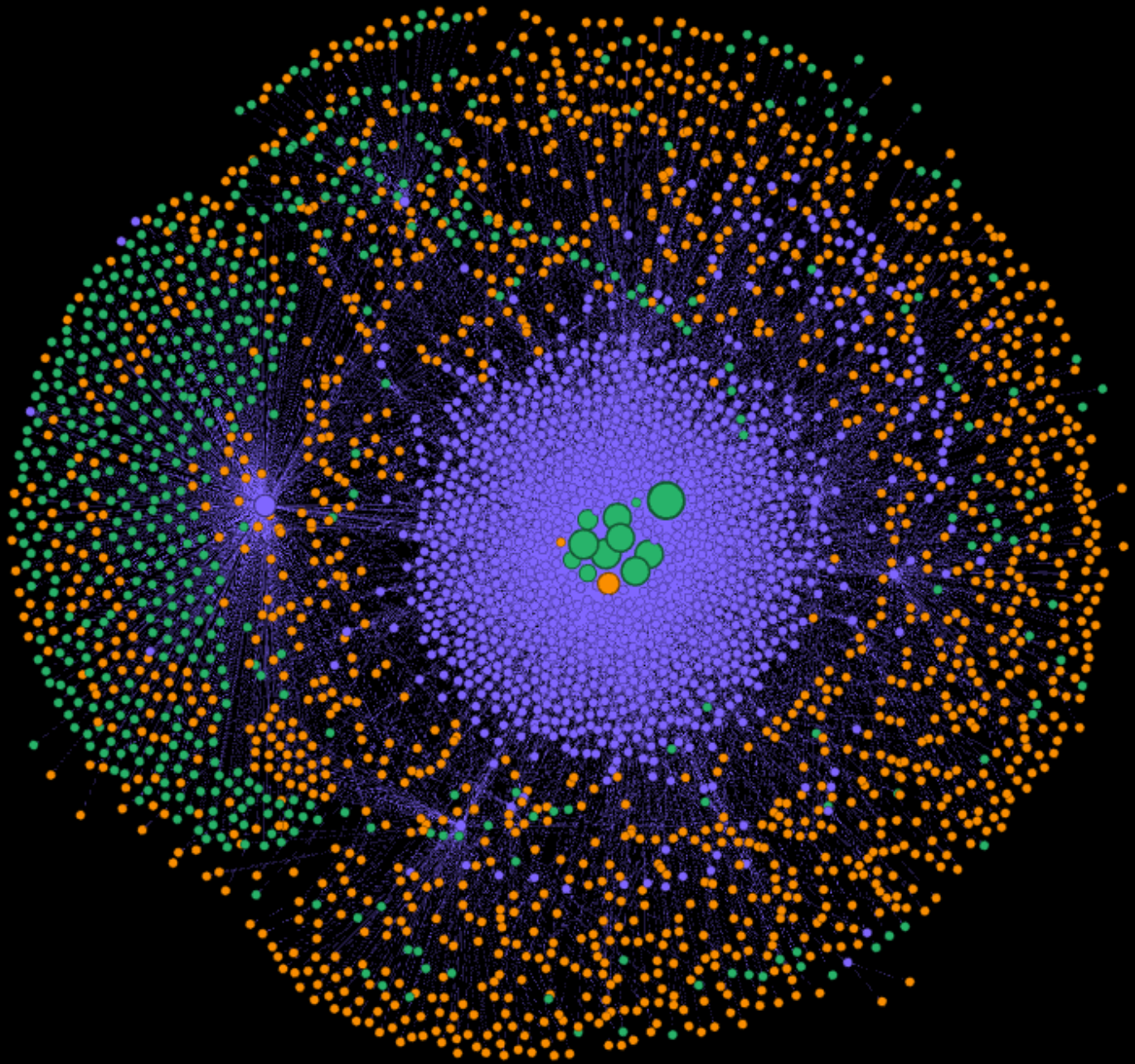
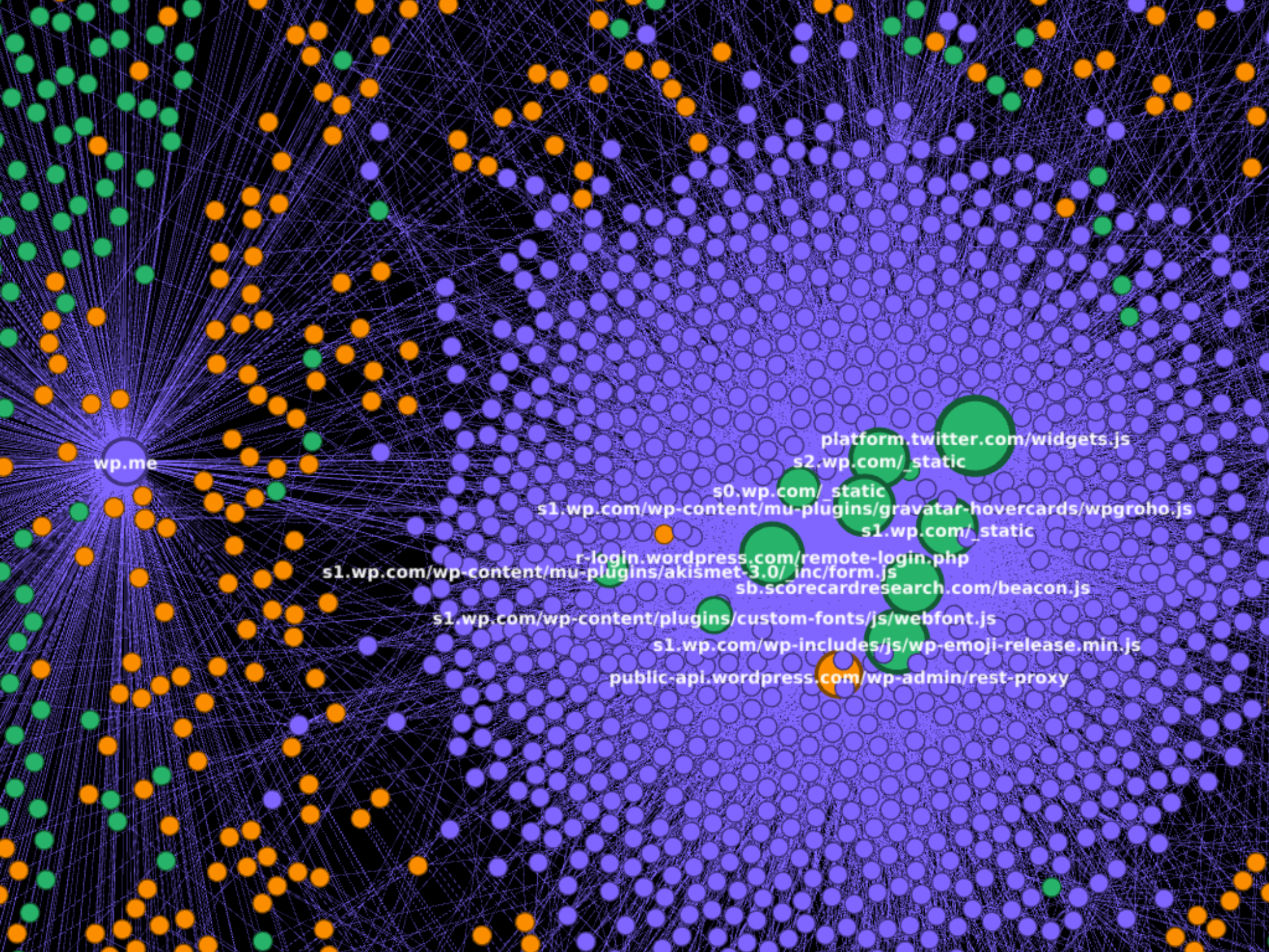
Preliminary conclusion

- Incorporating tracking data in communication graph does not yield many interesting results.
- In fact, sometimes sites are clustered together that are not linked in any way.
- Reduced connectivity, density, and average degree.

However, the bigger silos with a higher degree have not yet been considered.

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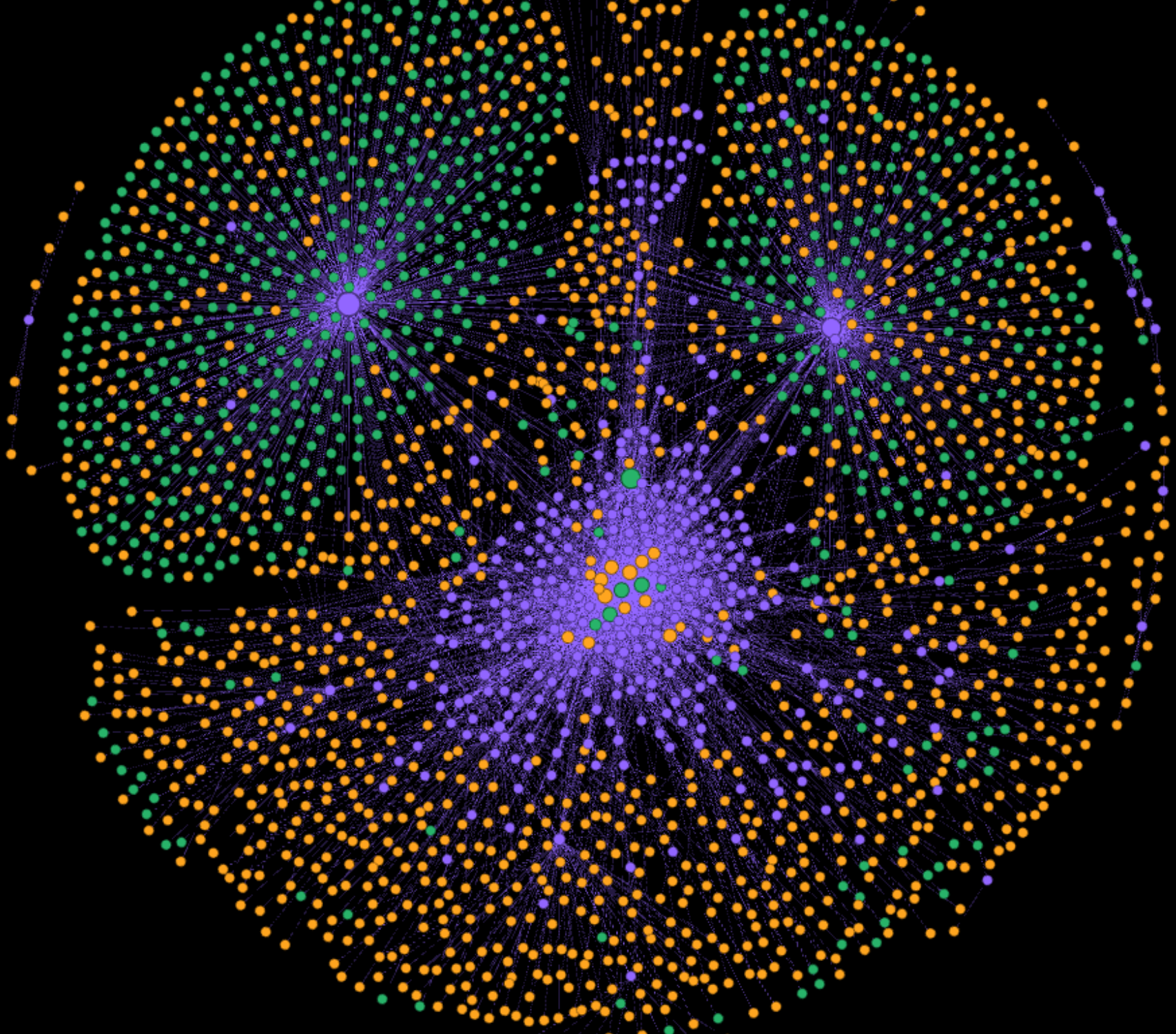

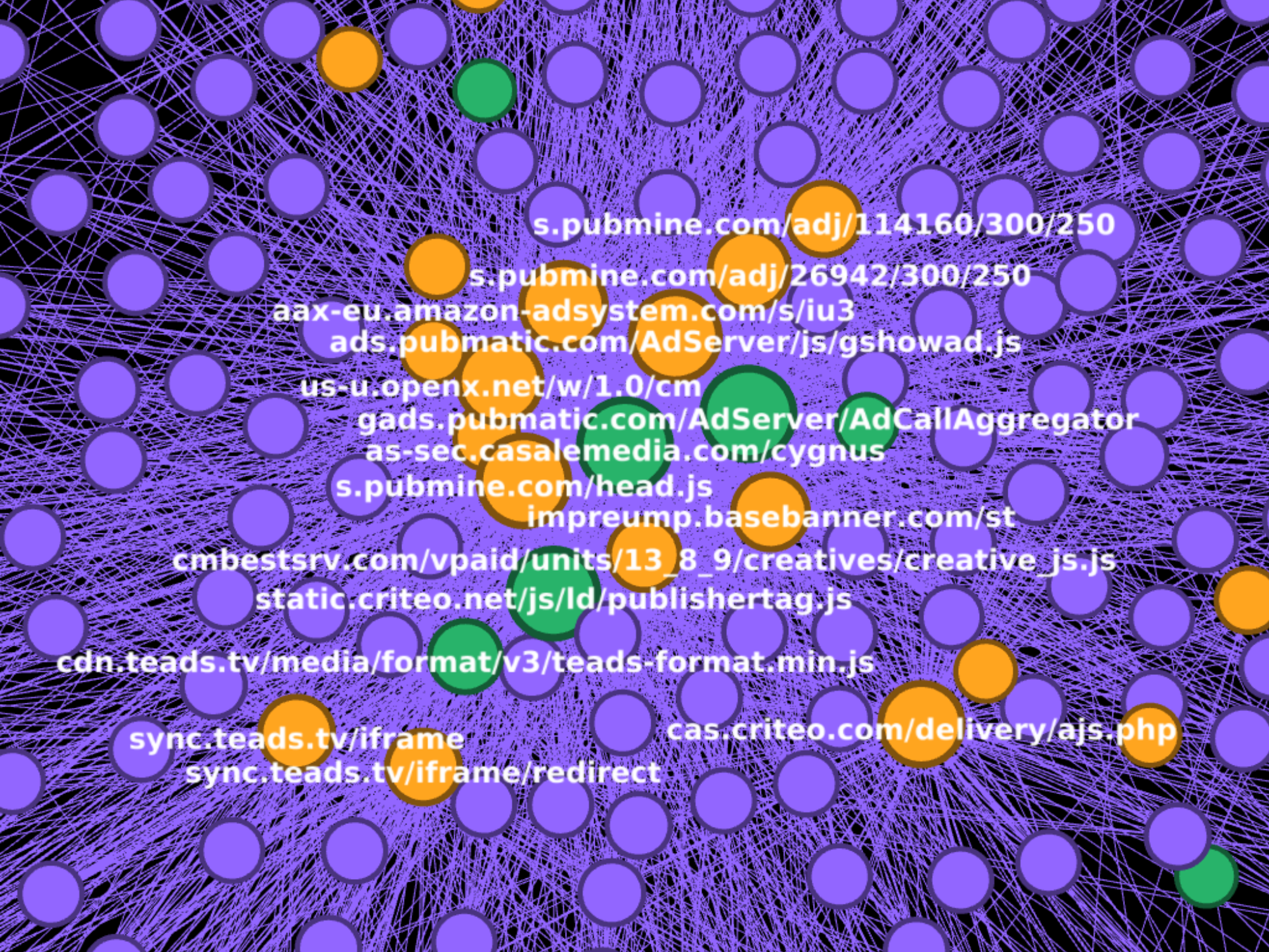
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sync.teads.tv/iframe/redirect

Conclusion

- Although very labour-intensive, it is indeed possible to detect tracking networks using this approach.
- The tracking networks seem to be 'hidden' within larger networks.
- In general, it appears that the detected communities can be further split up.

Future research

- Automated approach: recursive Louvain
- Tracking probabilities
- Different community detection algorithms

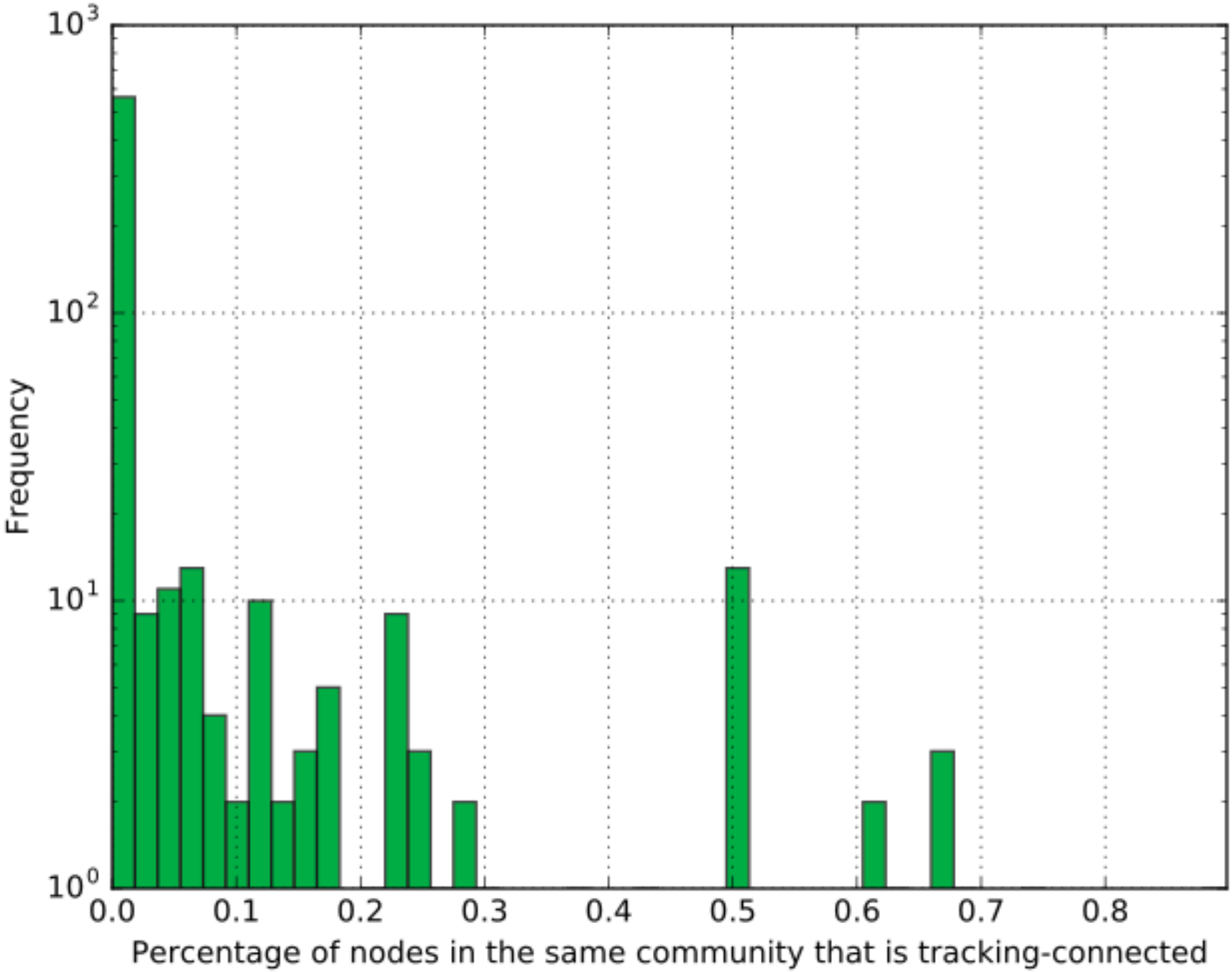
End of presentation

Thank you for your attention!

Appendix

Advertisement network:
- Inner edges: 66972
- Outer edges: 112843

Hyperlink connected:
- Total hyperlinks found: 827724
- Amount of connected domains sharing at least one piece of tracking code: 84234


10^3
10^2
10^1
10^0
Frequency
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Percentage of nodes in the same community that is tracking-connected