Web privacy measurement in real-time bidding systems. A graph-based approach to RTB system classification

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Appendices

To provide the reader with relevant background information, we list the appendices. They relate to various supplements to discussed subjects. The outline is as follows.

A: Workshop participation
B: Filtering challenging problems
C: Acquisitions, mergers, and partnerships
D: Example of partner networks: Denmark (DK)

A: Workshop participation

In Section 1.5 we marked the first step of our research methodology as workshop participation. In this appendix, we provide an overview. In Section A1 we present the different roles in which our participation took place. Section A2 contains an overview of the workshops that we have visited. All workshops contribute to Web Privacy Measurement (WPM).

A1: PARTICIPATING ROLES

During the time taken to conduct the research, Rob van Eijk participated in ten relevant workshops in four different roles.

(1) Participation on behalf of the Autoriteit Persoonsgegevens.
(2) Participation on behalf of the Article 29 Data Protection Working Party.
(3) Participation on behalf of the Council of Europe.
(4) Participation in a personal capacity.

Below, we give a brief characterization of the roles.

Role 1: Autoriteit Persoonsgegevens

Rob van Eijk served as Technologist and Senior Supervision Officer for the Autoriteit Persoonsgegevens, the Dutch DPA. In this role, he participated in four international working groups:

(1) the Global Privacy Enforcement Network (GPEN),[361]
(2) the Internet Privacy Engineering Network (IPEN),[362]

361 GPEN was established „to foster cross-border co-operation among privacy authorities". URL: https://privacyenforcement.net/public/activities (9 November 2015).

362 IPEN was established „to bring together developers and data protection experts with a technical background from different areas in order to launch and support projects that build privacy into everyday tools and develop new tools which can effectively protect and enhance our privacy". URL: https://secure.edps.europa.eu/EDPSWEB/edps/EDPS/IPEN (9 November 2015).

(3) the International Working Group on Data Protection in Telecommunication (IWGDPT),[363] and
(4) the Technology Subgroup of the Article 29 Data Protection Working Party (Art. 29 WP).[364]

Role 2: Article 29 Data Protection Working Party

Rob van Eijk represented the Article 29 Data Protection Working Party (Art. 29 WP) in various international meetings. His participation has been noted by, e. g., Boogert [2011], W. Davis [2013], Doty and Mulligan [2013, p. 152], Pels [2013], Libbenga [2013; 2014], Swift [2014], Zuiderveen Borgesius [2014, p. 332, footnote 1063], and Zuiderveen Borgesius and McDonald [2015, footnote 82 and acknowledgments]. Below, we list three representations.

(1) the multi-stakeholder negotiations held by the World Wide Web Consortium (W3C) on Do Not Track (DNT),
(2) a public debate on DNT held by the Member of the European Parliament (MEP) Amelia Andersdotter and MEP Francoise Castex, and
(3) the Roundtable on Online Behavioral Advertising (OBA) held by the European Commission.[365] The roundtable touched, e. g., on DNT as a potential consent mechanism in the European data protection and privacy context.

363 The International Working Group on Data Protection in Telecommunications (IWGDPT) was established in the framework of the International Conference of Data Protection and Privacy Commissioners (ICDPPC) which was established to create „an environment in which privacy and data protection authorities around the world are able effectively to act to fulfill their mandates, both individually and in concert, through diffusion of knowledge and supportive connections". URL: http://datenschutz-berlin.de/content/europa-international/international-working-group-on-data-protection-in-telecommunications-iwgdpt (9 November 2015).

364 The Technology Subgroup of Art. 29 WP has a focus on adressing new technological developments that trigger (new) legal questions in respect to the EU data protection and privacy framework. The Art. 29 WP was set up „under the Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data". URL: http://ec.europa.eu/justice/data-protection/article-29/index_en.htm (9 November 2015).

365 The roundtable was held by DG CONNECT, Sector Digital Privacy. URL: https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/Presentation%20Online%20Behavioural%20Advertising%20%28OBA%29.pdf (9 November 2015).

Role 3: Council of Europe

He represented the Council of Europe in the following workshop co-organized by the Council of Europe and the Internet Society. Internet Governance Forum, 'Who is following me: tracking the trackers'.[366]

Role 4: Personal capacity

In his personal capacity, he served as a member of the program committee of the following four workshops.

(1) Berkeley Center for Law & Technology workshop Web Privacy Measurement (2012).[367]
(2) W3C workshop Do Not Track and beyond (2012).[368]
(3) W3C workshop on privacy and user-centric controls (2014).[369]
(4) W3C workshop on privacy and linked data (2018).[370]

To provide somewhat more insights into the multi-stakeholder negotiations held by the W3C on DNT, we elaborate below on role 2 (Art. 29 WP). The W3C has kept an archive containing all the DNT discussions of the Tracking Protection Working Group on the public mailing list.[371]

Furthermore, the Art. 29 WP has archived its two responses to two public calls for review by the W3C. The Technology Subgroup of Art. 29 WP drafted the letters (i. e., role 1). First, the response to W3C's public consultation of the technical W3C document containing the DNT building blocks [Article 29 Working Party, 2014a].[372] Second, the response to W3C's public consultation on the normative framework of DNT. [Article 29 Working Party, 2015b].[373]

366 URL: http://www.internetsociety.org/who-following-me-tracking-trackers-igf2012 (9 November 2015).
367 URL: https://www.law.berkeley.edu/centers/bclt/past-events/2012-conferences-2/may-2012-web-privacy-measurement/ (9 November 2015).
368 URL: http://www.w3.org/2012/dnt-ws/ (9 November 2015).
369 URL: http://www.w3.org/2014/privacyws/pc.html (9 November 2015).
370 URL: https://www.w3.org/2018/vocabws/program-committee.html (20 April 2018).
371 URL: http://lists.w3.org/Archives/Public/public-tracking/ (9 November 2015).
372 URL: http://ec.europa.eu/justice/data-protection/article-29/documentation/other-document/files/2014/20140606_wp29_ts_standardisation_letter_to_w3c.pdf (9 November 2015)
373 URL: http://ec.europa.eu/justice/data-protection/article-29/documentation/other-document/files/2015/20151001__letter_of_the_art_29_wp_w3c_compliance.pdf (9 November 2015).

A2: WORKSHOP OVERVIEW

This section provides an overview of the actual workshops. The overview groups the workshops together by each of the four roles (Section 12). Within a role, the workshops are grouped by hosting organization and sorted in alphabetical order. The year in which a workshop took place is shown in parentheses.

Role 1: Autoriteit Persoonsgegevens

(1) Conference Computers, Privacy & Data Protection (European Data Protection Supervisor (EDPS) panel 2015,[374] Norwegian DPA panel 2016).[375]
(2) European Commission (DG CONNECT): workshop SMART 2013/0071, ePrivacy Directive: assessment of transposition, effectiveness and compatibility with proposed Data Protection Regulation (2014).
(3) Leiden University: e-Law symposium on the future of privacy and innovation (2015).
(4) Future of Privacy Forum: New technologies - new privacy approaches? (2015).
(5) Internet Privacy Engineering Network (2014).[376]
(6) International Data Protection and Privacy Commissioners Conference (2015).
(7) International Working Group on Data Protection in Telecommunications (2011 - 2016).
(8) Institute for Information Law (IViR) & Berkeley Law workshop on online tracking protection & browsers (2011).
(9) Institute for Information Law (IViR) & Berkeley Law workshop on online tracking (2014).
(10) Leiden University and University of Twente: roundtable on privacy and WiFi tracking (2017).
(11) Vereniging voor Media- en Communicatierecht Series: Aspects of cookies: web tracking and online behavioral advertising (2011).[377]

374 URL: https://www.youtube.com/watch?v=6SEdnWlSZyk (10 December 2015).
375 URL: https://www.youtube.com/watch?v=BMcxO7PRsKQ (10 May 2016).
376 URL: https://www.youtube.com/watch?v=mO7bjmUAq-Q (10 December 2015).
377 See also, Verhulst [2012].

ROLE 2: ARTICLE 29 DATA PROTECTION WORKING PARTY

(1) European Parliament (LIBE): Browser settings and consent: A brief introduction to Do Not Track (DNT) (2017).
(2) European Parliament: Do Not Track, is self-regulation enough? (2014).[378]
(3) European Commission (DG CONNECT): Roundtable on online behavioral advertising (2013, 2014).
(4) W3C Global Considerations Task Force Face-to-Face (2013).
(5) W3C Tracking Protection Working Group, 2nd - 8th Face-to-Face (2011–2016).

ROLE 3: COUNCIL OF EUROPE

Internet Governance Forum: Workshop who is following me, tracking the trackers (2012).[379]

ROLE 4: PERSONAL CAPACITY

(1) Amsterdam University: Amsterdam Privacy Conference (2012, 2018).
(2) Amsterdam University: IViR Information Influx Conference (2014).
(3) Berkeley Center for Law & Technology: Web Privacy Measurement Workshop (2012).
(4) Conference Computers, Privacy & Data Protection (ENISA panel, 2018).[380]
(5) Council of the European Union: Working Party on Telecommunications and Information Society (2017).
(6) Datenschutzfachtagung workshop: Datenschutzmanagement à la Brüssel (2012).
(7) Dagstuhl Seminar 17162 on Online Privacy and Web Transparency (2017).
(8) Erasmus University: Leadership challenges with big data; workshop on ethical, legal and privacy challenges (2015, 2018).
(9) Free and Open source Software Developers' European Meeting (2012, 2013, 2014).

378 URL: https://www.youtube.com/watch?v=T9fqpE5e5S0 (10 December 2015).
379 URL: https://www.youtube.com/watch?v=mtPqt906u_g (10 December 2015).
380 URL: https://www.youtube.com/watch?v=_ehlooemvJ0 (7 February 2018).

(10) Future Of Privacy Forum on Personal Information: The benefits and risks of de-identification (2011).
(11) IAPP Europe Data Protection Congress (2012) .
(12) IAPP Practical Privacy Series: FTC & consumer privacy (2011).
(13) League of European Research Universities: LERU Summer School (2016).
(14) Leiden University: Big data symposium (Dual PhD Centre, Chamber of Commerce The Hague, VNO-NCW, 2015).
(15) Leiden University: Big data symposium (Ministry of Infrastructure and Environment) (2016).
(16) Leiden University: e-Law symposium on the future of privacy and innovation (2015).
(17) Leiden University: Mini conference on the occasion of the opening of the Leiden Centre of Data Science (2014).
(18) Oxford Internet Institute: workshop to discuss the new ethical, legal and technical challenges for research with vast datasets of mobile connectivity data (2013).[381]
(19) Princeton University: workshop on web privacy and transparency conference (livestream) (2014).
(20) RSM, Erasmus University: Leadership challenges with big data & analytics (2015, 2016, 2018).
(21) Wall Street Journal: Data transparency weekend (2012).[382]
(22) Worchester Polytechnic Institute, Colloquium Series: Forensic aspects of digital investigation (2013).
(23) W3C Workshop on Do Not Track and beyond (2012).
(24) W3C Workshop on privacy and user-centric controls (2014).
(25) W3C Workshop on web tracking and user privacy (2011).

381 Acknowledgment in Zevenbergen, Brown, Wright, and Erdös [2013].

382 Adams, Fedor, Felten, Felten, Fenton, Mayer, Ralli, Toubiana, Turner, and Van Eijk [2012] built a browser extension and named it Tracking Report Card. The browser extension showed end-users an indication of web tracking in a visual and easy-to-read reporting format. The report was collated from an automated database built with a cloud-based crawling infrastructure. Moreover, the data disclosed whether web sites honor opt-out and DNT requests by removing its tracking cookies. The browser extension provided non-technical end-users with information about whether and how they were tracked.

B: Filtering challenging problems

In Section 1.5 we marked the second step of our methodology as filter the challenging problems put forward in the workshops in a way that we can combine the problems resulting in distilling a PS and the corresponding RQs. Table B.1 shows the result of the second step of our research methodology. For completeness we remark that Table 1.1 links the PS and the RQs to the precise places where we address RQ1 and RQ2.

Table B.1: Mapping of the filtered workshops with RQs.

FILTERED WORKSHOP	RQ1	RQ2
Berkeley Law Web Privacy Measurement Workshop	✓	
EU Parliament workshop Do Not Track, is self-regulation enough?		✓
EU Roundtable Online Behavioral Advertising		✓
Dagstuhl Seminar 17162 Online Privacy and Web Transparency	✓	✓
IGF Workshop Tracking the Trackers		✓
IViR & Berkeley Law Workshop on Online Tracking		✓
Princeton Web Privacy and Transparency Conference	✓	
W3C Tracking Protection Working Group meetings	✓	✓
W3C Workshop Do Not Track and beyond		✓
W3C Workshop Privacy and User-Centric Controls		✓
W3C Workshop Web Tracking and User Privacy		✓

C: Acquisitions, mergers, and partnerships

Table C.1: Acquisitions and mergers (1/7) [Van Eijk & Chester, 2014; 2015].

TECHNOLOGY CONSOLIDATION	(JANUARY 2013 - DECEMBER 2015)
Accenture [Acquity Group]	AOL [PrecisionDemand]
Accenture [AD.Dialeto]	AOL [velos]
Accenture [Chaotic Moon Studios]	AOL [Vidible]
Accenture [Cimation]	AppNexus [Alenty]
Accenture [Cloud Sherpas]	AppNexus [MediaGlu]
Accenture [i4C Analytics]	AppNexus [Yieldex]
Accenture [Mortgage Cadence]	Berkshire Partners [Catalina]
Accenture [Procurian]	Brightcove [Unicorn Media]
Accenture [Reactive Media]	Clarke Holdings [Valassis]
Accenture [Sagacious Consultants]	Comcast [Contingent Netw. Serv.]
Accenture [Tquila]	Comcast [FreeWheel]
Acxiom Corp [Allant Group]	Comcast [NBC Universal]
Acxiom Corp [LiveRamp]	Comcast [PowerCloud Systems]
Adobe [Aviary]	Comcast [Visible World]
Adobe [Digital Analytix]	comScore [MdotLabs]
Adobe [Efficient Frontier]	comScore [Proximic]
Adobe [Fotolia]	comScore [Rentrak Corporation]
Adobe [Ideacodes]	Criteo [AdQuantic]
Adobe [Mixamo]	Criteo [DataPop]
Adobe [Neolane]	Criteo [Tedemis]
Adobe [Satellite]	DataXu [JasperLabs]
Adobe [Thumb Labs]	Deloitte Digital [Banyan Branch]
AOL [Adap.tv]	Dentsu [Explido]
AOL [Aiguarentacar]	Dentsu [Fifty Four Media]
AOL [Convertro]	Dentsu [IID]
AOL [gdgt]	Dentsu [Lesmobilizers]
AOL [Gravity]	Dentsu [Oddfellows]
AOL [Kanvas Labs]	Dropbox [Aria Glassworks]
AOL [Millennial Media]	Dropbox [Bubbli]

Table C.2: Acquisitions and mergers - continued (2/7).

TECHNOLOGY CONSOLIDATION	(JANUARY 2013 - DECEMBER 2015)
Dropbox [Clementine]	Facebook [Monoidics]
Dropbox [CloudOn]	Facebook [Oculus VR]
Dropbox [Droptalk]	Facebook [Onavo]
Dropbox [Endorse]	Facebook [Osmeta]
Dropbox [Foundry Hiring]	Facebook [Parse]
Dropbox [HackPad]	Facebook [PrivateCore]
Dropbox [Loom]	Facebook [ProtoGeo]
Dropbox [Mailbox]	Facebook [Pryte]
Dropbox [MobileSpan]	Facebook [QuickFire Networks]
Dropbox [Parastructure]	Facebook [Spaceport.io]
Dropbox [Photo Lab]	Facebook [SportStream]
Dropbox [PiCloud]	Facebook [Storylane]
Dropbox [Pixelapse]	Facebook [Teehan &Lax]
Dropbox [Predictive Edge]	Facebook [TheFind, Inc.]
Dropbox [Readmill]	Facebook [VocalIQ]
Dropbox [Sold]	Facebook [WhatsApp]
Dropbox [TapEngage]	Facebook [Wit.ai]
Dropbox [Umano]	Google [Adometry]
Dropbox [Zulip]	Google [Agawi Inc]
Dunnhumby [Sociomantic Labs]	Google [Alpental Technologies]
Dunnhumby [Standard Analytics]	Google [Appetas]
eXelate [Affinnova]	Google [Appurify]
eXelate [Arbitron]	Google [Autofuss]
eXelate [eXelate]	Google [Bebop]
eXelate [Harris Interactive]	Google [Behavio]
eXelate [Indicus Analytics]	Google [Bitspin]
Experian [41 st Parameter]	Google [Boston Dynamics]
Experian [AdTruth]	Google [Bot & Dolly]
Experian [Conversen]	Google [Bump Technologies]
Facebook [Ascenta]	Google [Dark Blue Labs]
Facebook [Atlas]	Google [Deepmind Technolgies]
Facebook [Branch Media]	Google [Digisfera]
Facebook [Endaga]	Google [Directr]
Facebook [Hot Studio]	Google [Divide]
Facebook [Jibbigo]	Google [Divshot]
Facebook [Little Eye Labs]	Google [DNNresearch]
Facebook [LiveRail]	Google [drawElements]

Table C.3: Acquisitions and mergers - continued (3/7).

TECHNOLOGY CONSOLIDATION	(JANUARY 2013 - DECEMBER 2015)
Google [Emu Messenger]	Google [Timeful]
Google [Firebase]	Google [Titan Aerospace]
Google [FlexyCore]	Google [Toro]
Google [Flutter]	Google [Vision Factory]
Google [Fly Labs]	Google [Wavii]
Google [Gecko Design Inc.]	Google [Waze]
Google [Green Throttle Games]	Google [WIMM Labs]
Google [Holomni]	Google [Zync Render]
Google [Impermium]	Gravity4 [adX Search]
Google [Industrial Pereception Inc.]	Gravity4 [Argyle Social]
Google [Jetpac]	Gravity4 [Bolzter]
Google [Jibe Mobile]	Gravity4 [Conyak]
Google [Launchpad Toys]	Gravity4 [EuroAds]
Google [Lift Labs]	Gravity4 [EzLike]
Google [mDialog]	Gravity4 [Kanary]
Google [Meka Robotics]	Gravity4 [Pixels]
Google [Nest Labs]	Gravity4 [Triggit]
Google [Odysee]	Gravity4 [Zurmo]
Google [Oyster]	Group M [Plista]
Google [Pie]	Group M [The Exchange Lab]
Google [Pixate]	Havas Media [ElisaDBI]
Google [Polar]	Havas Media [GT Media]
Google [Pulse.io]	Havas Media [MFG Labs]
Google [Quest Visual]	Havas Media [Revenue Frontier]
Google [Rangespan]	Hitachi Data Syst. [Pentaho]
Google [RelativeWave]	Hitachi Data Syst. [Prizm Payment Serv.]
Google [Schaft]	IBM [AlchemyAPI]
Google [Skillman & Hackett]	IBM [Aspera]
Google [Skybox Imaging]	IBM [Blekko]
Google [SlickLogin]	IBM [Blue Box]
Google [Softcard]	IBM [Clearleap]
Google [Songza]	IBM [Cleversafe]
Google [Spider.io]	IBM [Cloudant]
Google [Stackdriver]	IBM [Cognea]
Google [Talaria]	IBM [Compose]
Google [Terra Bella]	IBM [CrossIdeas]
Google [Thrive Audio]	IBM [CSL International]

Table C.4: Acquisitions and mergers - continued (4/7).

TECHNOLOGY CONSOLIDATION	(JANUARY 2013 - DECEMBER 2015)
IBM [Daeja Image Systems]	Lotame [AdMobius]
IBM [Explorys]	Mastercard [Applied Predictive Techn.]
IBM [Fiberlink]	Mastercard [C-sam]
IBM [Gravitant]	Mastercard [Pinpoint]
IBM [Merge Healthcare]	Mastercard [Provus]
IBM [Meteorix]	Mastercard [Transaction Network Serv.]
IBM [Phytel]	MediaMath [Akamai]
IBM [Silverpop]	MediaMath [Spree7]
IBM [SoftLayer]	MediaMath [Tactads]
IBM [Star Analytics]	Merkle [500friends]
IBM [StrongLoop]	Merkle [5th Finger]
IBM [The Now Factory]	Merkle [Brilig]
IBM [The Weather Company]	Merkle [IMPAQT]
IBM [Trusteer]	Merkle [New Control]
IBM [Unica]	Merkle [RKG]
IBM [Urbancode]	Milennial [Jumptap]
IBM [Xtify]	Milennial [Metaresolver]
IgnitionOne [Knotice]	Milennial [NEXAGE]
Interpublic [Black Sheep]	Neustar [Aggregate Knowledge]
Interpublic [Genuine Interactive]	Neustar [Bombora Technologies]
Interpublic [Halesway]	Neustar [GO.CO]
Interpublic [Perfect Fools]	Neustar [MarketShare]
Interpublic [Profero]	NICE Systems [Causata]
Interpublic [Spookes Labs]	Omnicom [Agency Republic]
Kroger [Dunnhumby]	Omnicom [Haygarth]
Kroger [Harris Teeter]	Omnicom [HMKM]
Kroger [Roundy's]	Omnicom [LiTHe]
Kroger [Vitacost]	Omnicom [Media Interactive]
LinkedIn [Bizo]	Omnicom [Mobile5 Media]
LinkedIn [Bright.com]	Oracle [Acme Packet]
LinkedIn [Careerify]	Oracle [AdKarma]
LinkedIn [Fliptop]	Oracle [All Media Network]
LinkedIn [lynda.com]	Oracle [BigMachines]
LinkedIn [Newsle]	Oracle [Bitzer Mobile]
LinkedIn [Pulse]	Oracle [BlueKai]
LinkedIn [Refresh.io]	Oracle [CloudMonkey]
Lithium [Klout]	Oracle [Compendium]

Table C.5: Acquisitions and mergers - continued (5/7).

TECHNOLOGY CONSOLIDATION	(JANUARY 2013 - DECEMBER 2015)
Oracle [Corente]	Salesforce [Kerensen Consulting]
Oracle [Datalogix]	Salesforce [MinHash]
Oracle [Eloqua]	Salesforce [Pardot]
Oracle [Front Porch Digital]	Salesforce [RelateIQ]
Oracle [GreenBytes]	Salesforce [SteelBrick]
Oracle [LiveLOOK]	Salesforce [Tempo AI]
Oracle [LYFE Mobile]	Salesforce [Toopher]
Oracle [Maxymiser]	SDL [Alterian]
Oracle [Micros Systems]	Sizmek [PointRoll]
Oracle [Nimbula]	Sizmek [StrikeAd]
Oracle [Push IO]	Spredfast [Mass Relevance]
Oracle [Responsys]	Spredfast [Shoutlet]
Oracle [Rhythm NewMedia]	Sprinklr [Booshaka]
Oracle [StackEngine]	Sprinklr [Branderati]
Oracle [Tekelec International]	Sprinklr [Dachis Group]
Oracle [TOA Technologies]	Sprinklr [Get Satisfaction]
Pitney Bowes [Borderfree]	Sprinklr [newBrandAnalytics]
Pitney Bowes [Real Time Content]	Sprinklr [Pluck]
PubMatic [Mocean Mobile]	Sprinklr [Scup]
Rakuten Marketing [DC Storm Limited]	Sprinklr [TBG Digital]
Rakuten Marketing [Deep Forest Media]	Staples [Accolade Promotion Group]
Rakuten Marketing [Ebates]	Staples [Office Depot]
Rakuten Marketing [Fits.me]	Staples [PNI Digital Media]
Rakuten Marketing [Overdrive]	Staples [Runa]
Rakuten Marketing [Slice]	Teradata [Appoxee]
Rakuten Marketing [Spotlight]	Teradata [FLXone]
Rakuten Marketing [Viber Media]	Teradata [Hadapt]
Rakuten Marketing [Viki]	Teradata [RainStor]
Rakuten Marketing [Voyagin]	Teradata [Revelytix]
Rakuten Marketing [Webgistix]	Teradata [Think Big Analytics]
RichRelevance [Precog]	Twitter [Adrenaline Mobility]
RocketFuel [X+1]	Twitter [Apps & Zerts]
Rubicon Project [Chango]	Twitter [Bluefin Labs]
Salesforce [Clipboard]	Twitter [CardSpring]
Salesforce [EdgeSpring]	Twitter [Cover Lockscreen]
Salesforce [EntropySoft]	Twitter [Crashlytics]
Salesforce [ExactTarget]	Twitter [Fastlane]

Table C.6: Acquisitions and mergers - continued (6/7).

TECHNOLOGY CONSOLIDATION	(JANUARY 2013 - DECEMBER 2015)
Twitter [Gnip]	Xaxis [24/7 Media]
Twitter [Lucky Sort]	Xaxis [Bannerconnect]
Twitter [Marakana]	Yahoo [Admovate]
Twitter [Mesagraph]	Yahoo [alike]
Twitter [Mitro]	Yahoo [Astrid]
Twitter [MoPub]	Yahoo [Aviate]
Twitter [Namo Media]	Yahoo [Bignoggins Productions]
Twitter [Niche]	Yahoo [Blink]
Twitter [Periscope Co]	Yahoo [Bookpad]
Twitter [SecondSync]	Yahoo [Bread]
Twitter [SnappyTV]	Yahoo [BrightRoll]
Twitter [Spindle]	Yahoo [ClarityRay]
Twitter [TapCommerce]	Yahoo [Cloud Party]
Twitter [Tellapart]	Yahoo [Cooliris]
Twitter [tenXer]	Yahoo [Distill]
Twitter [Trendrr]	Yahoo [EvntLive]
Twitter [Ubalo]	Yahoo [Flurry]
Twitter [Whetlab]	Yahoo [GhostBird Software]
Twitter [ZeroPush]	Yahoo [GoPollGo]
Twitter [Zipdial]	Yahoo [Hitpost]
Verizon [OnCue]	Yahoo [Incredible Labs]
Walmart Labs [Adchemy]	Yahoo [IQ Engines]
Walmart Labs [Inkiru]	Yahoo [Jybe]
Walmart Labs [Luvocracy]	Yahoo [Lexity]
Walmart Labs [PunchTab]	Yahoo [Loki Studios]
Walmart Labs [Stylr]	Yahoo [LookFlow]
Walmart Labs [Tasty Labs]	Yahoo [Luminate]
Walmart Labs [Torbit]	Yahoo [Media Group One]
WPP [DNX]	Yahoo [Meh Labs]
WPP [FusePump]	Yahoo [MessageMe]
WPP [Medialets]	Yahoo [MileWise]
WPP [Ootworld]	Yahoo [PeerCDN]
WPP [Percolate Industries]	Yahoo [PlayerScale]
WPP [Precise Media]	Yahoo [Polyvore]
WPP [The Data Republic]	Yahoo [Propeld]
WPP [Twist Image]	Yahoo [Ptch]
WPP [VML]	Yahoo [Quik.io]

Table C.7: Acquisitions and mergers - continued (7/7).

TECHNOLOGY CONSOLIDATION (JANUARY 2013 - DECEMBER 2015)	
Yahoo [Qwiki]	Yahoo [Tomfoolery]
Yahoo [RayV]	Yahoo [Tumblr]
Yahoo [Rockmelt]	Yahoo [Vizify]
Yahoo [Rondee]	Yahoo [Wander]
Yahoo [SkyPhrase]	Yahoo [Xobni]
Yahoo [Sparq]	Yahoo [Zofari]
Yahoo [SteamFunk Labs]	Yahoo [Ztelic]
Yahoo [Summly]	

D: Partner networks: Denmark (DK)

Here, we provide somewhat more complex examples of partner networks in Denmark (DK), which is situated on the right hand of the scale (see Figure 4.6).[383] The aim of the examples is to zoom in on the five leading partner networks and their interconnections.

The results reported in this appendix are based on research data collected by visiting 475 news items from 25 news websites in Denmark. Table D.1 lists the number of news items (denoted as 'items' in the second and fourth column) per digital media (denoted as 'origin' in the first and third column).

Table D.1: Overview of news websites in Denmark (DK).

ORIGIN	ITEMS	ORIGIN	ITEMS
bornholm.nu	38	rudersdal.lokalavisen.dk	19
nordjyske.dk	38	stiften.dk	19
www.fyens.dk	38	tidende.dk	19
albertslund.lokalavisen.dk	19	www.bt.dk	19
cphpost.dk	19	www.jv.dk	19
ekstrabladet.dk	19	www.kristeligt-dagblad.dk	19
folketidende.dk	19	www.information.dk	19
furesoe.lokalavisen.dk	19	borsen.dk	16
gentofte.lokalavisen.dk	19	jyllands-posten.dk	14
hilleroed.lokalavisen.dk	19	www.jyllands-posten.dk	4
hoersholm.lokalavisen.dk	19	penge.borsen.dk	3
lyngby-taarbaek.lokalavisen.dk	19	finans.dk	1
politiken.dk	19		

I compiled and refactored a referrer graph from our research data collected from Denmark. The resulting graph is depicted in Figure D.1. The node '`crawled.io`' is depicted as the center of the blue subgraph. We made the graph sparse with a directed-force

383 Denmark (DK) with N=719 nodes, E=1,348 edges, and C_B=33 clusters.

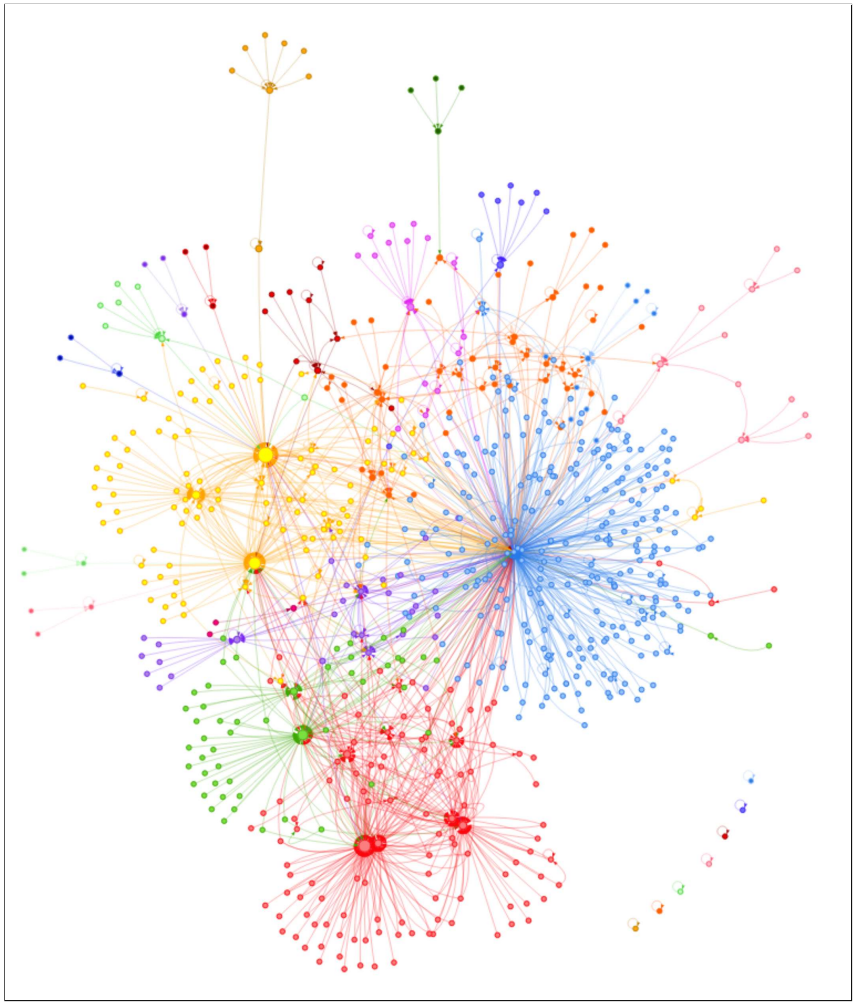

Figure D.1: Generic web-tracking graph: Denmark (DK) with N=719 nodes, E=1,348 edges, and C_B=33.

layout. The directed graph consists of 719 distinct nodes and 1,348 distinct edges. The following seven nodes are not connected to any other node:

(1) 'o.twimg.com',[384]
(2) 'pbs.twimg.com',
(3) 'ton.twimg.com',
(4) 'aarhusfestuge.dk',[385]
(5) 'realtime.services.discuss.com',[386]
(6) 'livewire.ritzau.de:6101',[387] and
(7) 'aus5.mozilla.org'.[388]

We grouped these unconnected nodes together in the bottom-right corner of Figure D.1.

We remark that 33 clusters of partner networks were identified with a cluster-edge betweenness algorithm [Csárdi & Nepusz, 2006]. Below we list the five leading clusters identified by their central node(s) (see Definition 4.16).

(1) the Rubicon Project (Figure D.2, p. 269),
(2) Adform (Figure D.3, p. 270),
(3) Adspine (Figure D.4, p. 271),
(4) AppNexus (Figure D.5, p. 272), and
(5) Google (Figure D.6, p. 273).

Interconnection (see Definition 4.19) between partner network is depicted nicely in, e. g., Figure D.5. The picture shows precisely where AppNexus is connected with two edges into each of its neighboring networks, i. e., the Rubicon Project (see Figure D.2), Adform (see Figure D.3), and Google (see Figure D.6).

384 The origins 'twing.com' belongs to Twitter.
385 This seems to be an anomaly, i. e., an HTTP request without a referrer header or a location header.
386 HTTP traffic related to the Discus blog comment hosting service. URL: https://www.crunchbase.com/organization/disqus (24 February 2018).
387 HTTP traffic related to the Livewire social platform. URL: https://www.crunchbase.com/organization/livewire (24 February 2018).
388 The origin 'aus5.mozilla.org' is related to the headless crawler.

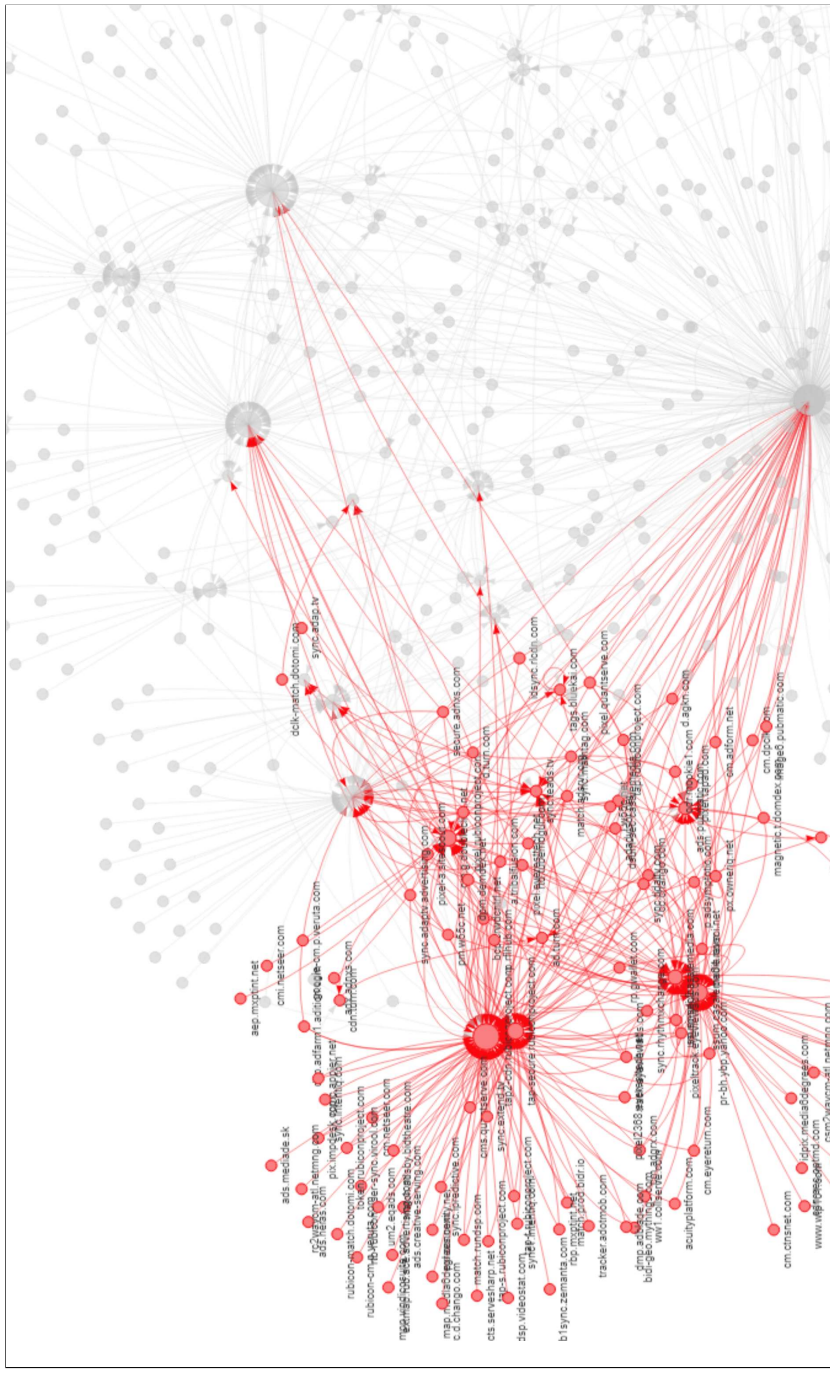

Figure D.2: Partner network: the Rubicon Project (DK).

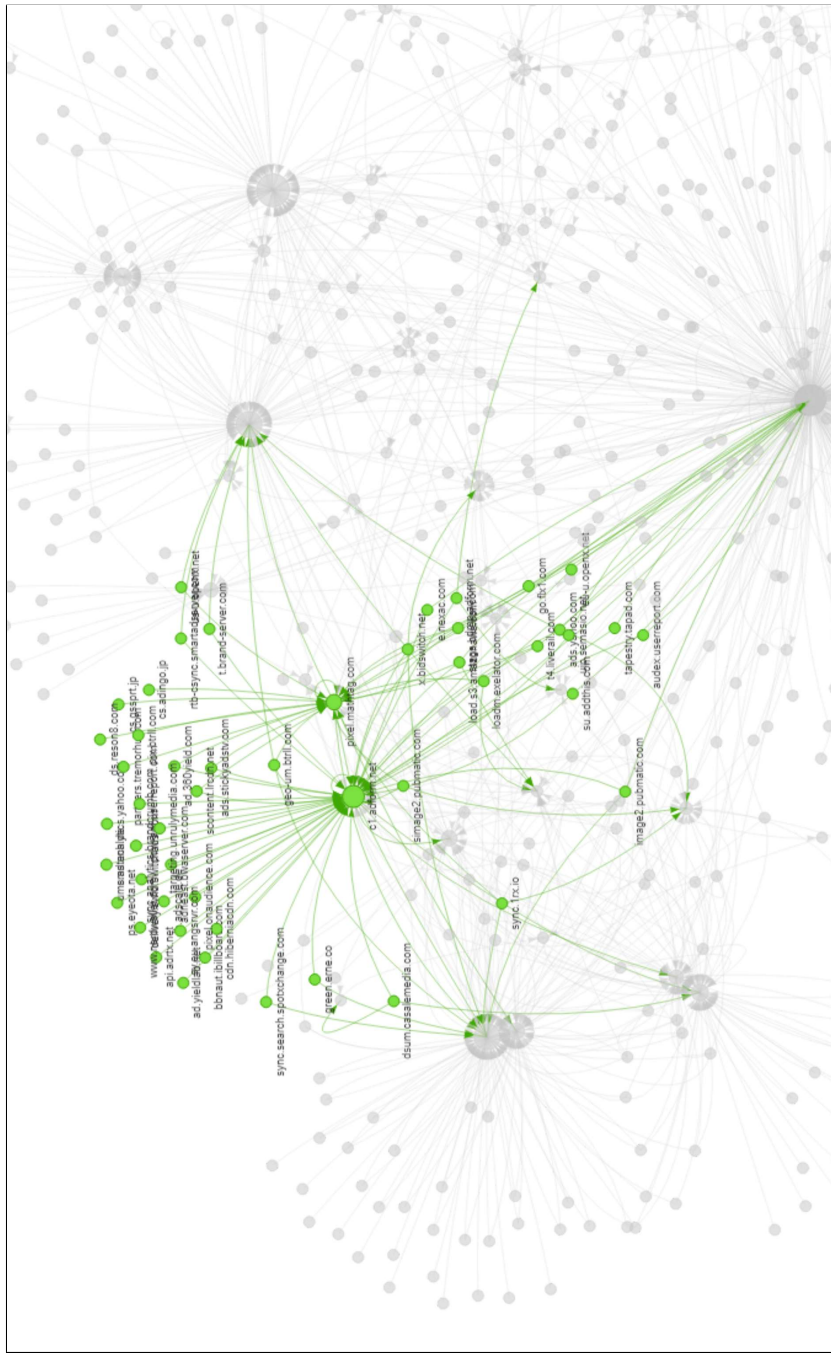

Figure D.3: Partner network: Adform (DK).

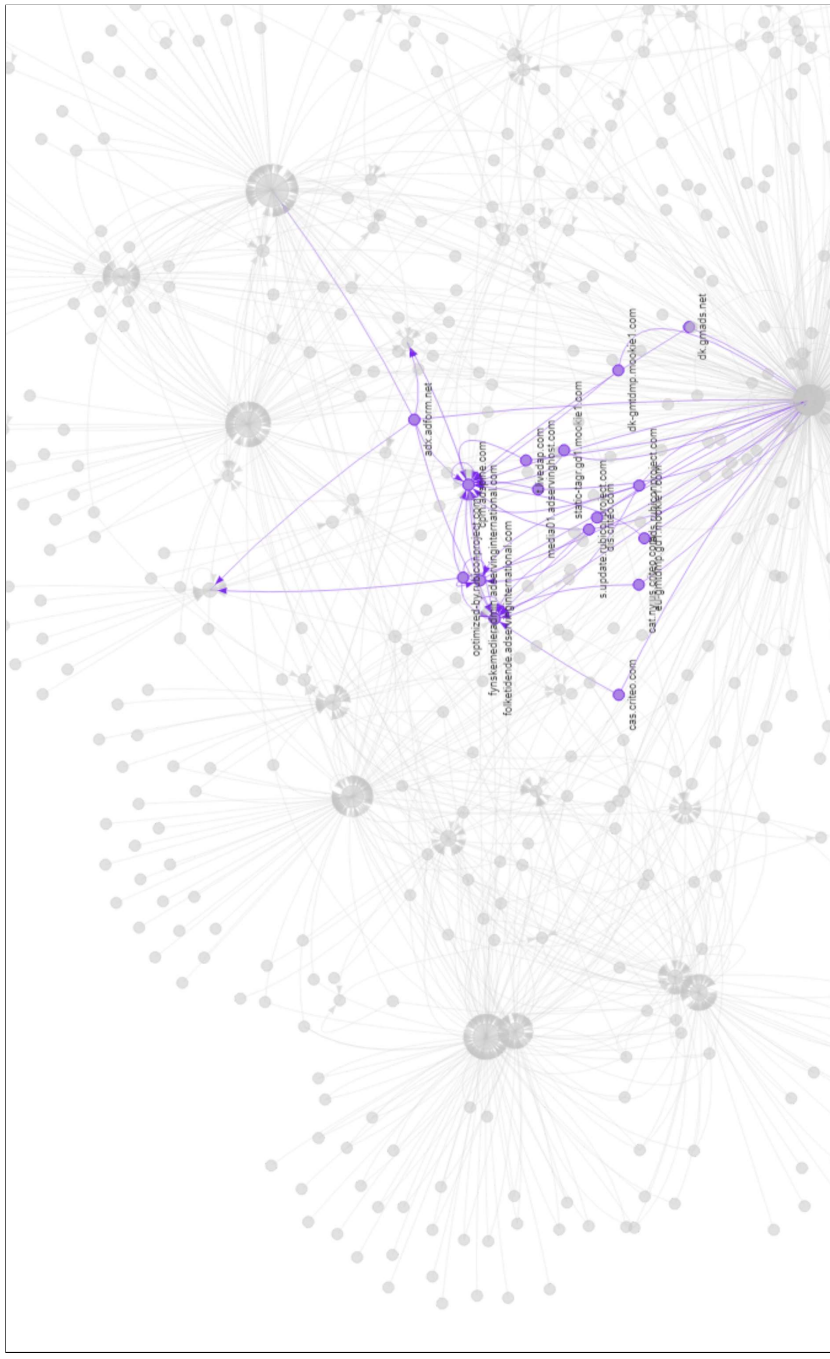

Figure D.4: Partner network: Adspine (DK).

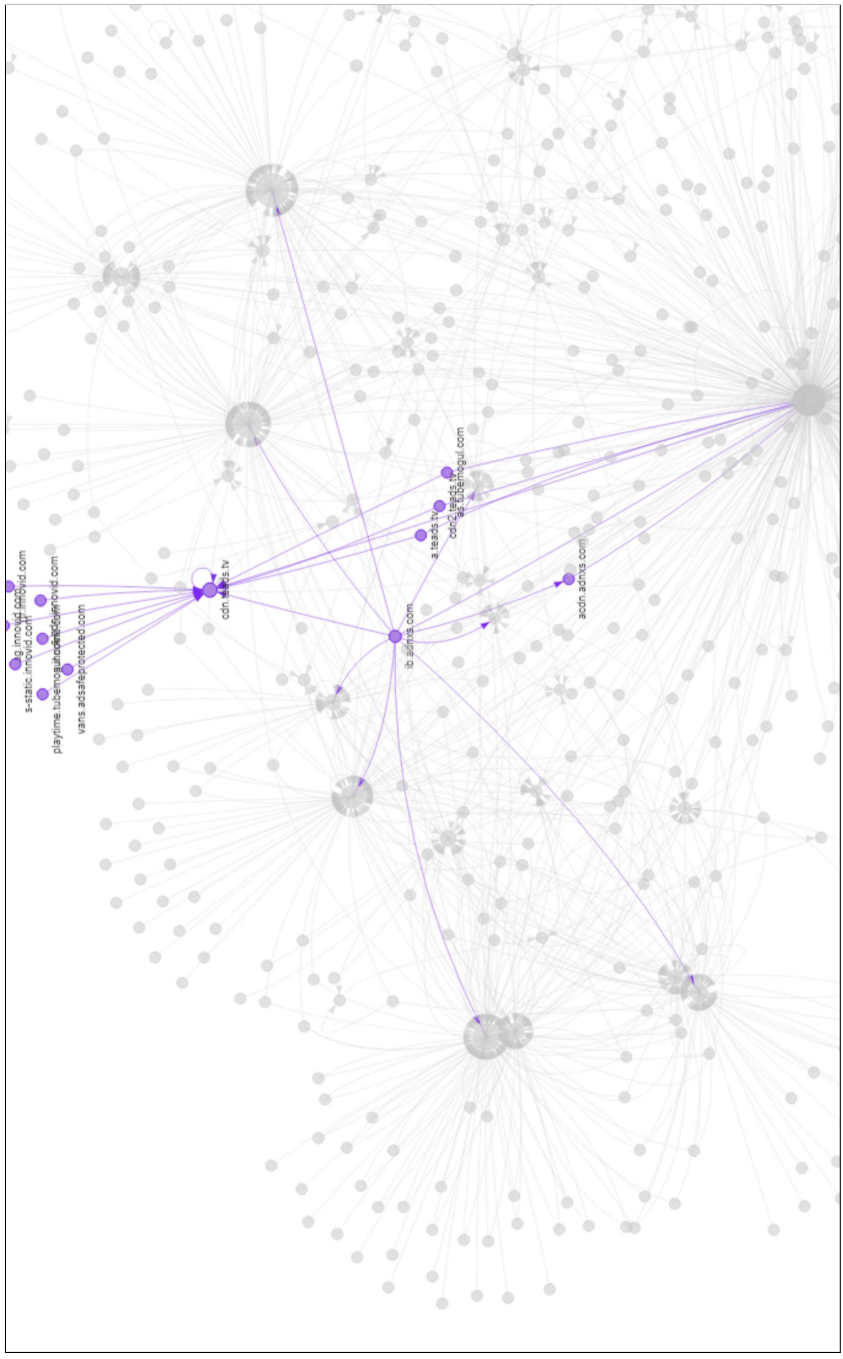

Figure D.5: Partner network: AppNexus (DK).

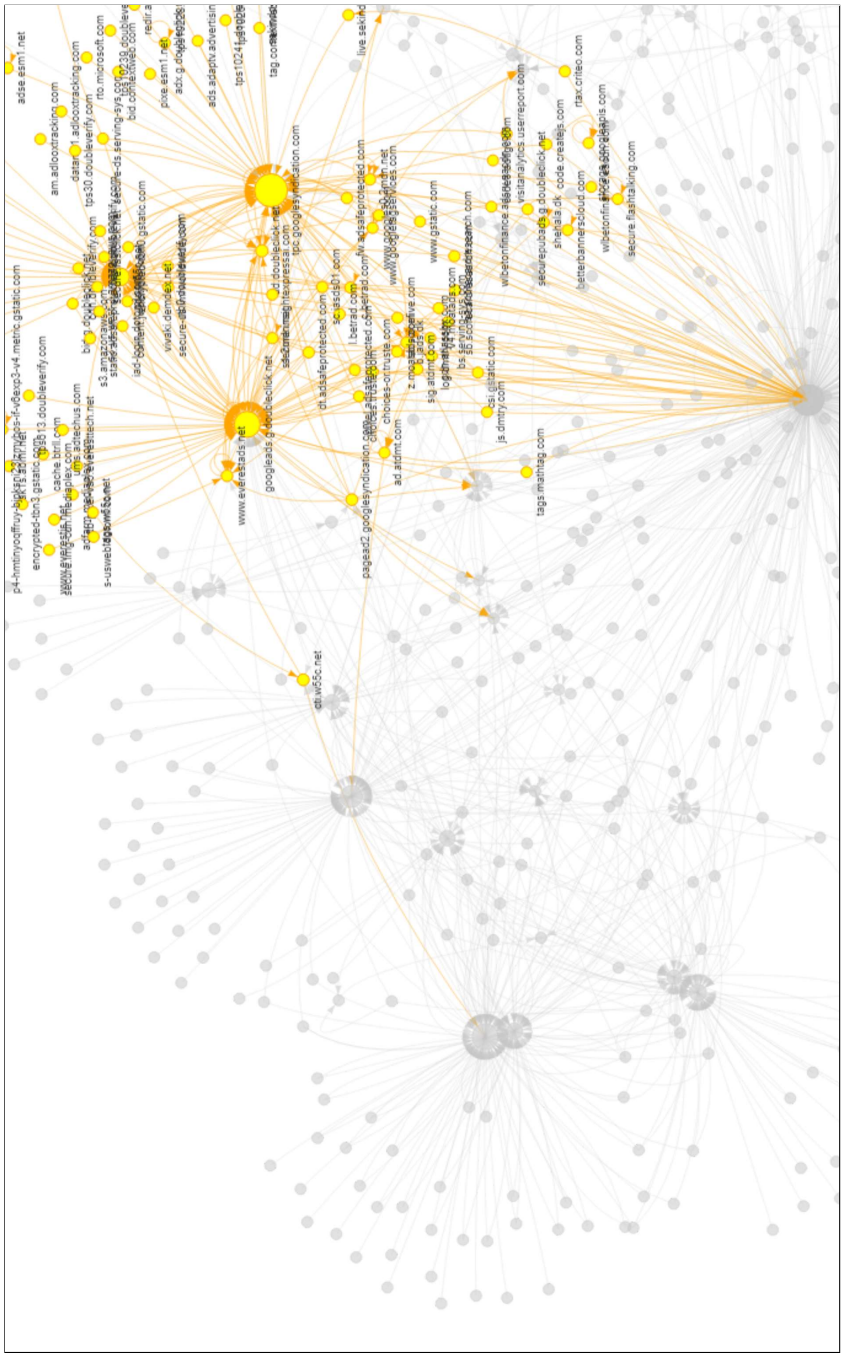

Figure D.6: Partner network: Google (DK).