Social Network Analysis

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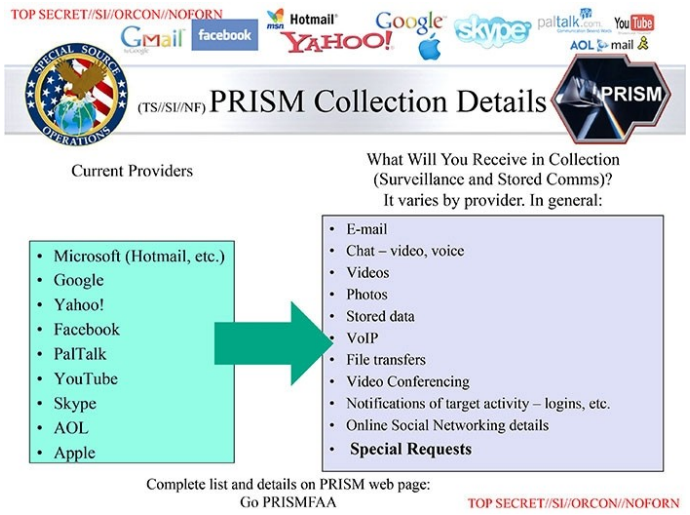
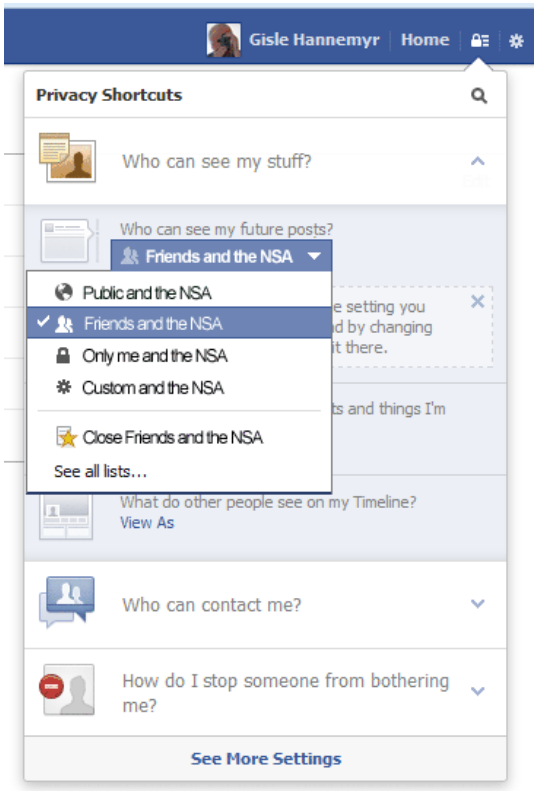
1 The Problem

Prism



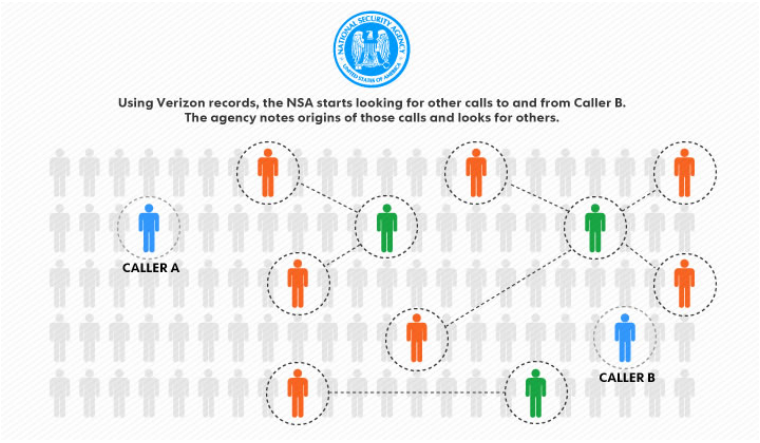
Quelle: NSA

Facebook



Twitter picture by Gisle Hannemyr: ☞ http://v.gd/ysxDPw

Metadata Analysis



Quelle: USA Today

2 Foundations

Social Networks

- Social networks are networks of people or institutions and their connections
- Social networks can be seen as a means of recording and measuring the connections between people or institutions
- Different disciplines use different things to measure these connections
- E.g., in linguistics, researchers tend to use communicative traffic (that is what people say or do) to build social networks and they use these networks to get an idea of the options that people have for sharing meanings

(Rebekah Wegener)

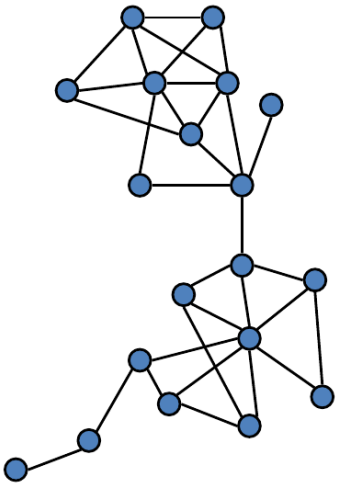
Concepts

- **Density** (the number of connections)
- **Multiplexity** (the number of contexts they know each other from)
- **Directionality** (the dominant direction of communication)
- **Centrality** (the character who has the most connections)
- **Network Morphology** (the changing shape of the network i.e. are different parts quite different shapes?)

(Rebekah Wegener)

Nodes

- *Actors / nodes / vertices / points*
  - Computers / Telephones
  - Persons / Employees
  - Companies / Business Units
  - Articles / Books
  - Can have properties (attributes)
- Ties / edges / arcs / lines / links



(Johannes Putzke)

Vertices

- Actors / nodes / vertices / points
- *Ties / edges / arcs / lines / links*
  - connect pair of actors
  - types of relations
    - friendship
    - acquaintance
    - kinship
    - advice
    - hindrance
    - sex
  - allow different kind of flows
    - messages
    - money
    - diseases

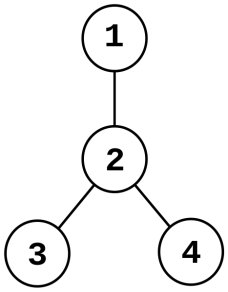
Centrality Measures

- Who is the most prominent?
  - Who knows the most actors? (**Degree Centrality**)
  - Who has the shortest distance to the other actors? (**Closesness Centrality**)
  - Who controls knowledge flows? (**Betweenness Centrality**)
  - Who is in most shortest paths?(**Betweenness Centrality**)
  - …

Further Concepts

- Strength of a tie
- Weight of a tie
- Directional or Non-Directional
- Reachability
- Cliques
- Groups

Adjacency Matrices



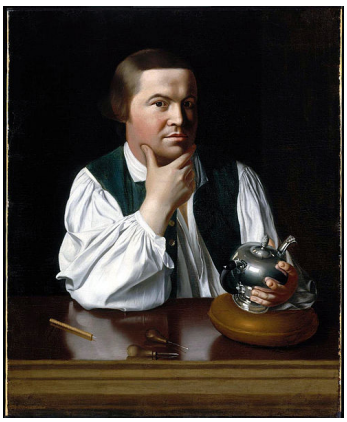
$$\begin{array}{c|c} & \begin{matrix} 1 & 2 & 3 & 4 \end{matrix} \\ \hline \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix} & \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix} \end{array}$$

☞ Wikipedia

3 Example

Paul Revere

Paul Revere was an American patriot in the American Revolution.
He is most famous for alerting Colonial militia of approaching British forces before the battles of Lexington and Concord.
Revere was a prosperous and prominent Boston silversmith, who helped organize an intelligence and alarm system to keep watch on the British military.



Portrait of Paul Revere by John Singleton Copley

Paraphrased from Wikipedia: ☞ http://v.gd/V3WnrQ

Example Analysis

"Rest assured that we only collected metadata on these people, and no actual conversations were recorded or meetings transcribed. All I know is whether someone was a member of an organization or not. Surely this is but a small encroachment on the freedom of the Crown's subjects. I have been asked, on the basis of this poor information, to present some names for our field agents in the Colonies to work with. It seems an unlikely task."

☞ Kieran Healy, Jun 9th, 2013

Organizations and Persons

We consider the following organizations and their members: StAndrewsLodge (A), LoyalNine (B), North-Caucus (C), LongRoomClub (D), TeaParty (E), Bostoncommittee (F), LondonEnemies (G) ...

	A	B	C	D	E	F	G	...
Adams.John	0	0	1	1	0	0	0	...
Adams.Samuel	0	0	1	1	0	1	1	...
Allen.Dr	0	0	1	0	0	0	0	...
Appleton.Nathaniel	0	0	1	0	0	1	0	...
Ash.Gilbert	1	0	0	0	0	0	0	...
Austin.Benjamin	0	0	0	0	0	0	1	...
Austin.Samuel	0	0	0	0	0	0	1	...
Avery.John	0	1	0	0	0	0	1	...
Baldwin.Cyrus	0	0	0	0	0	0	1	...
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋱

(Kieran Healy)

Adjacency Matrix

- Mr Breiger's insight was that our table of 254 rows and seven columns is an adjacency matrix, and that a bit of matrix multiplication can bring out information that is in the table but perhaps hard to see.
- Take this adjacency matrix of people and groups and transpose it—that is, flip it over on its side, so that the rows are now the columns and vice versa. Now we have two tables, or matrices, a 254x7 one showing "People by Groups" and the other a 7x254 one showing "Groups by People".
- If you multiply out A(AT), you will get a 254x254 "Person by Person"

(Kieran Healy)

Persons and Persons

		(1)	(2)	(3)	(4)	...
(1)	Adams.John	-	2	1	1	...
(2)	Adams.Samuel	2	-	1	2	...
(3)	Allen.Dr	1	1	-	1	...
(4)	Appleton.Nathaniel	1	2	1	-	...
(5)	Ash.Gilbert	0	0	0	0	...
(6)	Austin.Benjamin	0	1	0	0	...
⋮	⋮	⋮	⋮	⋮	⋮	⋱

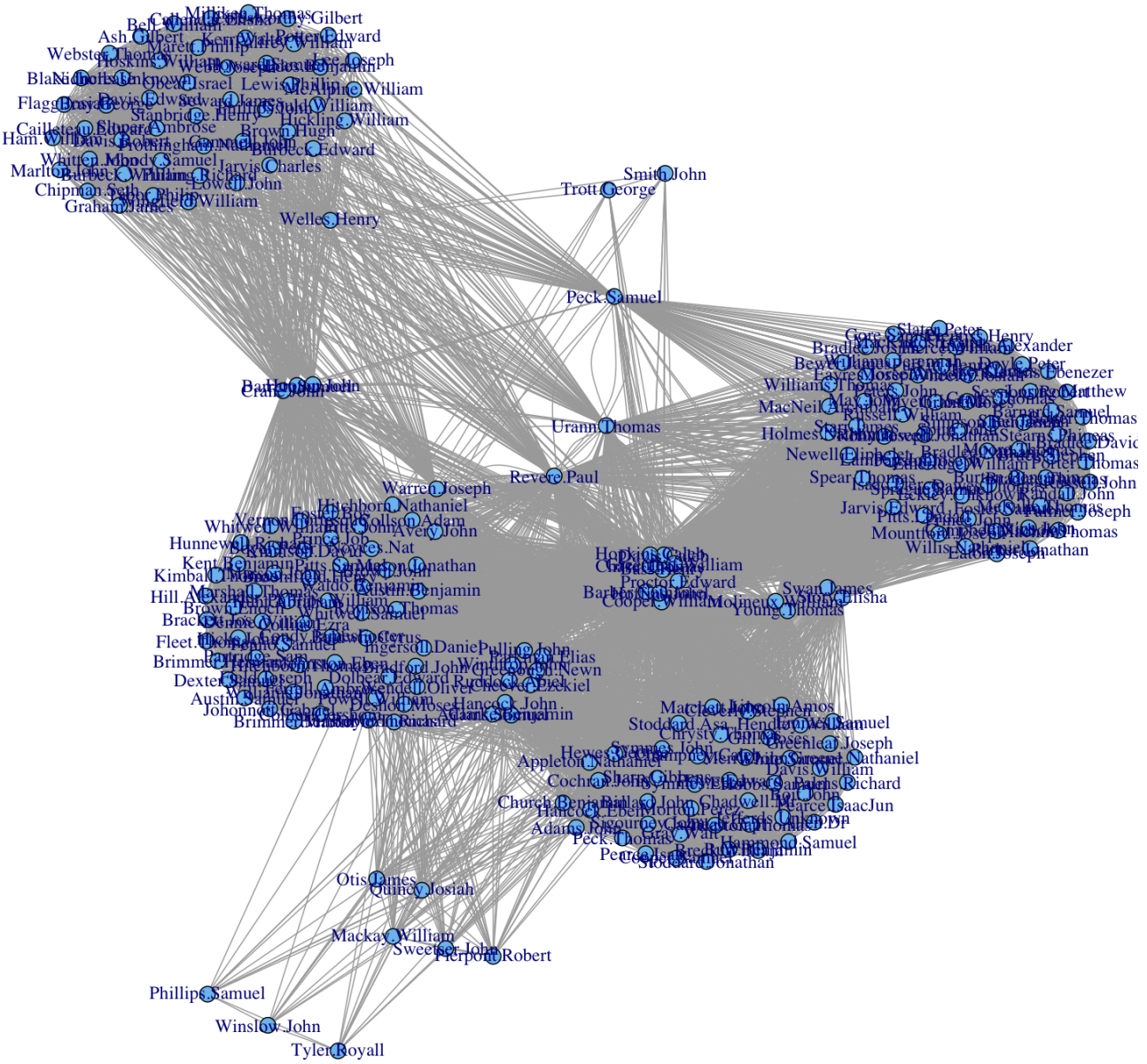
(Kieran Healy)

Betweenness

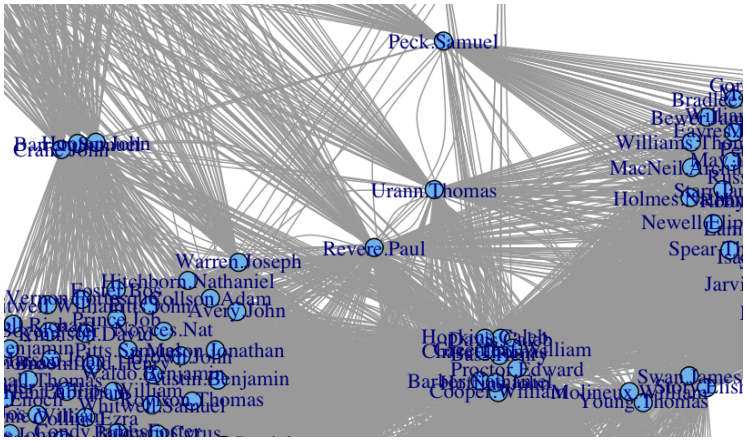
3839	-	Revere.Paul
2185	-	Urann.Thomas
1817	-	Warren.Joseph
1150	-	Peck.Samuel
931	-	Barber.Nathaniel
931	-	Cooper.William
931	-	Hoffins.John
⋮	⋮	⋮

(Kieran Healy)

Centrality



(Kieran Healy)



Moxie Marlinspike

"If the federal government had access to every email you've ever written and every phone call you've ever made, it's almost certain that they could find something you've done which violates a provision in the 27,000 pages of federal statues or 10,000 administrative regulations. You probably do have something to hide, you just don't know it yet."

☞ Moxie Marlinspike, June 12, 2013

4 References

References

- Rebekah Wegener: Ling 109 – Language, Culture and Communication. Sociocultural Contexts: social networks (Lecture Slides). Macquarie University, Sydney, Australia.
- Johannes Putzke: Social Network Analysis. Basic Concepts, Methods & Theory (Lecture Slides). University of Cologne, Germany.
- Kieran Healy: Using Metadata to Find Paul Revere. Blog Post: http://v.gd/LM2Kr3. June 9th, 2013.
- Moxie Marlinspike: We Should All Have Something To Hide. Blog Post: http://v.gd/KvBIsH. June 12th, 2013.

Recommended Reading

- Hanneman & Riddle: Introduction to Social Network Methods. Available online: http://v.gd/vzRyXX, 2005.
- Cory Doctorow: Little Brother. Creative Commons licensed young adult novel. Published as printed or e-book in different languages: http://v.gd/JrRBz6.
- Edward Snowden: Interview. YouTube-Video: http://youtu.be/5yB3n9fu-rM, 2013.
- heise online: "Spiegel": BND weitet Internet-Überwachung aus. Online-News: http://heise.de/-1889298, 2013.