Detection of Small Covert Networks Embedded in Large Networks

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Overview

- Definitions,
- A Model to Reflect Those,
- A Particular Implementation: Salafi Jihadi Network,
- Strategies for Detecting Groups,
- Some Results, and
- Flaws, Extensions, and Outlook

What is *Covert*?

a covert network is a sub graph where edge information is unavailable, unreliable, or indistinguishable from whole graph structure - but that sub graph is informative

. . . or Operationally

A relatively small, organized group of conspirators, masking their existence via communication discipline and taking advantage of a noisy background, who are preparing some event.
For this particular talk: Salafi Jihadi network as described by Sageman, et al[1].
Note: not that group's more recent focus on *leaderless jihad*.

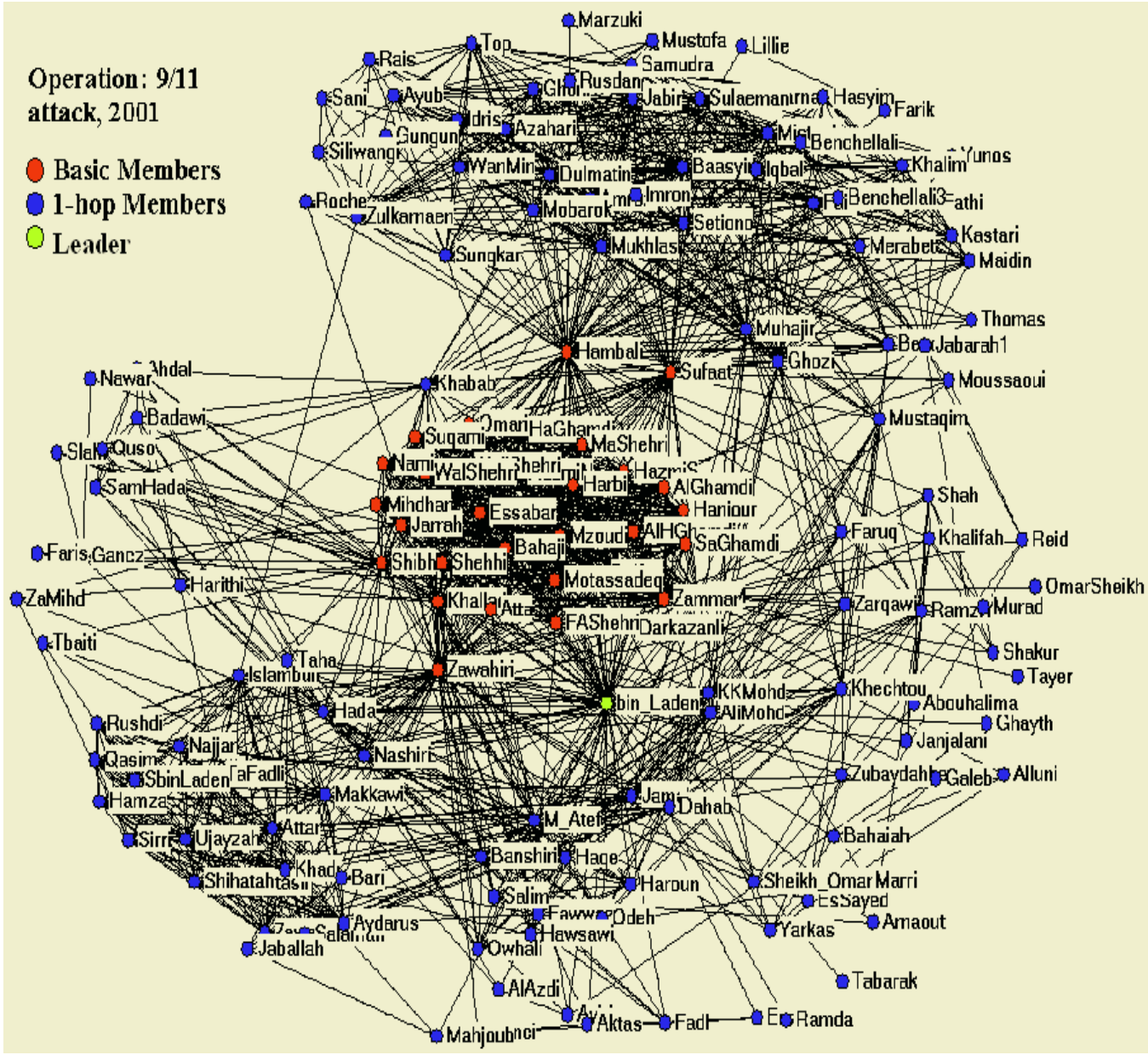


Fig. 4. The 1-hop Network of the September 11th Attack

Salient Features

- highly interconnected subordinate groups, and
- bridging middle managers,
- communications masked with some tradecraft,
- missing from picture: vast background population

Simple Implementation addressing a Salafi Jihadi-like Network

background population many small cliques, which are recursively cliqued into single graph

covert leader embedded in background, with connections to subordinate groups

subordinates few, medium size cliques with connections between clusters

communications simple message content *Good* vs. *Bad*

. . . or Symbolically

- a structured population, P,
- covert leader, H,
- subordinate covert groups, $\{C_i\}$,
- stochastic behavior model for intra- and inter-group messages,
- drawn from a set vocabulary, V

Aside: Sales Pitch

Scala-based Implementation available for review/remix:

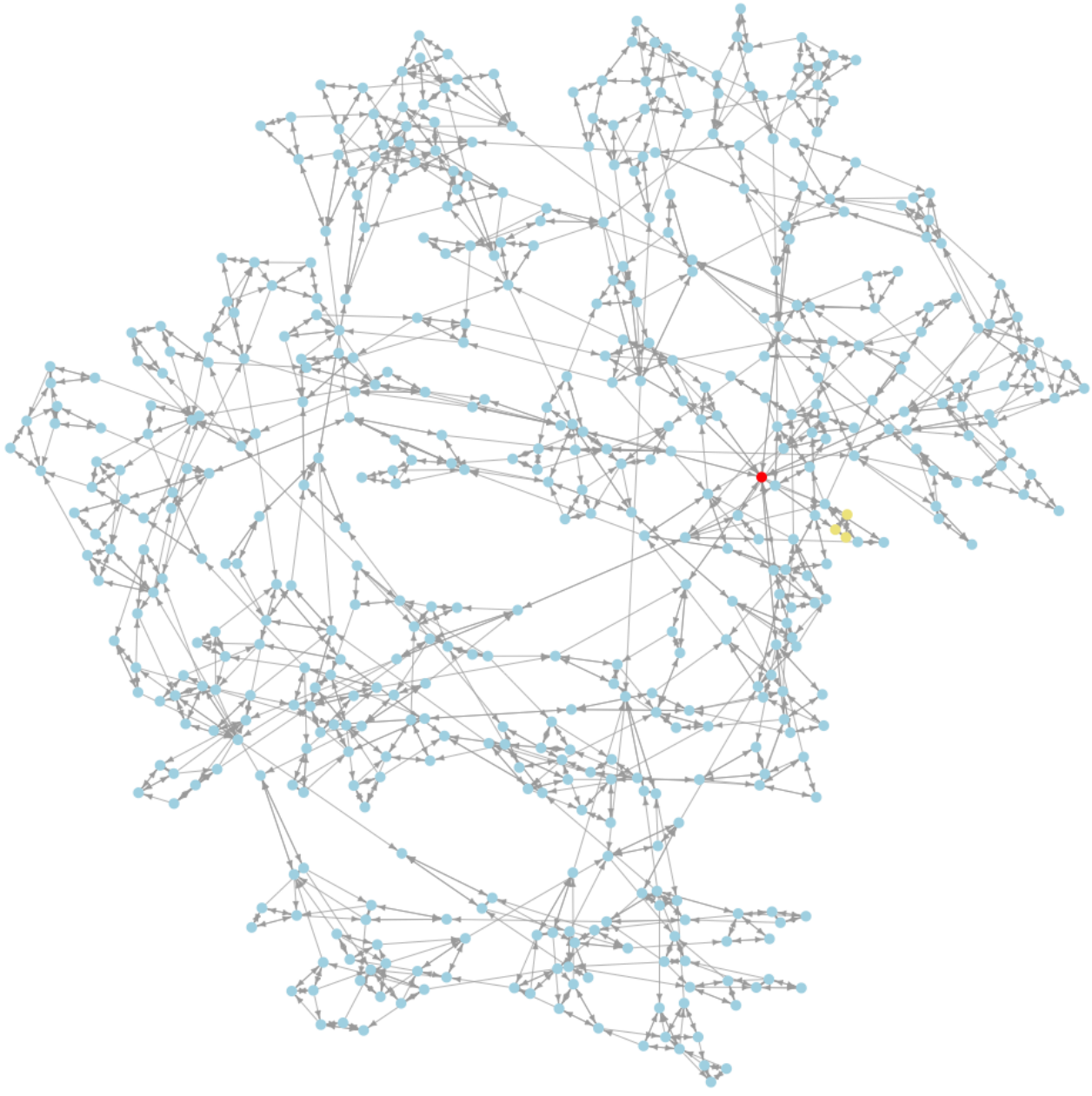
https://github.com/pearsonca/scala-commsim

Actively moving from closed, non-Scala implementation to that repository. Please request changes, point out bugs, etc.

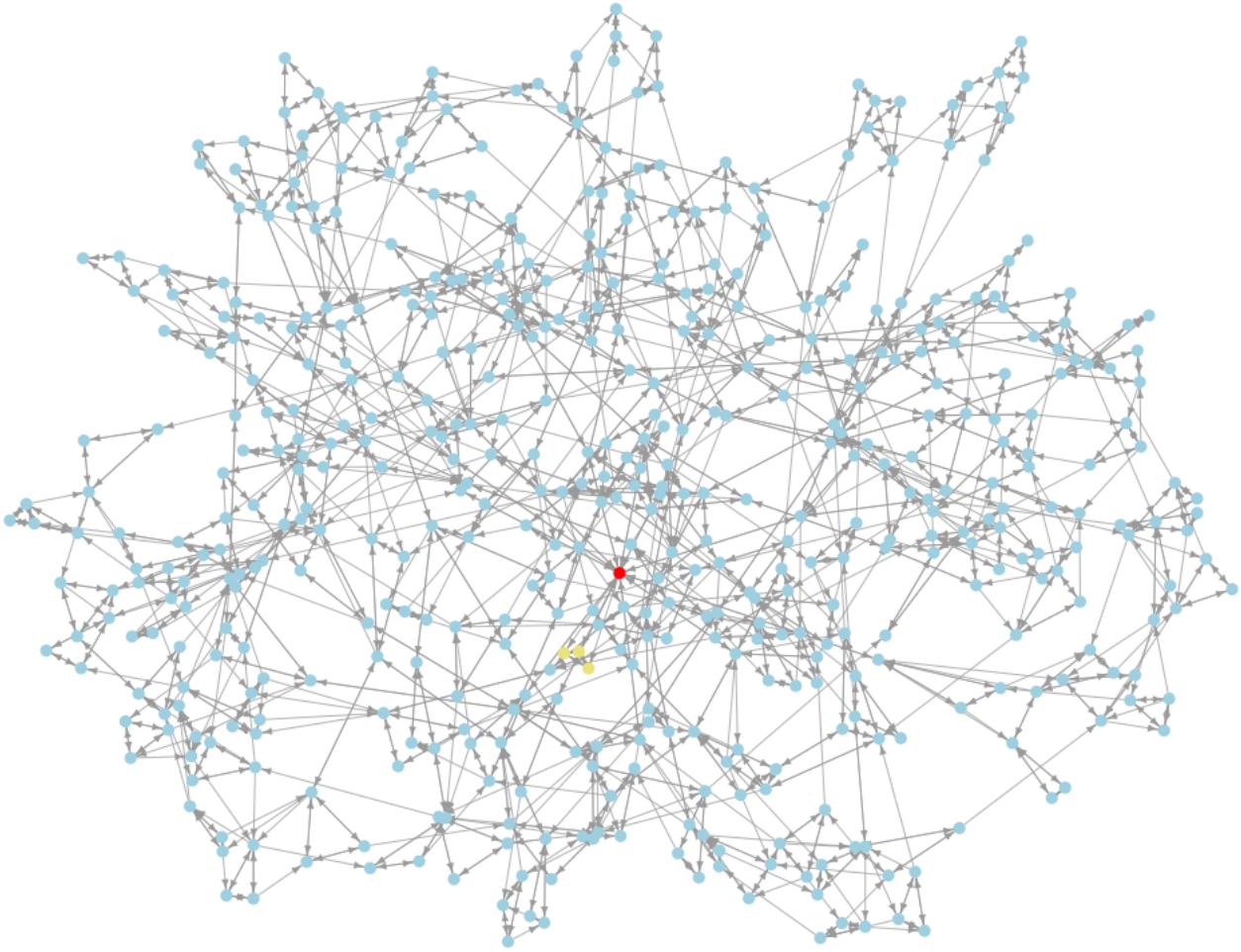
Also, this presentation:

https://github.com/pearsonca/sunbelt13-presentation

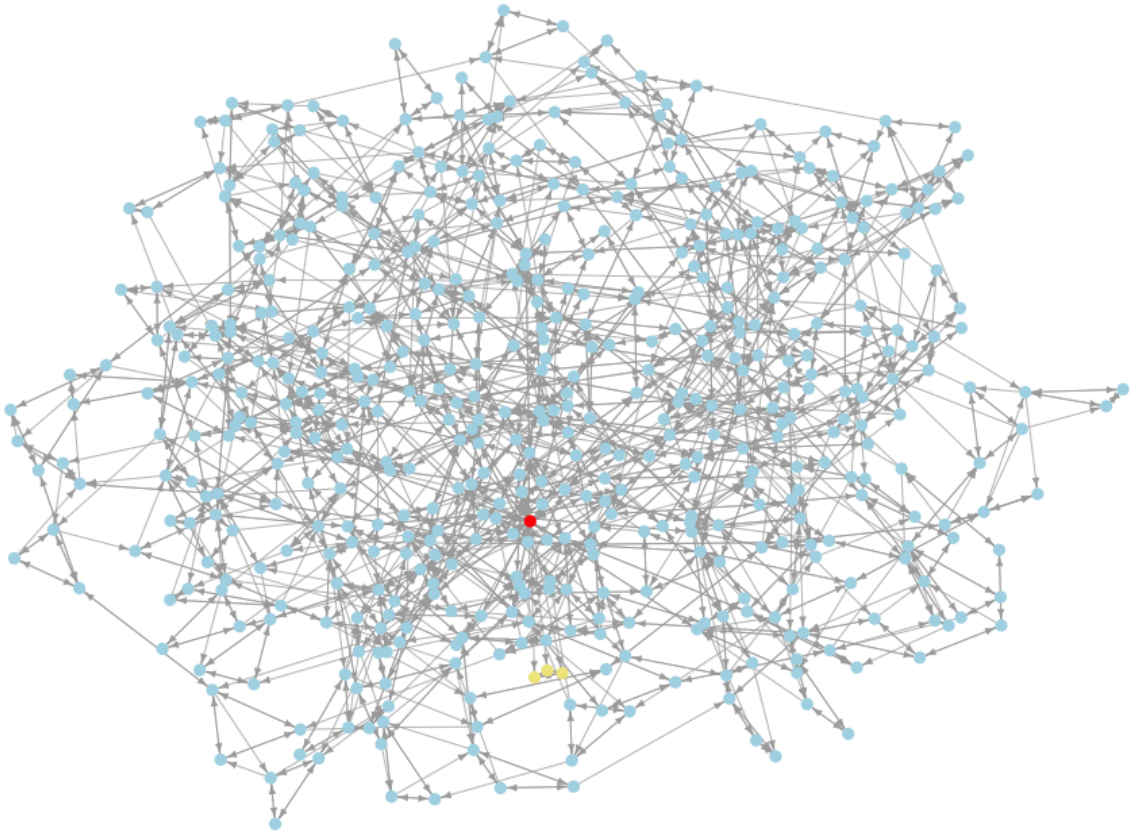
Some Networks Generated By This Procedure...



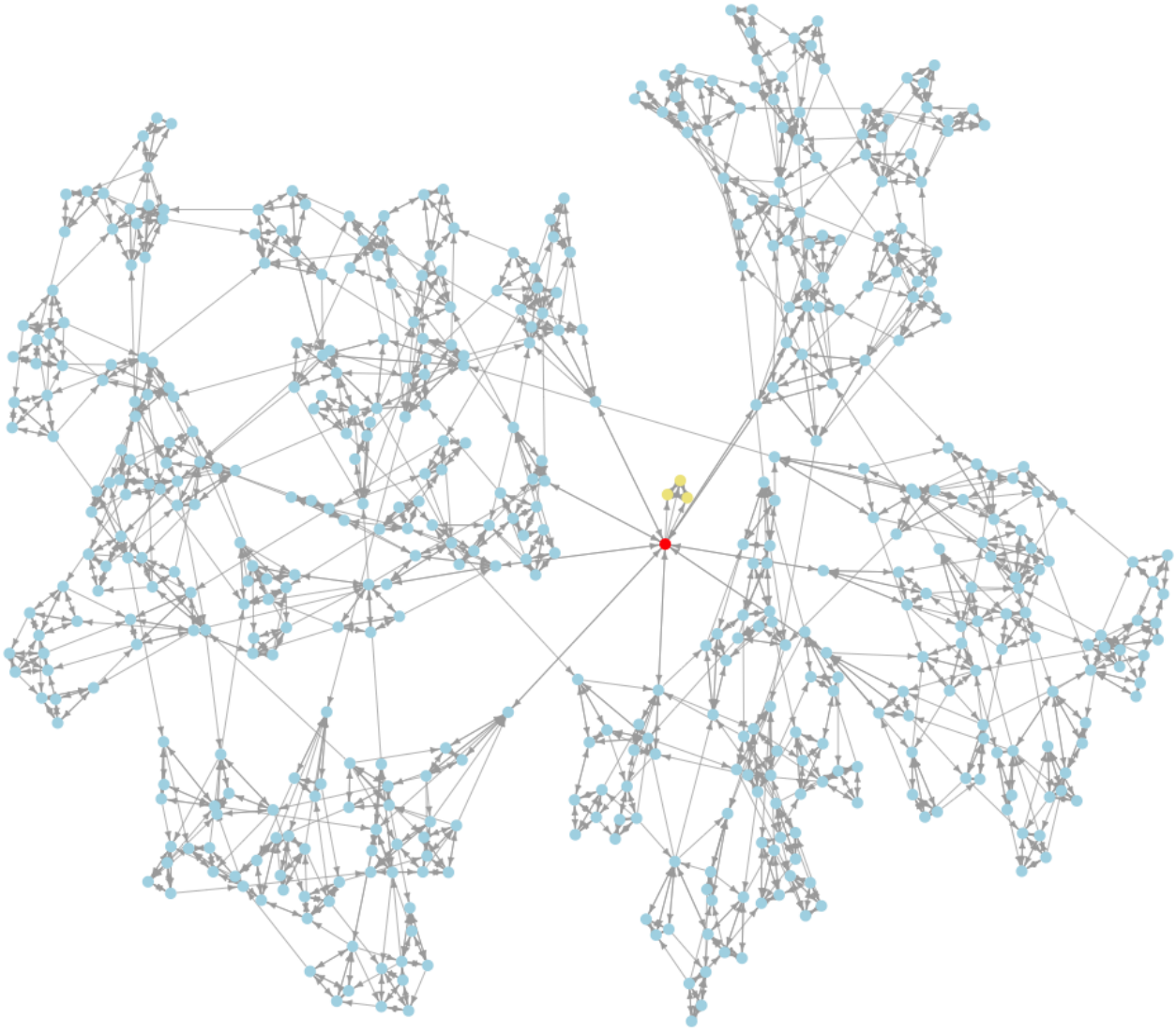
3 clique, 1% remix



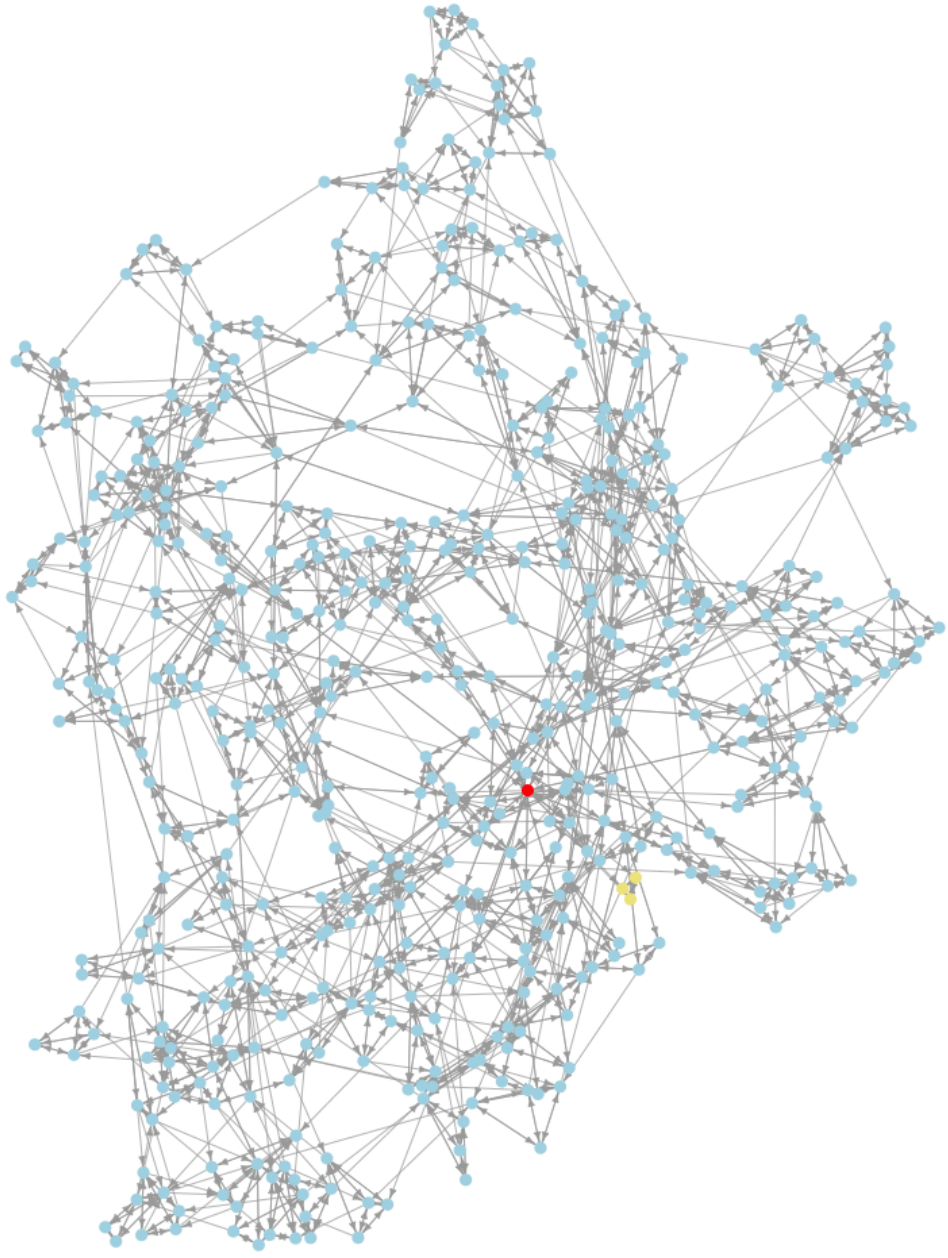
3 clique,
10% remix



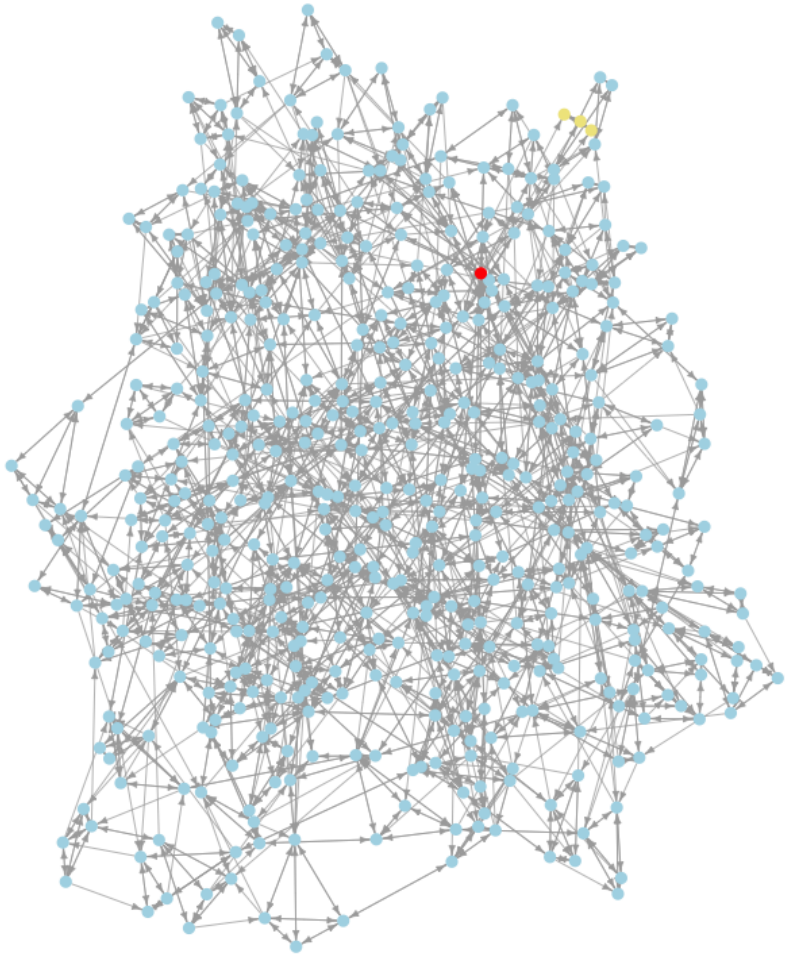
3 clique,
30% remix



4 clique, 1% remix

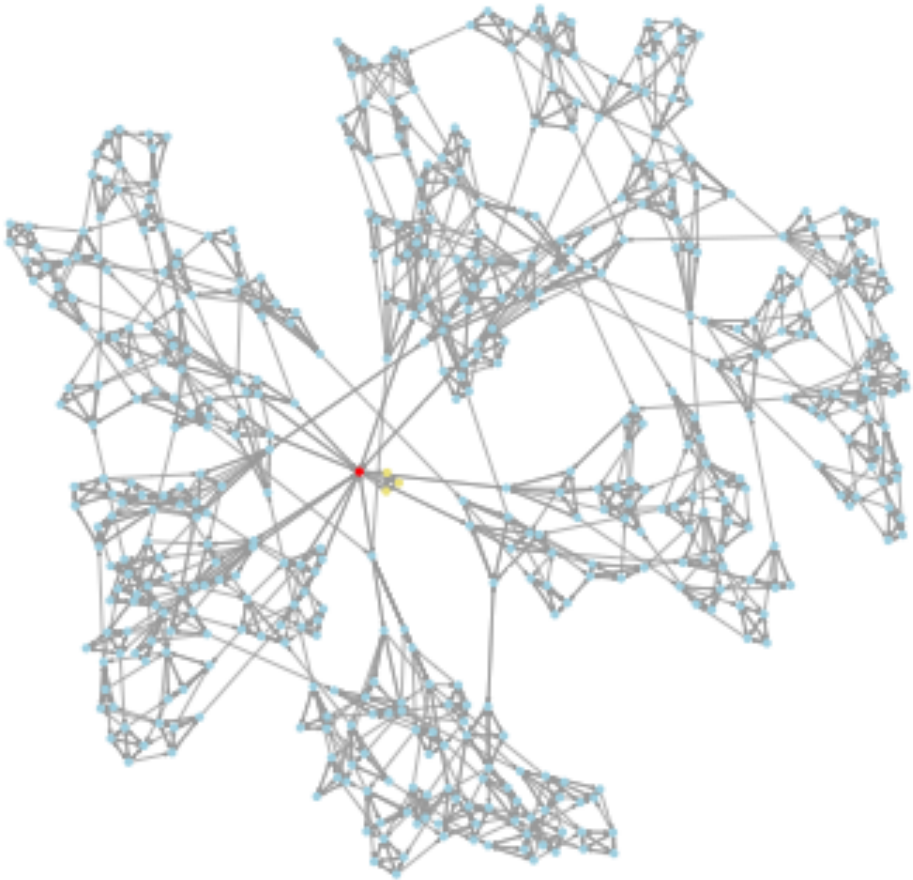


4 clique,
10% remix



4 clique,
30% remix

Steady State, Structural View vs. Real Time



Real Time Challenges to Detection

- population vs. covert group communication network initially unknown,
- potentially limited resources for monitoring those communications,
- thus gathered information unreliable / incomplete,
- and risk trade-offs: FPR & TPR vs. action by group

Detection Model: The Observer

An algorithmic description of

- the data limitations (e.g., random suppression or transformation of signals), and
- detection strategy(ies)

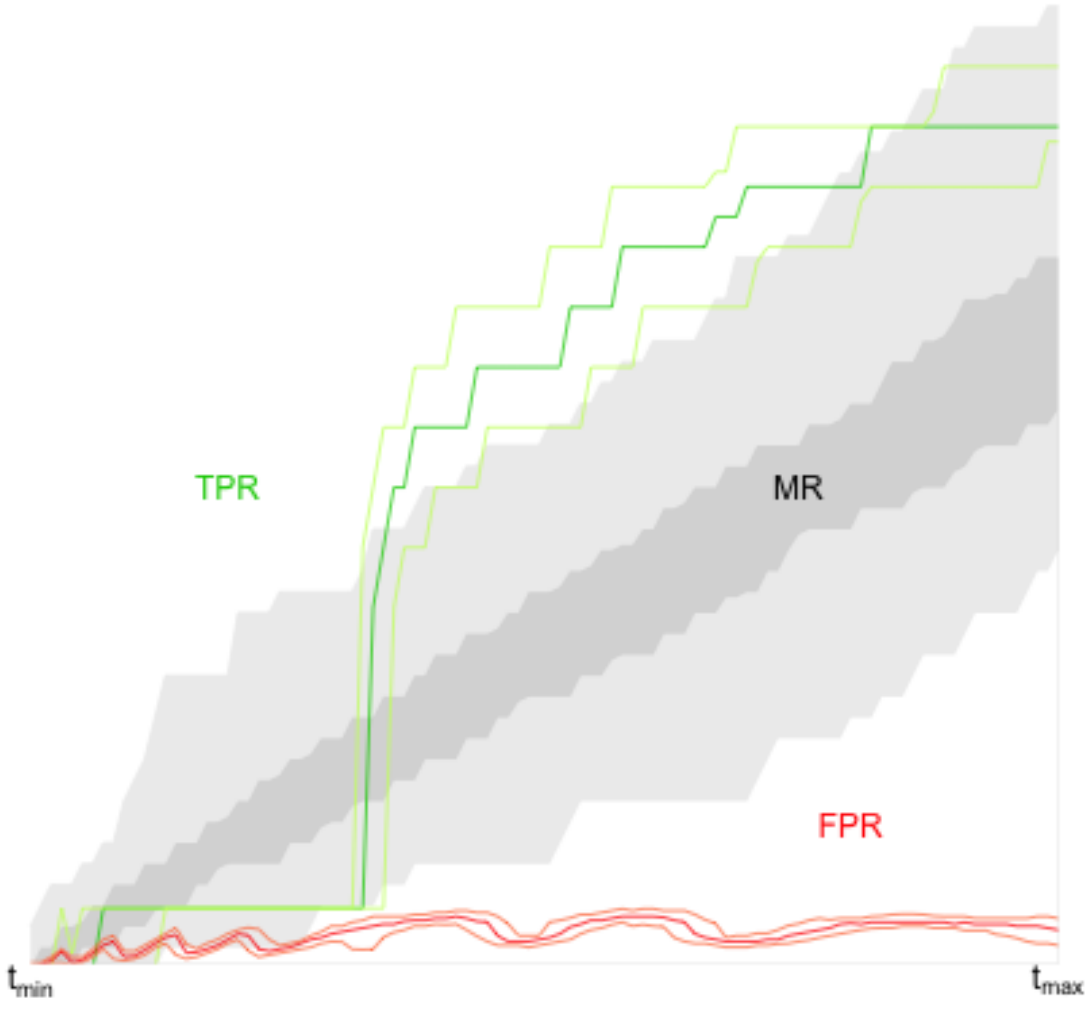
Some Simple Strategies

- pure content: pick up everyone that has sent and received a *Bad* message
- pure structural: pick up high / low degree individuals
- mixed structural / content

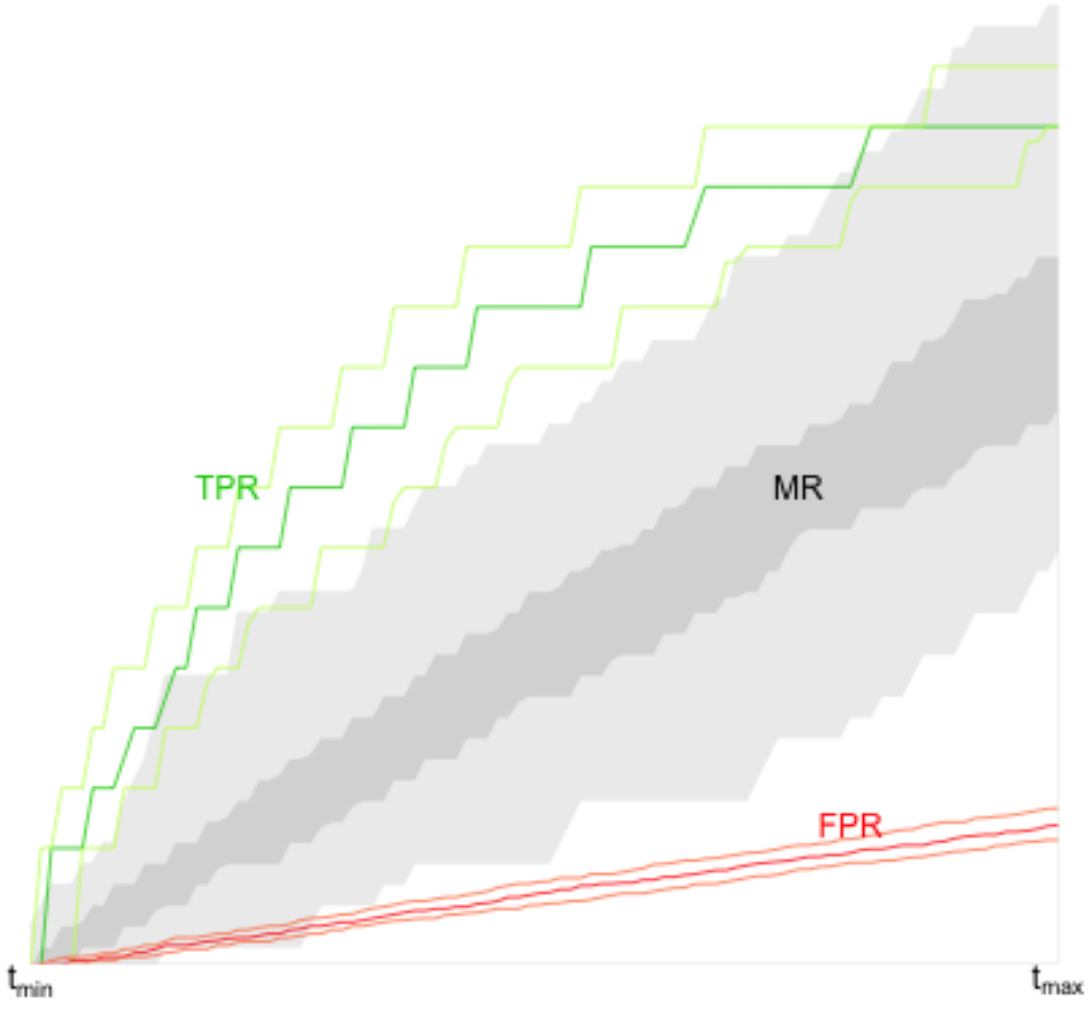
Appropriate Measures?

Assume that any given plot has some critical amount of planning-related communication.
But what else?

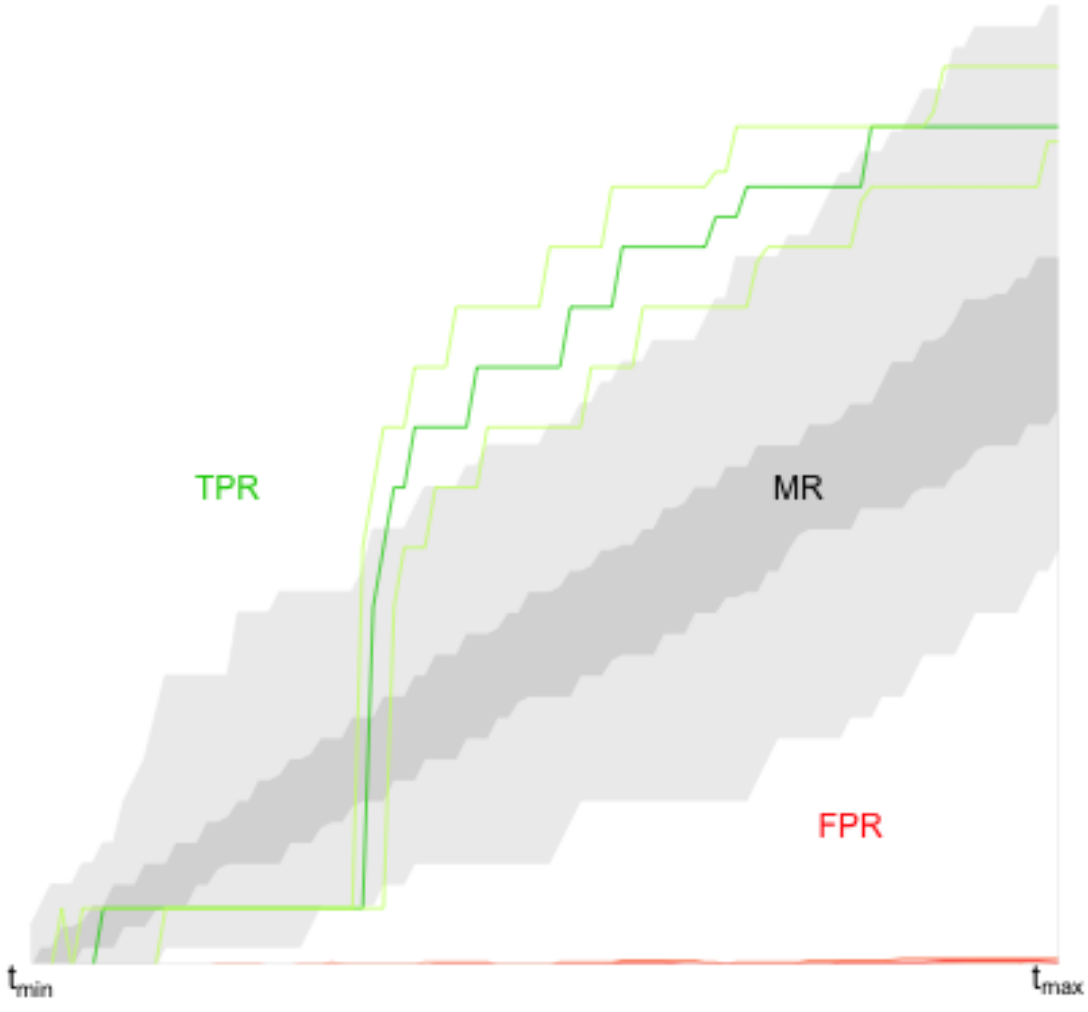
- true positive rate (hub + subordinates ID'd / total),
- false positive rate (background ID'd / background total),
- resource investment (not covered)



structural only



content only



structure + content

Flaws, Extensions, and Outlook

- limited vocabulary – add message diversity, require content detection as well,
- unsophisticated Observer model and strategies – add resource model, shifting strategies
- background / foreground structural generations – new generators, fitting to live traffic
- integrate additional relationship types – demo only uses “Family” and “Plot” contexts

Jialun Qin, Jennifer J Xu, Daning Hu, Marc Sageman, and Hsinchun Chen.

Analyzing terrorist networks: A case study of the global salafi jihad network.

In *Intelligence and security informatics*, pages 287–304. Springer, 2005.