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

. . . or Operationally

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

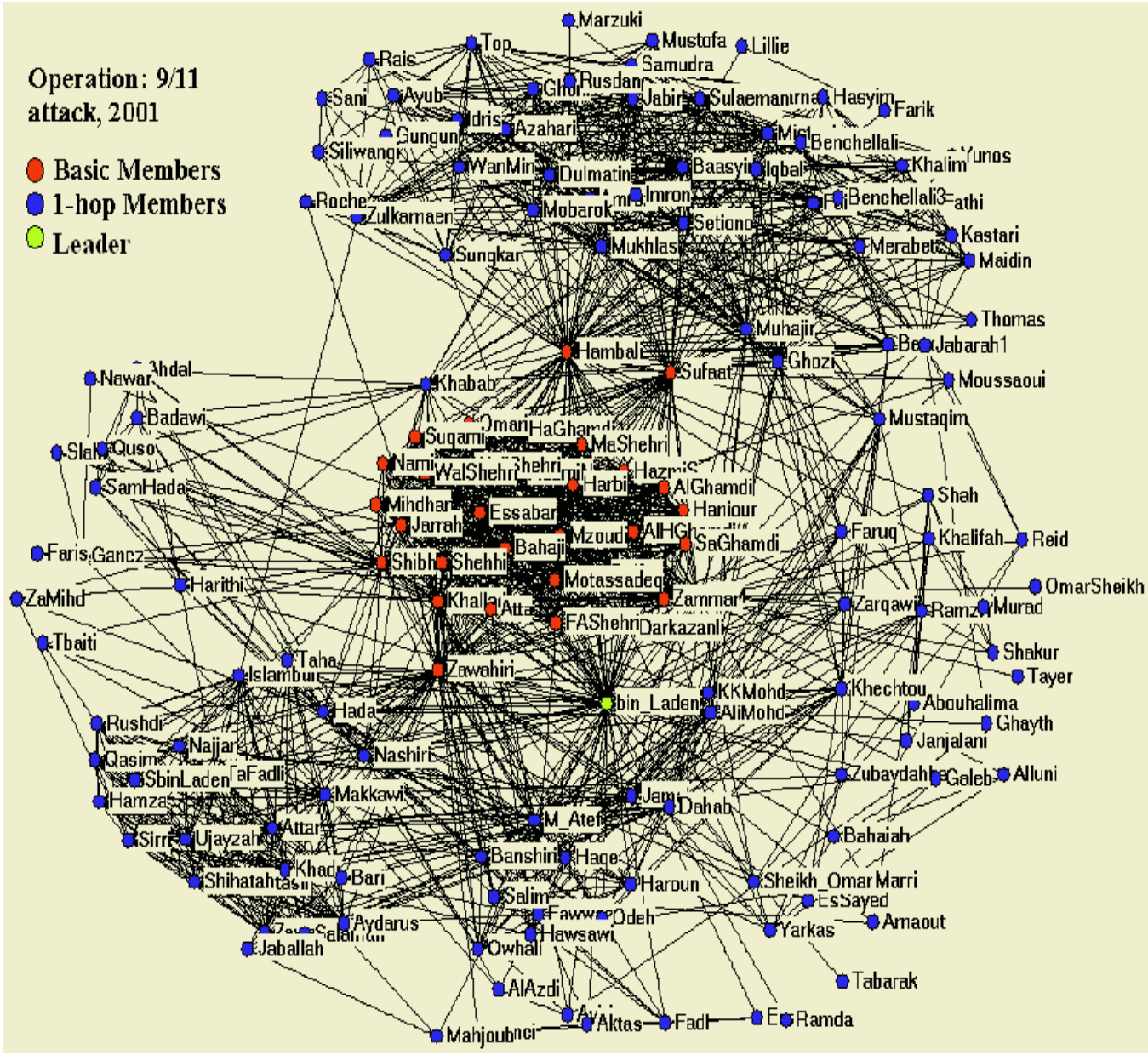


Fig. 4. The 1-hop Network of the September 11th Attack

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 stochastically added to cliques, outgoing connections to a random member of each of the covert 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

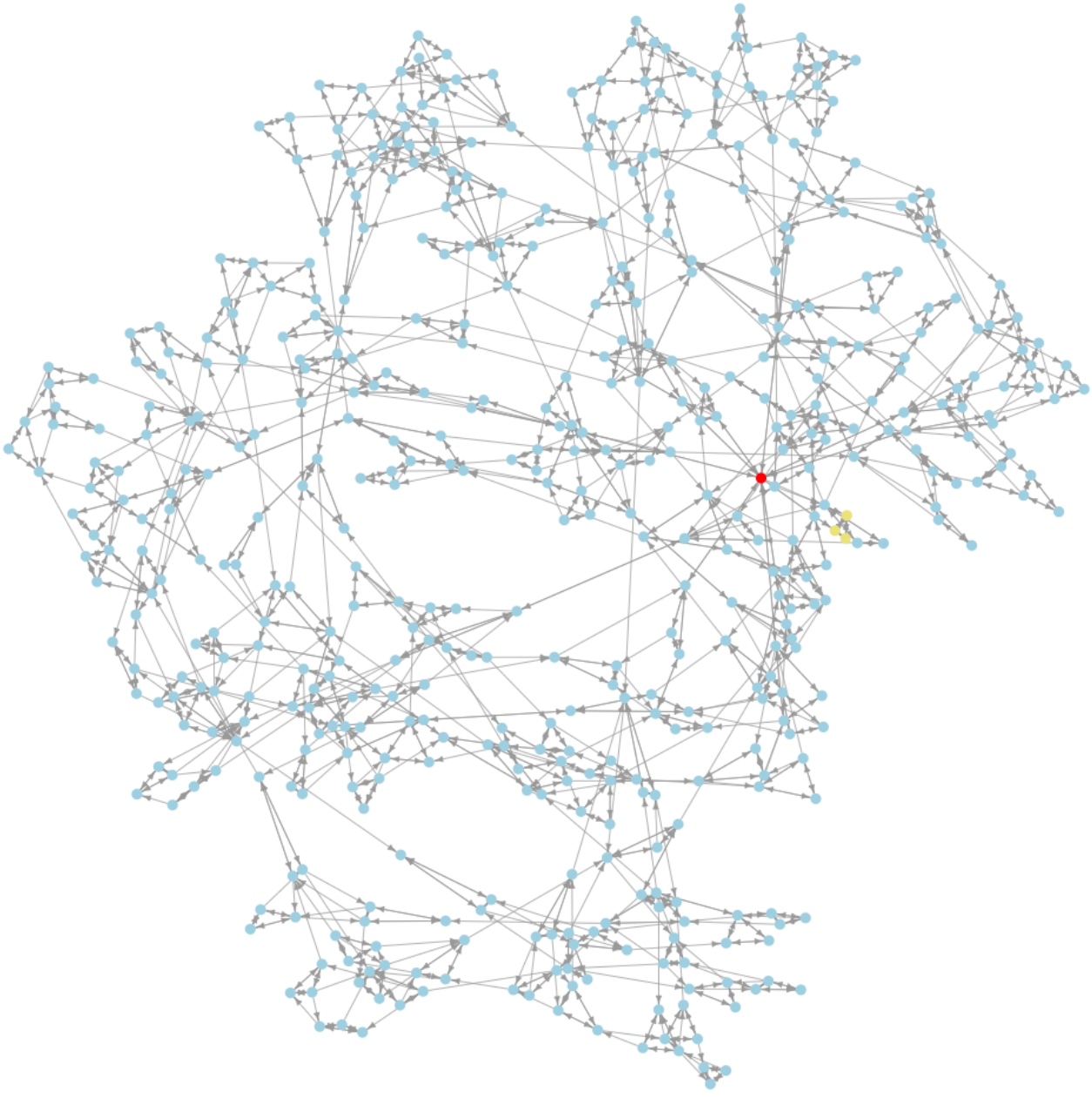
Scala-based Implementation available for review/remix:

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

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

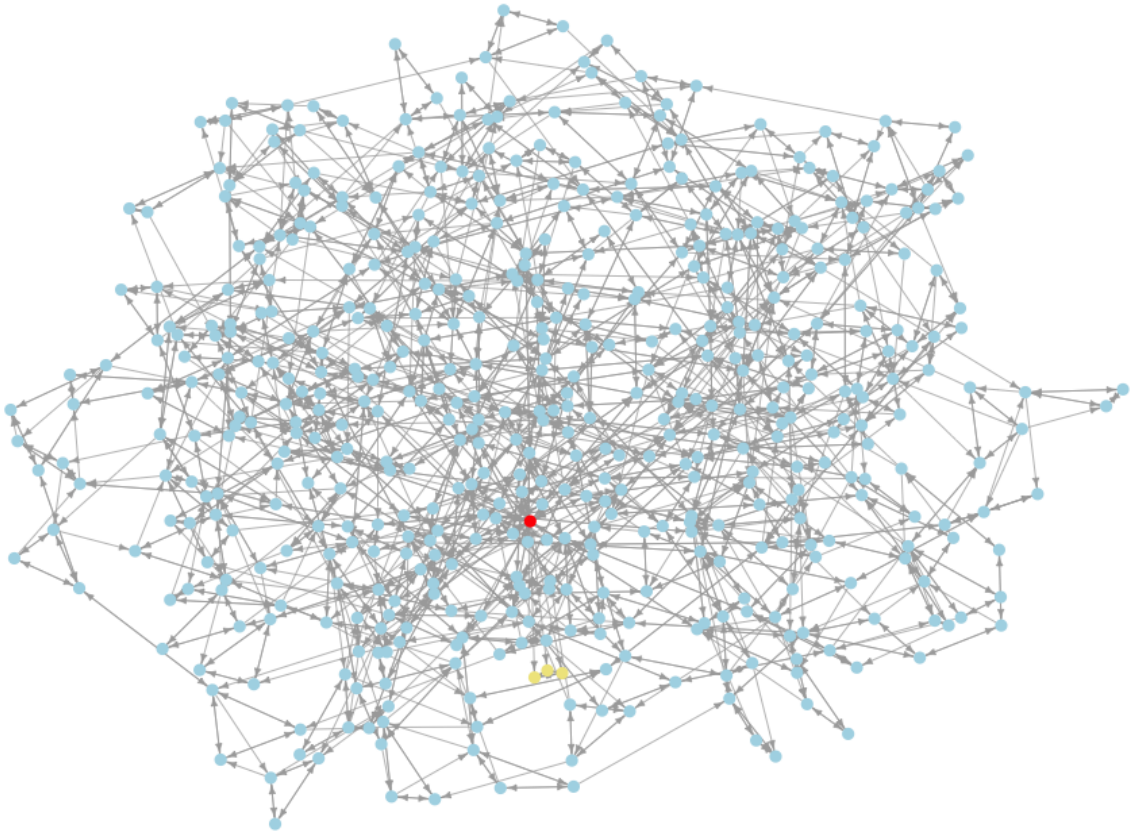
Also, this presentation:

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

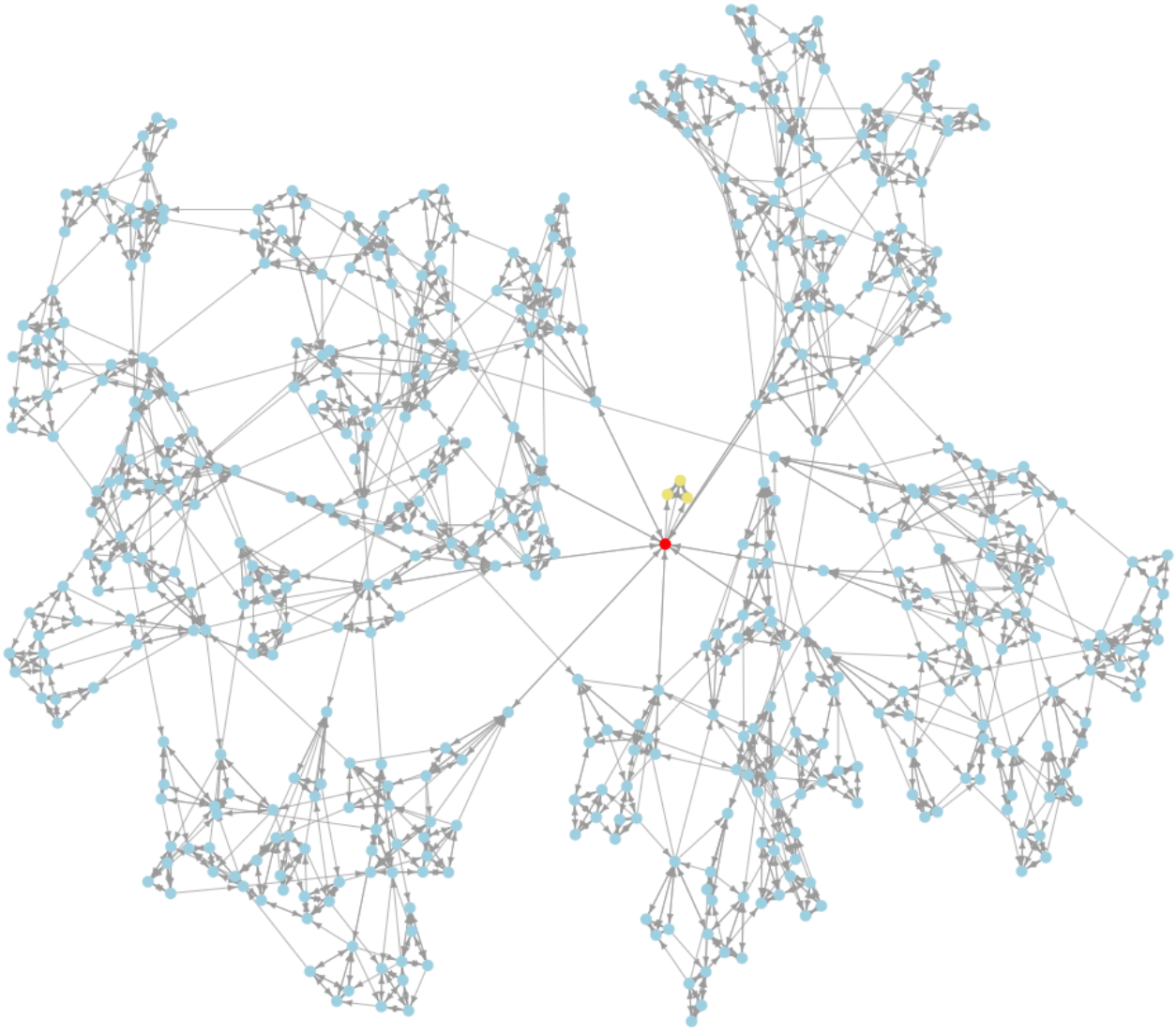


3 clique, 1% remix

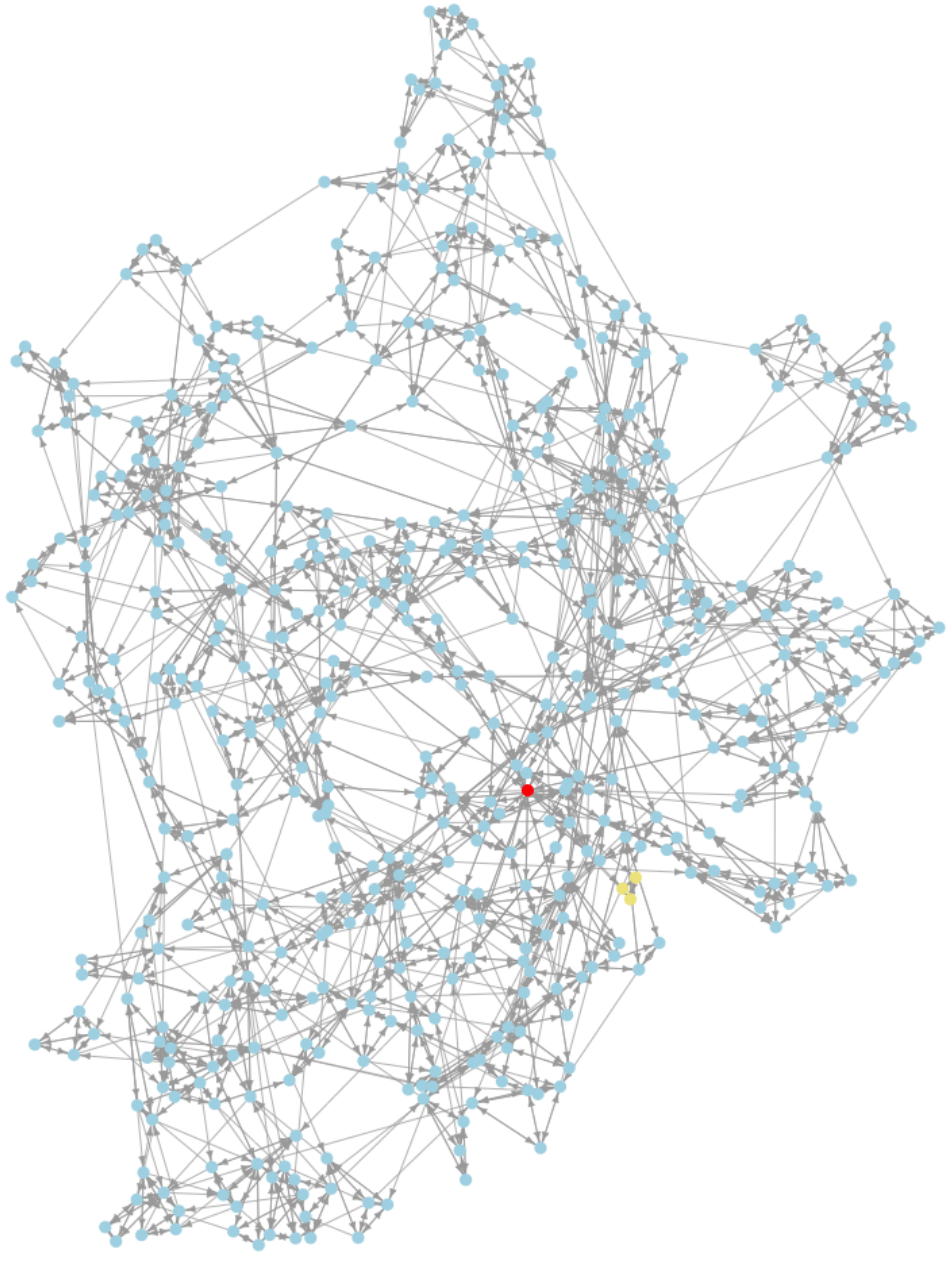
3 clique, 10% remix



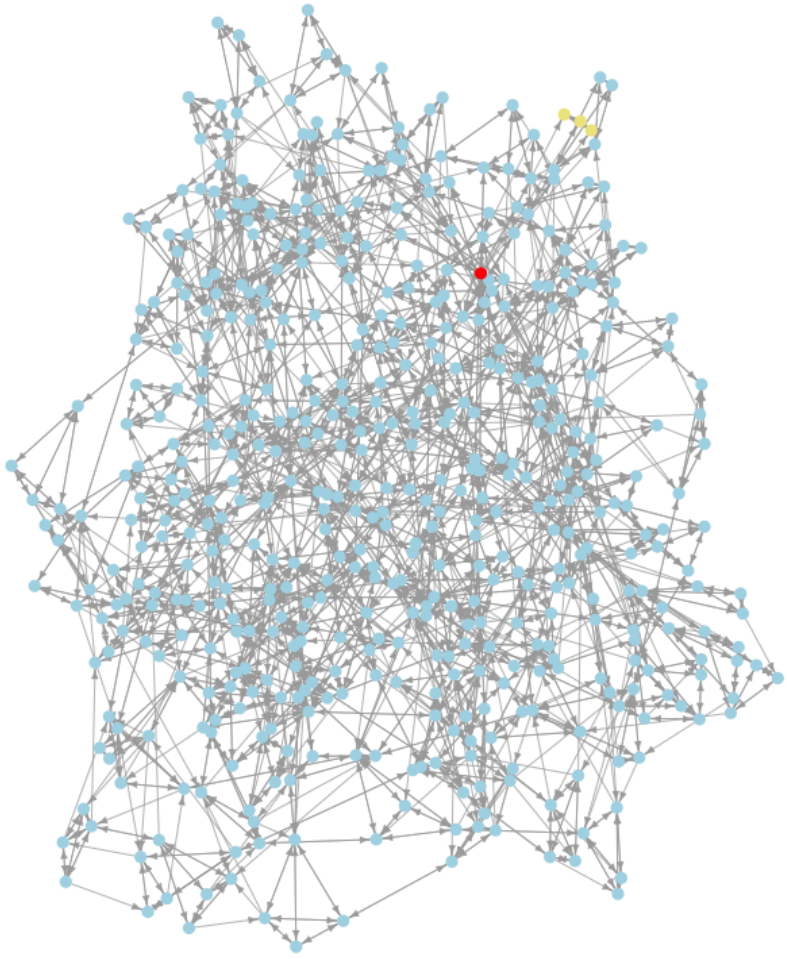
3 clique, 30% remix



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

Our Model: The Observer

An algorithmic description of

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

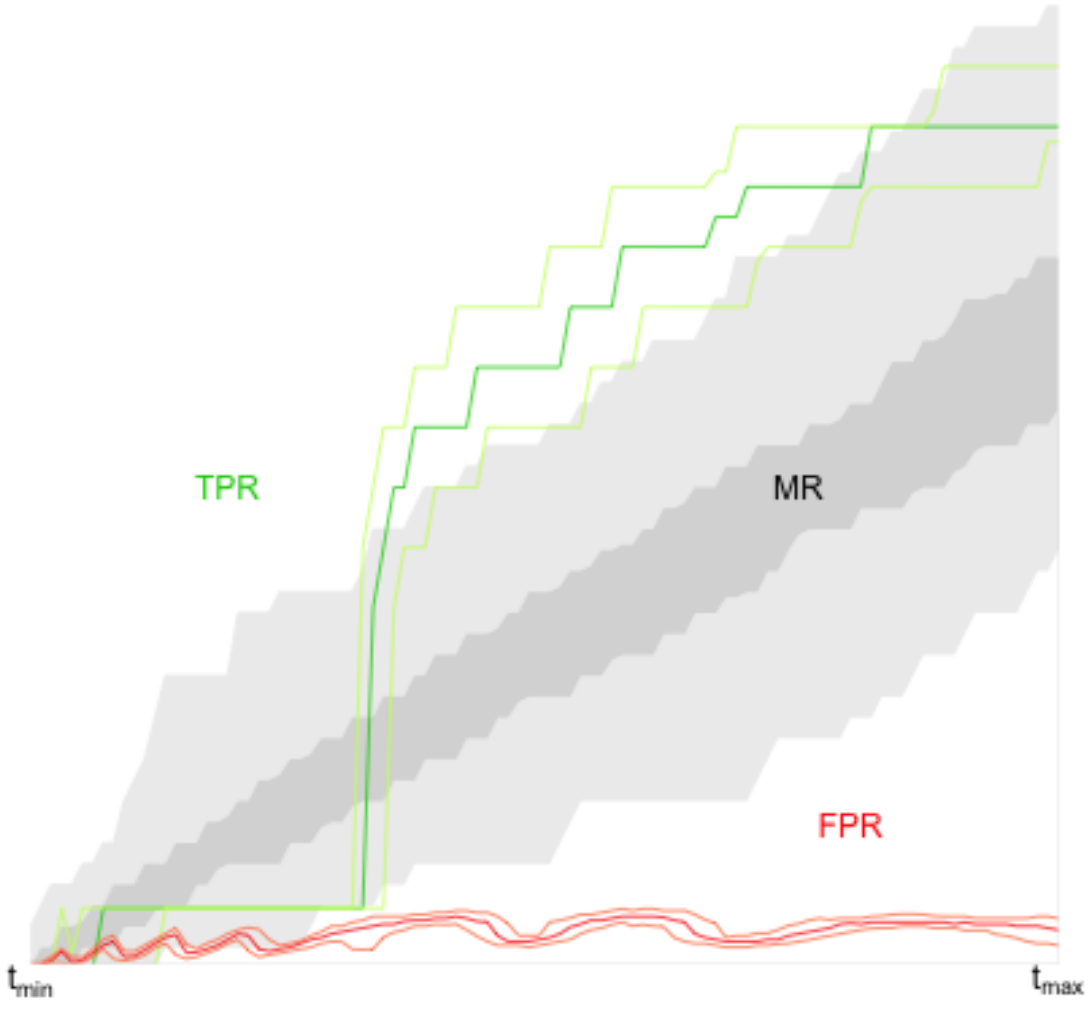
Some Simple Strategies

- pure content: pick up everyone that has sent and received a *Bad* message
- pure structural: pick up highest degree person and all people below median
- mixed structural and content

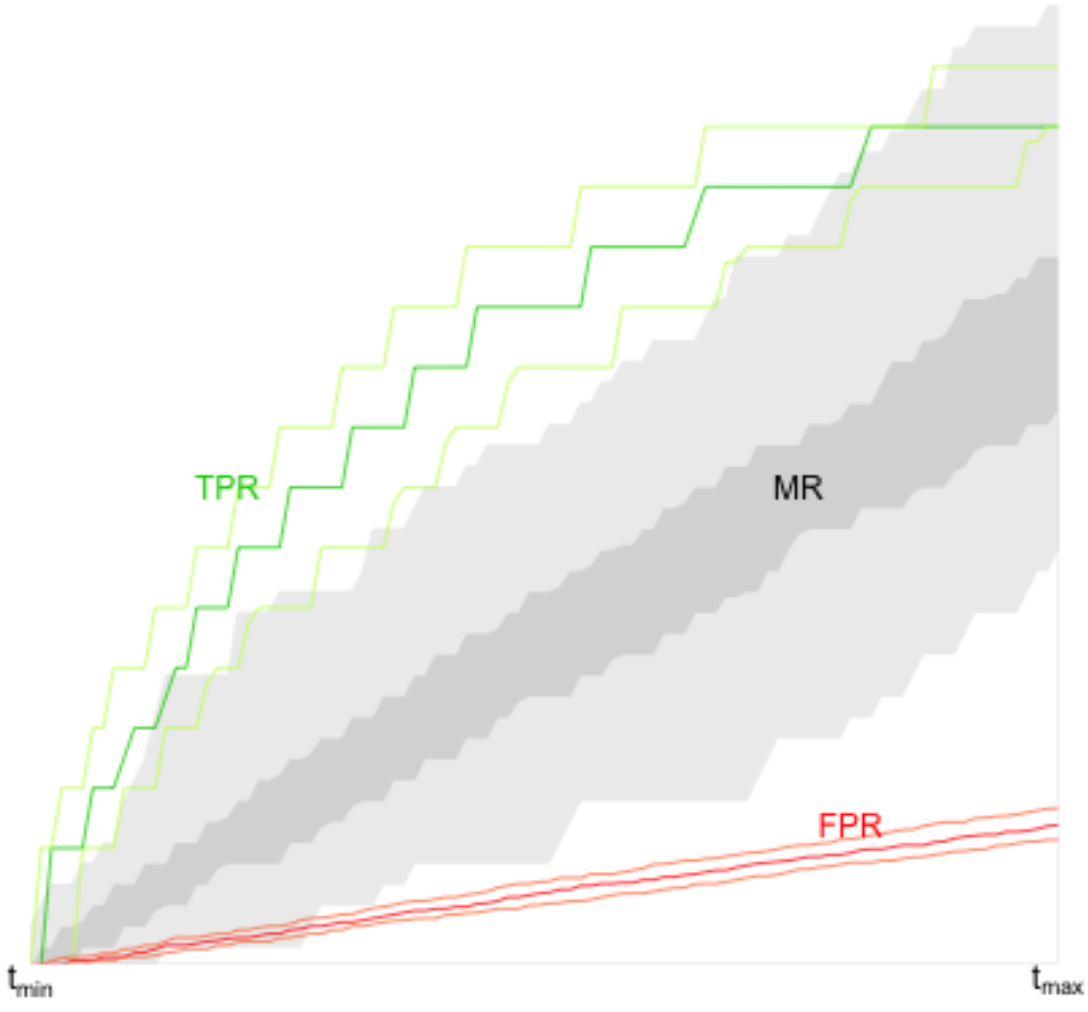
Appropriate Measures?

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

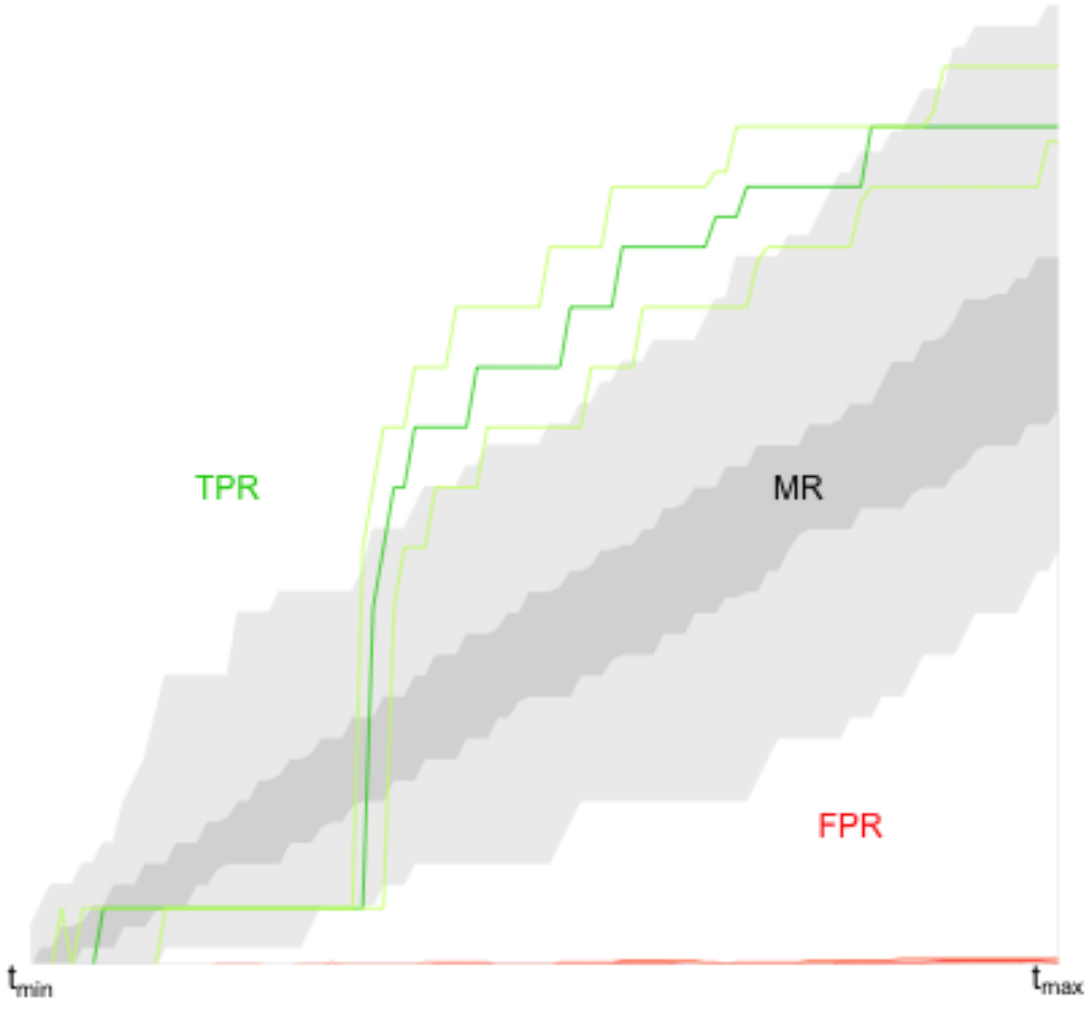
- true positive rate,
- false positive rate,
- resource investment



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