

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*.

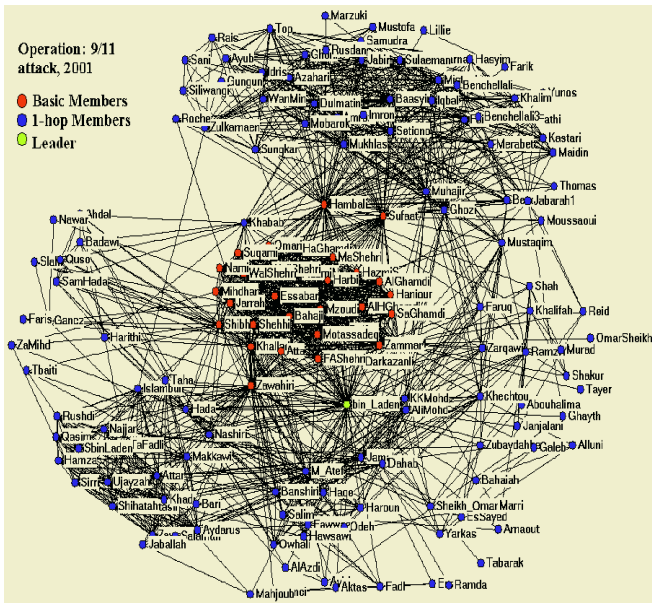


Fig. 4. The 1-hop Network of the September 11th Attack

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:

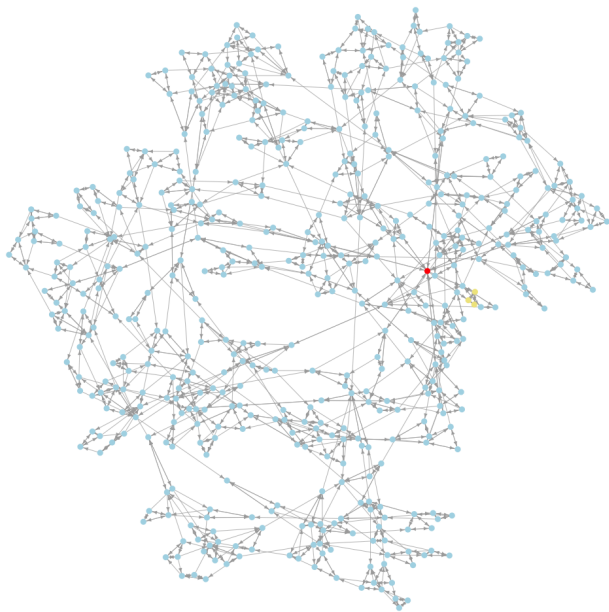
<https://github.com/pearsonca/scala-commsim>

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

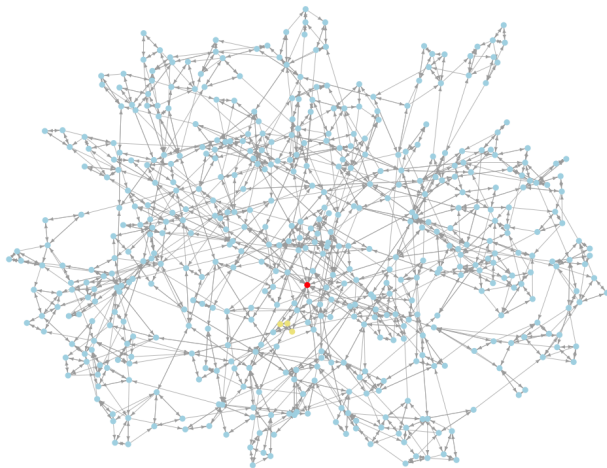
Also, this presentation:

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

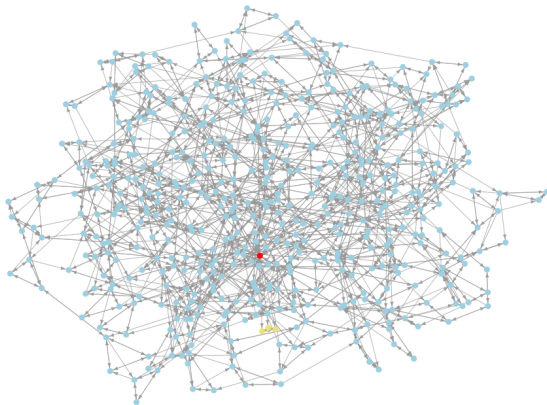
Some Networks Generated By This Procedure...



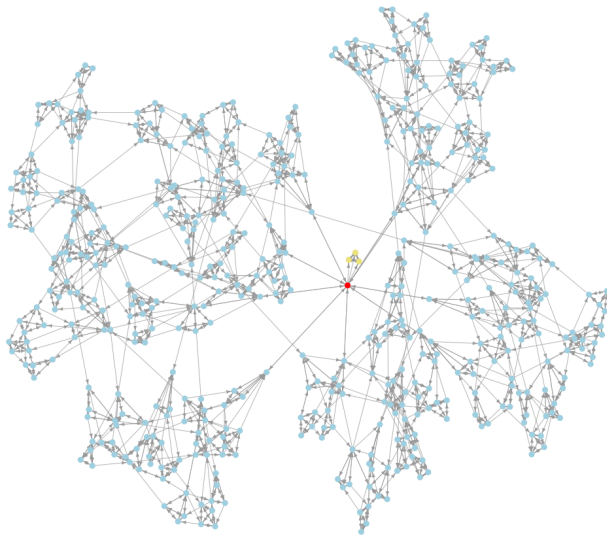
3 clique, 1% remix



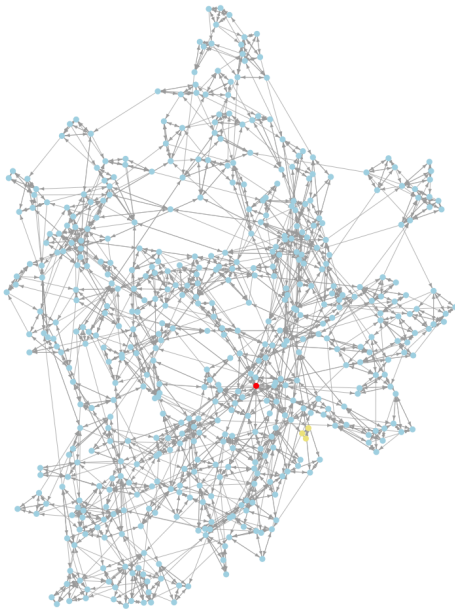
3 clique, 10% remix



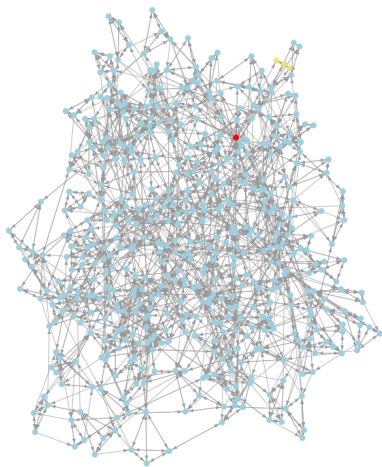
3 clique, 30% remix



4 clique, 1% remix

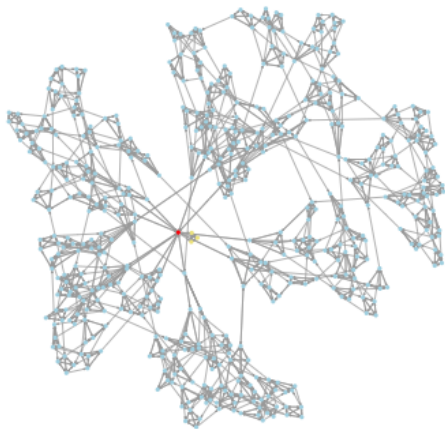


4 clique, 10% remix



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

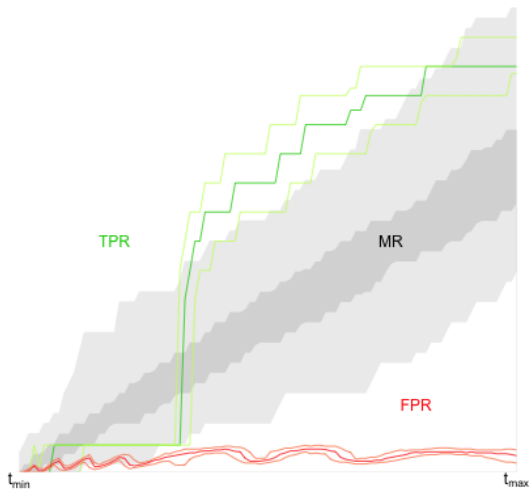
- ▶ pure content: pick up everyone that has sent and received a *Bad* message
- ▶ pure structural: pick up highest degree person and all people below median
- ▶ mixed structural and content

Appropriate Measures?

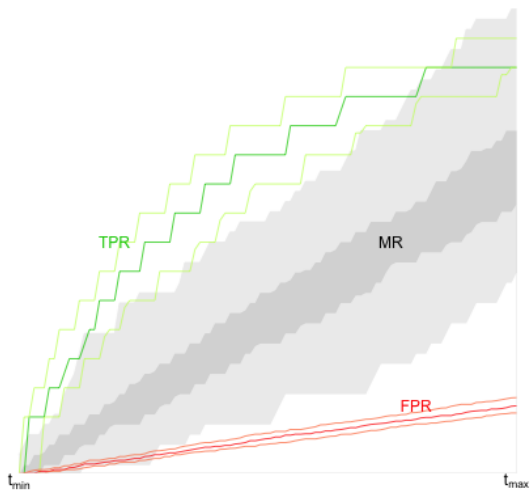
Assume that any given plot has some critical amount of planning-related communication.

But what else?

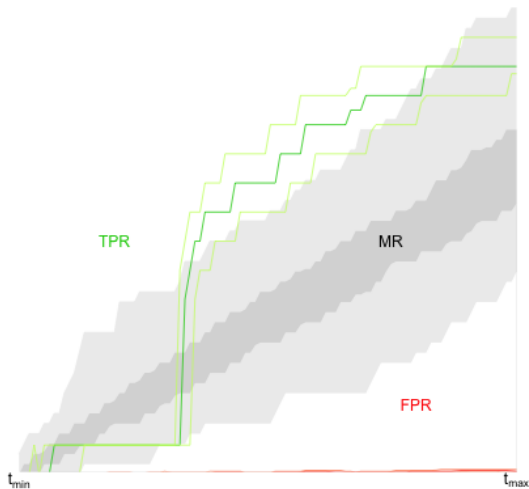
- ▶ true positive rate,
- ▶ false positive rate,
- ▶ resource investment



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



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.