TOP SECRET STRAP1

Graph theory in the operational environment

[redacted] - GCHQ

Information & Communications Technology Research (ICTR)

What I will cover

- Finding operational closed loops:
  - The reality of target behaviour
  - The process of looking for closed loops
  - Some statistics on a large graphs components
  - A real life example
  - Cheap and disposable handsets
  - Catching targets for real
  - What Donald Rumsfeld taught me about closed loops
- Using graphs to visualise and characterise timing relationships in a contact graph

What is a closed loop?

- A set of (for example) phones that communicate only amongst themselves as a means of communications security
- This is generally speaking too loose a definition for practical purposes

Tightening up the definition of a closed loop

- A component on three or more nodes that is neither the giant component nor a tree

Work on this topic since 2005

- GCHQ initially interested in topic following use of a closed loop by the July 7, 2005 bombers
- Analysis of anonymised meta-data for bulk UK-UK mobile call records indicated that this was a rare phenomenon and pointed to possible target discovery opportunities
- Closed loop analysis of VOICESAIL showed promise but work was truncated
- SANAR-08 presentation demonstrated that operational closed loops could in theory be discovered

The reality of target behaviour

- Targets from different IPT's regularly purchase groups of cheap mobile phones and use them operationally for a short period (possibly as long as three months) before getting a new set
- Two critical features:
  - Most of the phones start life at about the same time
  - Most of the phones are cheap handsets
- Sometimes the targets make a mistake and make a call to a phone outside the closed loop

The process of looking for closed loops

- Choose a time window (e.g. 10 days)
- Clean up the data for that period
- Componentize the graph
- Extract the components that fit the closed loop definition

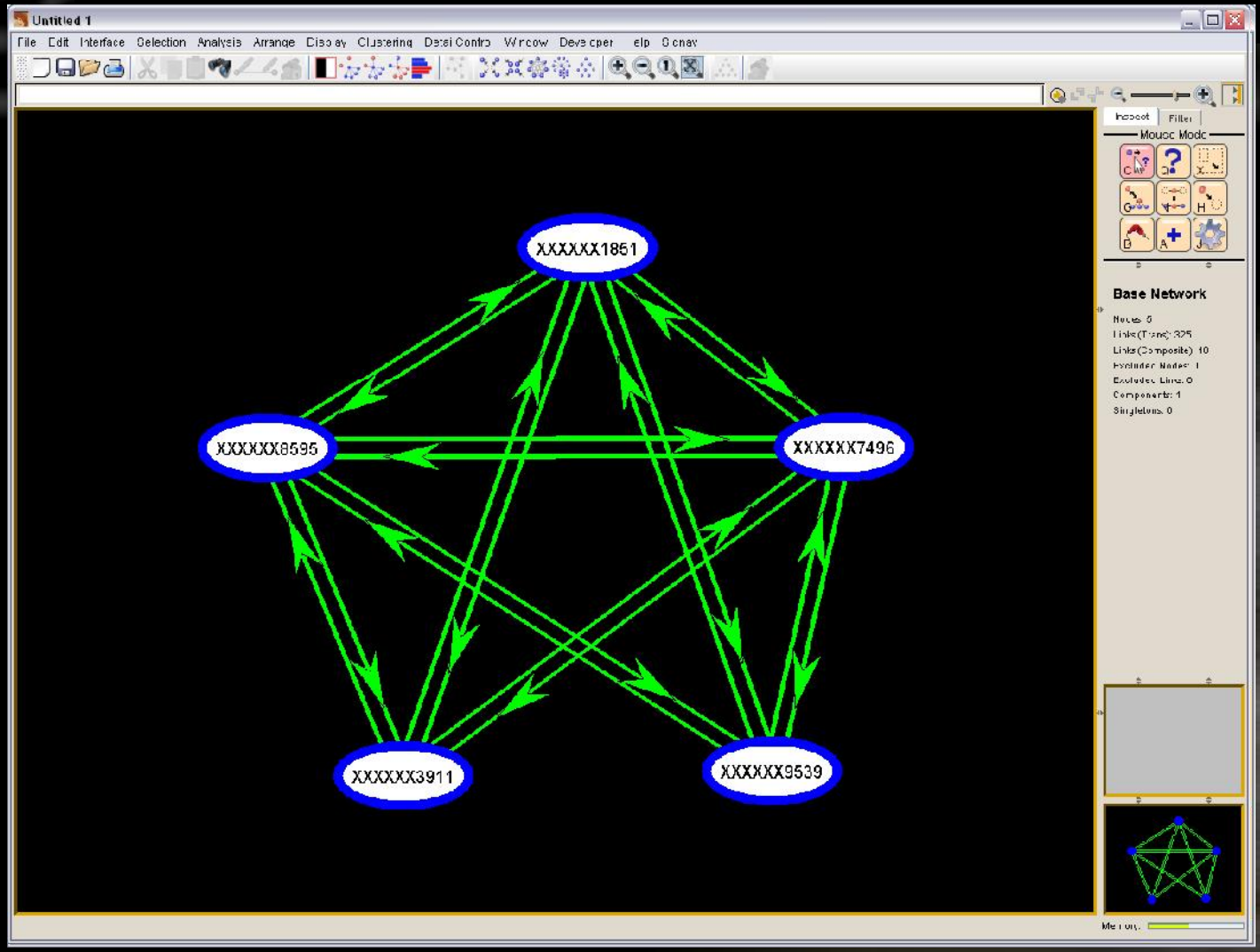
The effect of windowing

- We need to window the data or else slip ups by the closed loop members will render the group invisible
- Need to choose a window that is large enough to allow the giant component to form but not so large that we never see targets who periodically goof up.

Some statistics about components

- 1507405 edges and 1606330 nodes
- 922135 nodes in the giant component (57%)
- 222477 components, of which 218327 (98.1%) are trees
- 4149 non-tree, non-giant components, involving 39927 nodes (2.5% of total)
- 17 of these components had at least 70% of the nodes illuminating within a 3 week period.

A closed loop is born...



When geolocation is not enough...

- Targets love cheap handsets, bless ‘em
- Nokia occupy the largest segment of the cheap phone market. Nokia 1* phones are nasty.

Nokia 1616

"Unashamedly aimed at the bottom end of the mobile phone spectrum... under the bonnet things remain distinctly unimpressive"

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Vodafone 252

"A very affordable handset that comes with basic voice call and message services"

Samsung 1150

"This cut-price phone offers bare-bones functionality and lacks what many mobile users would deem to be essential features"

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Testing the cheap phone hypothesis

- What type of handset did the July 7, 2005 London bombers use?
- At least three of the four phones used on that day were a Nokia 1100