

Sensor networks for social interaction discovery at land and sea.

Measuring Social Structure in Animal Populations

Towards Telemetry on highly sparse “networks”

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Overview

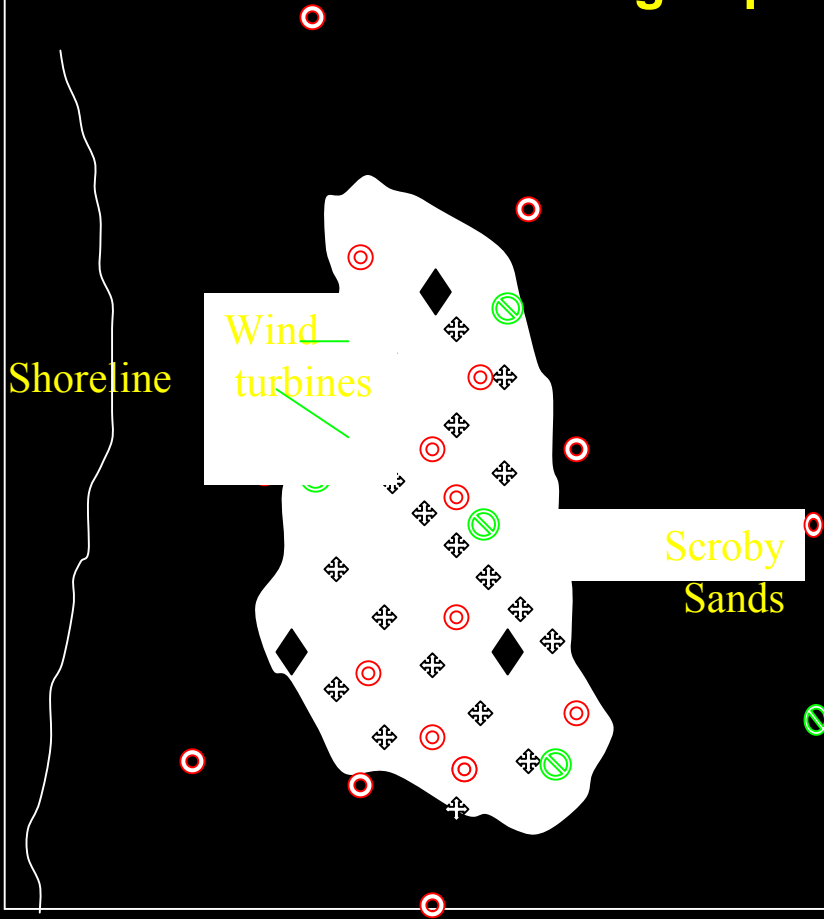


- Current Work on Distributed Algorithms
- New Question – the Social Life of Seals
- Problem
- Initial Approach to Solution

Target Deployment



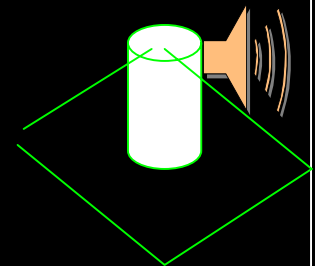
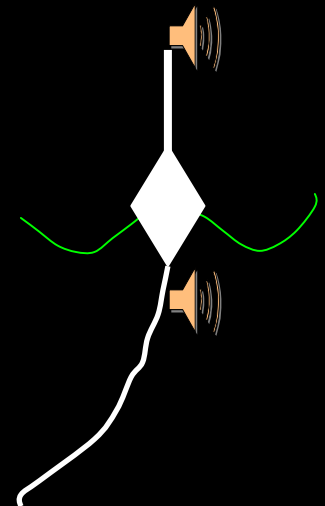
Measuring Impact on Coastal Erosion from Wind farms



Surface moored buoy, VHF comms (shore and/or other buoys), u/w comms and control of sensor packages, data storage.

Basic disposable sensor packages (e.g temp, turbidity). Limited storage and power. u/w comms.

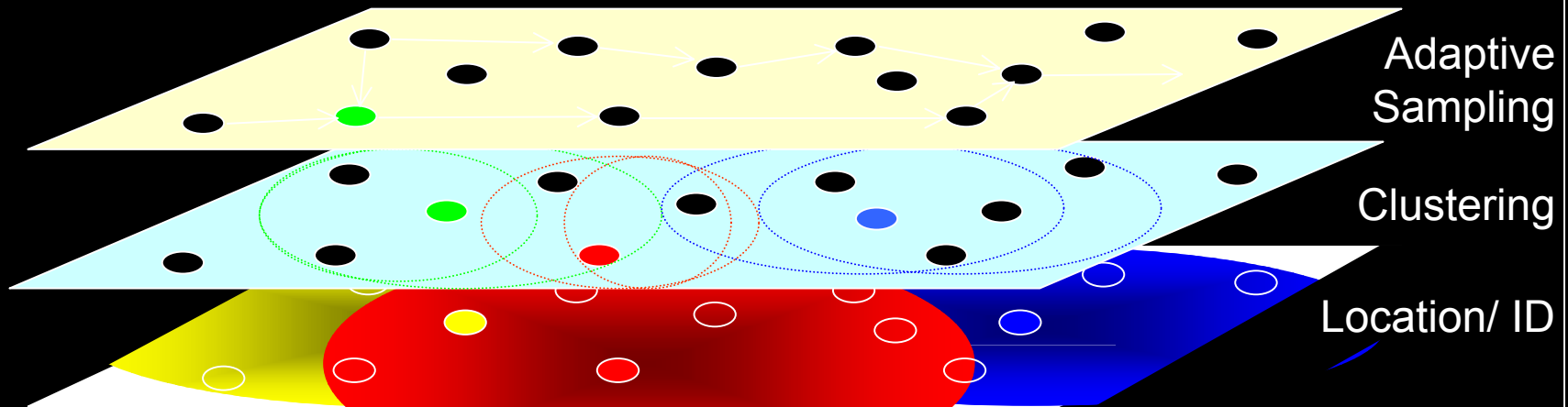
Enhanced disposable sensor package (e.g. temp, pressure, turbidity, current). Increased storage and power, u/w comms.



Distributed Algorithms in SECOAS



UCLs Focus:



- Clustering:
 - Ibiso Wokoma
- Location
 - Toks Adebutu
- Data Retrieval
 - Antonio Gonzaliz

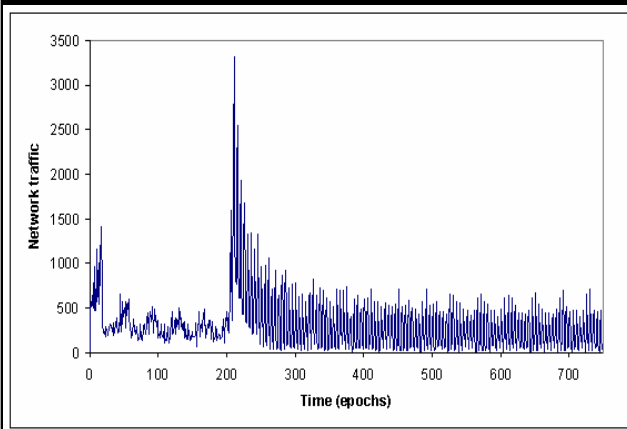
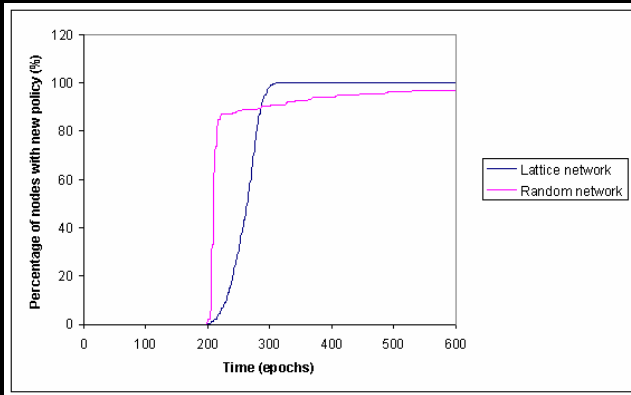
- Model Dependant Data Sampling
 - Venus Shum
- Support Platform – kOS
 - Mat Brittan, Hammed Hadid

Key kOS Concepts:



Support platform for Distributed Algorithms

- Self Synchronising
 - Locally & globally
- Shared information model
 - Data Dispersed, not sent!
- ➔ Routing
 - ➔ to much work
 - ➔ Not reliable
- Biologically inspired bits...



Real Biological Systems!

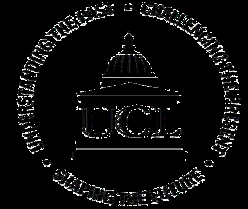


Flocking, pack, herd, etc. Animals: *Have Structure*

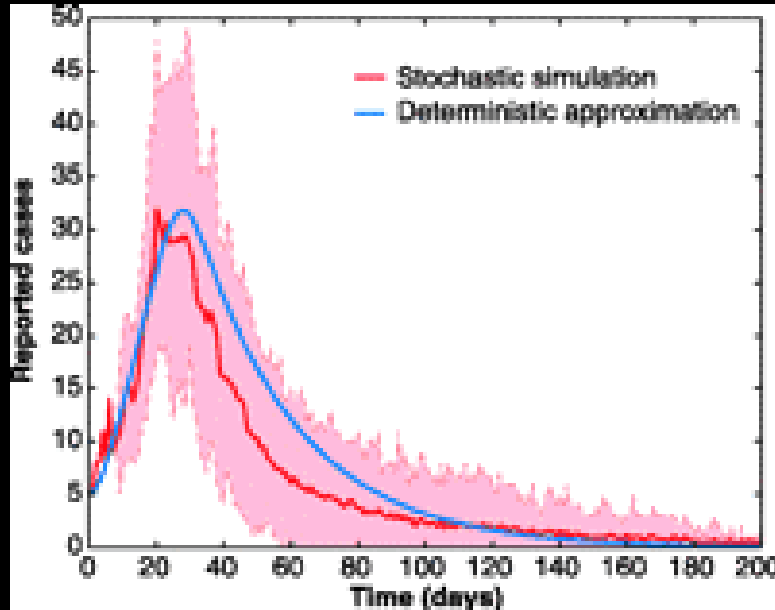


- Social Structure is a bit of a mystery...
 - E.g. seals in the natural works; but cows & badgers?
- Difficult to measure
 - Wide area, harsh environments, large MTBF

How important are “non-random models”?



Very



- Case of Foot & Mouth
- Culling Strategies
 - IP infected premises and at-risk farms
 - CD: Dangerous Contacts
 - CP contiguous premises

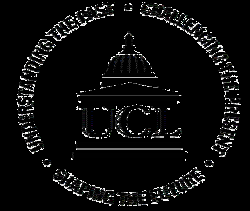
the localized nature of 'IP-centred' ring vaccination means that neighbouring uninfected areas retain high levels of susceptibility, which can generate new epidemics by means of long-range 'sparks' of infection

Nature 421, 136 - 142 (09 January 2003); doi:10.1038/nature01343

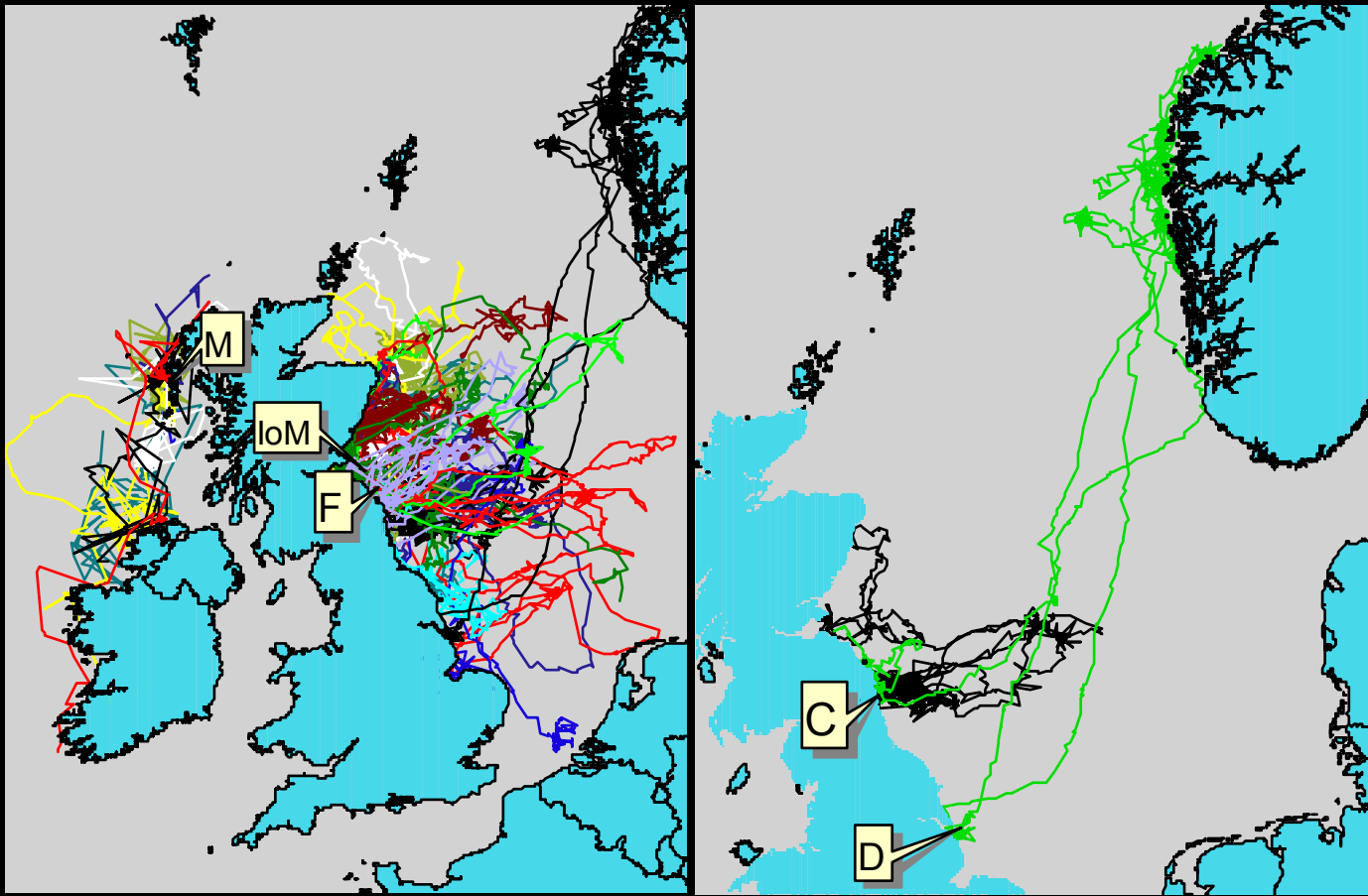
“Modelling vaccination strategies against foot-and-mouth disease”

M. J. KEELING*, M. E. J. WOOLHOUSE†, R. M. MAY‡, G. DAVIES§ & B. T. GRENFELL

What do Seals do?

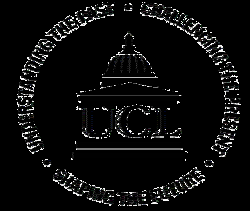


...Swim Away



Argos
satellite tag
tracks of 30
grey seal
pups

What is a node?

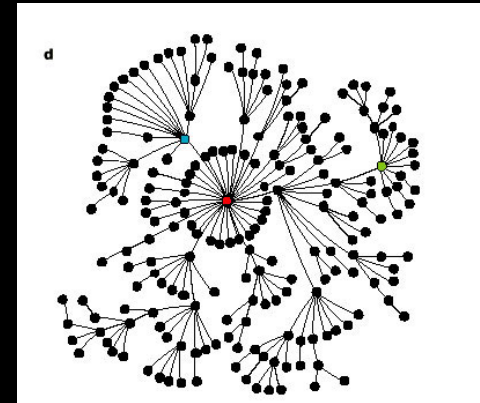
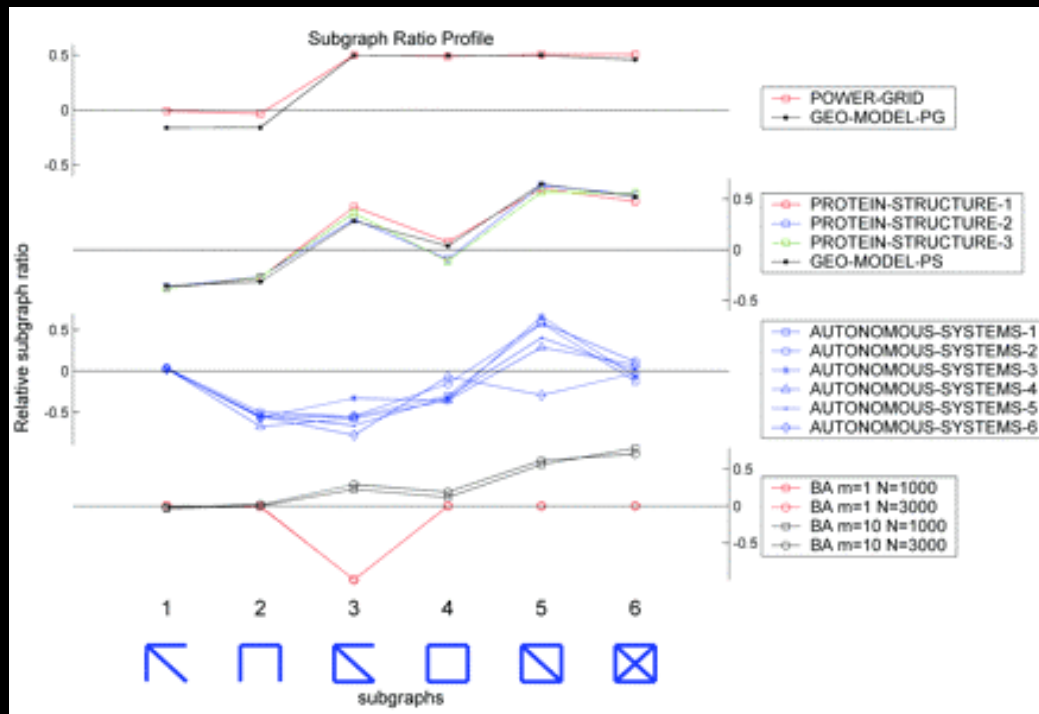


- A seal with a device which:
 - Can detect the ID of another seal at distance d_e
 - Record that ID, with time (locn?)
 - Communicate a history of encounters between nodes: Distance d_c
 - Communicate a history of encounters to 'base'.
 - Probably Ultrasound and / or RF

Can we distinguish social structures?

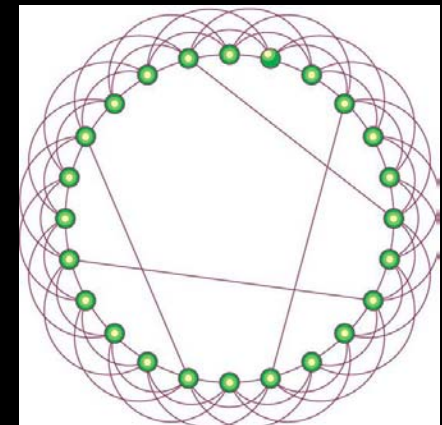


Just About, by measuring Encounters



Scale Free?

Small Worlds?



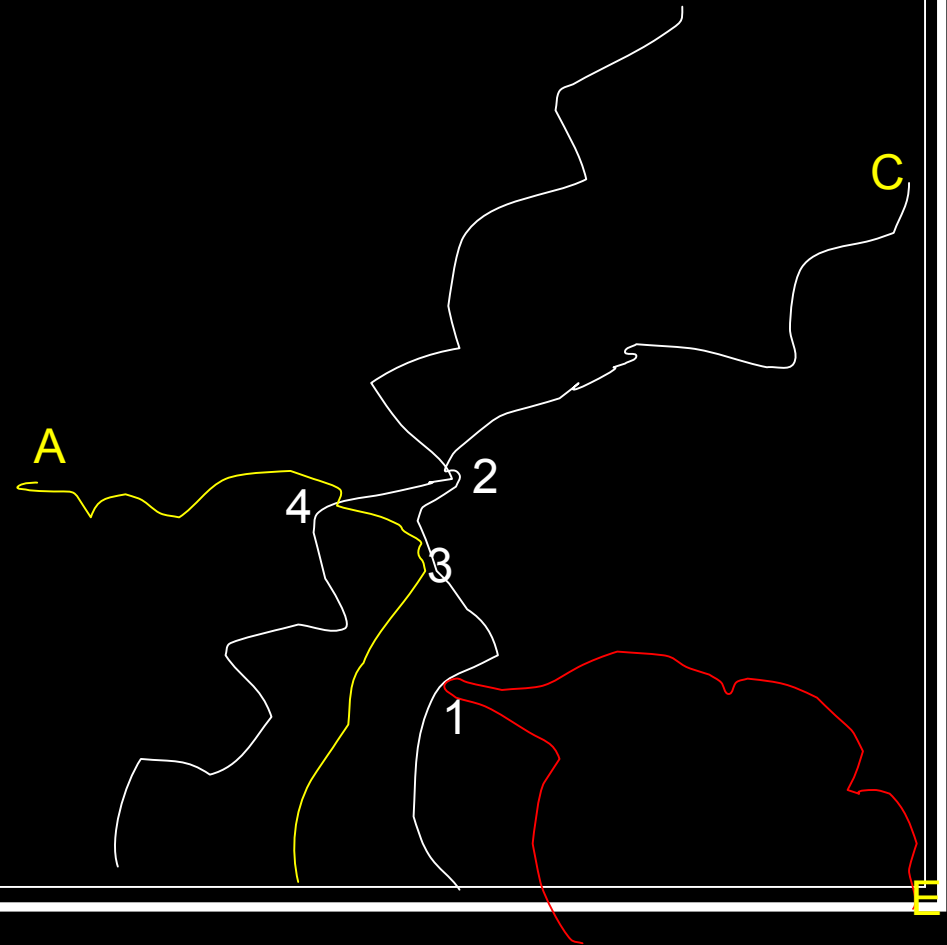
The Triad Significance Profile (TSP)

Technical Problem Space



'nodes' may not move in predictable directions

- To Know that:
 - $A \leftrightarrow B$
 - $E \leftrightarrow C$
 - $C \leftrightarrow B$
 - $A \leftrightarrow C$
- Each 'node' both
 - Records encounter
 - Acts as
 - 'router' or
 - 'db' component



What is an Encounter?



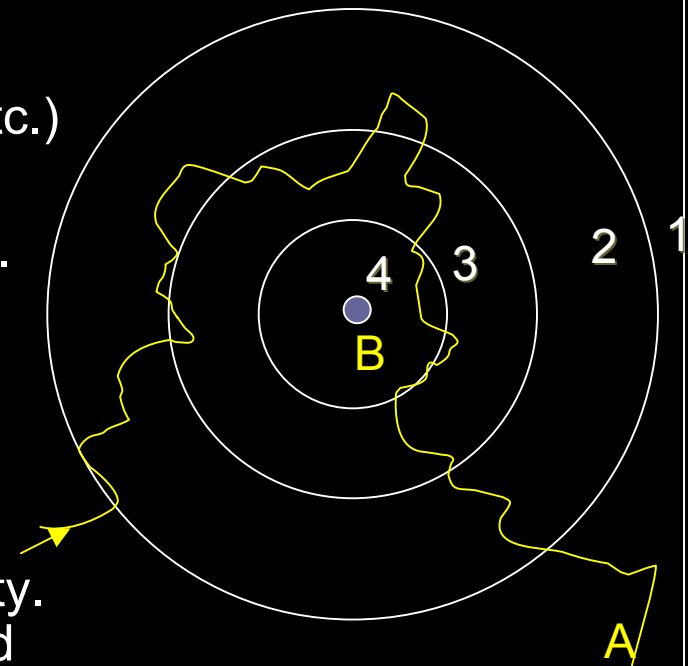
Parallels and differences....

■ Biological

1. Out of range
2. Similar region of interest (food, nesting etc.)
3. A & B can detect each other
4. Encounter – social / epidemiological / etc.

■ Technical

1. Out of range
2. Minimum physical detection (intermittent, coherent signal)
3. Establish media access, exchange identity.
An encounter is established and recorded
4. Can transfer data (encounter histories)



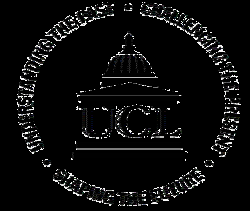
Telemetry?



Retrieving maximum information, despite high MTBF

- This cannot be a routed network:
 - No Direction vector
 - Infinitely small chance of, even transient, end to end.
- More like a Distributed Data Base
 - Loose integrity
 - Delete possible by base station
- Coherence provided by gossip...
 - **Dispersion of information like an epidemic...**
 - Over the Social Network → to be measured

The Big Issues Challenges & Opportunities...



Exploit current Sensor Node developments, then:

■ Science:

- Do we have sufficient statistical power?
- Using the social network to measure the social network (well, for the telemetry)
 - Surmountable Systematics?

■ Other Issues / Applications:

- *E.g.* DARPA – ATO – Survivable Networks
- Standard “information dispersion”?

Its going to be a messy business... ... but interesting!



Thank you for Listening.

