Brief Announcement: Opportunistic Information Dissemination in Mobile Ad-hoc Networks:

adaptiveness vs. obliviousness and randomization vs. determinism

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DISC 2011

Mobile Ad-hoc Network (MANET)

- Mobile set of nodes (processors with radio)
- No stable communication infrastructure
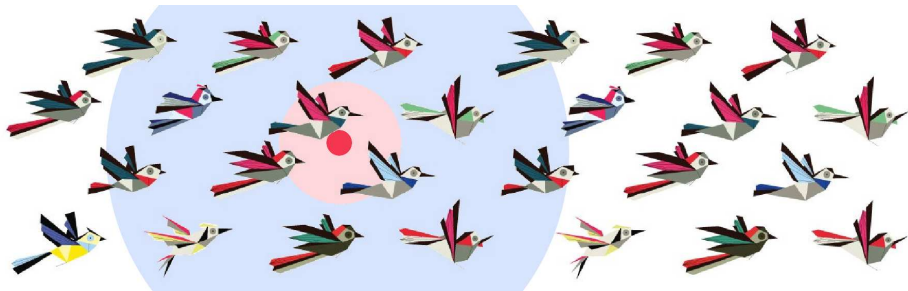- Multihop network

E.g.

Opportunistic Communication

Thanks to mobility and asynch activation

communication between x and y is feasible

even if a path never exists! (a ***chrono-path***)

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The Dissemination Problem

Some information held by a given source node x at time t,

must be disseminated to some set of nodes $S \subset V$.

In order to prove lower bounds we use Geocast.

Model

- Network:
  - n mobile nodes deployed in $\mathbb{R}^2$
  - slotted time steps:
    - slot length dominated by communication time
    - same for all nodes
- Node:
  - unique ID in $[n]$
  - may start/fail at any time slot
  - radio communication:
    - unique radio channel $\implies$ collisions
    - background noise $\equiv$ collision noise $\implies$ no collision detection
    - no simultaneous reception & transmission
    - limited range $r \implies$ multihop network

Model

- Adversary:
  - initial position and movement
  - de/activation schedule (lower bounds don't use it!)

  limited by three parameters:
  - a maximum speed $v_{max} > 0$
  - the system must be (α, β)-**connected**, $\alpha, \beta \in \mathbb{Z}^+$

Definition ((α, β)-connectivity)

While moving at $\leq v_{max}$ speed, $\forall$ non-trivial partition $(S, \overline{S})$,

$\exists \leq \alpha$ consecutive steps without a β-**stable edge** between S and $\overline{S}$.

(an edge is k-stable at time t if it exists for k consecutive steps $[t, t + k - 1]$)

Model

(α, β)-connectivity, for the partition defined by the information

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Model

- Randomized Protocols:

  - ***oblivious*** [C'01]: protocol access sequence of random variables at each node, independent of execution and mutually independent.

  - ***locally adaptive***: same but rv's may be mutually dependent. (still independent of the execution)

  - ***fair*** [C'01]: all nodes transmit with same probability in any given time step. (orthogonal def)

Results

		randomized	deterministic [FMMZ'10]
l.b.	oblivious	$w.p. \geq 2^{-n/2} \Rightarrow \Omega\left(\alpha n + n^2/\log n\right)$	$\Omega\left(\alpha n + n^3/\log n\right)$
	adaptive	$\Omega\left(\alpha n + n^2/\log n\right)$ exp.	$\Omega(\alpha n + n^2)$
	fair	$w.p. \geq 2^{-n/2} \Rightarrow \Omega\left(\alpha n + n^2/\log n\right)$	–
u.b.	oblivious	$O\left(\alpha n + (1+\alpha/\beta)\, n^2/\log n\right)$ w.h.p.	$O(\alpha n + n^3 \log n)$
	adaptive	–	$O(\alpha n + n^2)$
	fair	$O\left(\alpha n + (1+\alpha/\beta)\, n^2/\log n\right)$ w.h.p.	–

Conclusions

- local adaptiveness $\Omega\left(\alpha n + \frac{n^2}{\log n}\right) exp$

  does not help w.r.t. obliviousness $O\left(\alpha n + \left(1 + \frac{\alpha}{\beta}\right)\frac{n^2}{\log n}\right) whp.$

- linear separation between oblivious randomized $O\left(\alpha n + \left(1 + \frac{\alpha}{\beta}\right)\frac{n^2}{\log n}\right) whp$

  and oblivious deterministic $\Omega\left(\alpha n + \frac{n^3}{\log n}\right).$

- log separation between adaptive randomized $O\left(\alpha n + \left(1 + \frac{\alpha}{\beta}\right)\frac{n^2}{\log n}\right) whp$

  and adaptive deterministic $\Omega\left(\alpha n + n^2\right).$

Thank you