Opportunistic Forwarding in Workplaces

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CARTOON
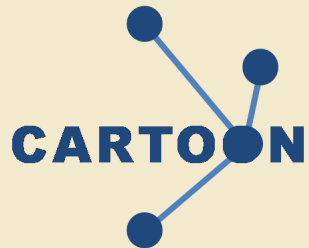
Context-Aware RouTing Over Opportunistic Networks

People carry underutilized radio devices that can be dynamically networked to provide improvised and unplanned network infrastructures, recently called Pocket Switched Network.

But, if your attempt is to efficiently exploit the people-provided connectivity you need to know all about human mobility and contact distribution.

Goals of the work

- most of the research focuses on sparse settings
- but: Future Internet with billions of mobile devices forming a pervasive infrastructure
- our focus: dense settings (workplaces, campuses …)
- why?
  - informal (w.r.t. institutional IT platforms); friendly; easy-to-use; inexpensive; unmanned
  - … as emerged from our survey
  - trend: SMSs → Twitter, Mobile Messaging
- problems:
  - impact of social relations on both contacts and forwarding
  - capability of satisfying users' needs

Pocket Mobility Trace Recorder

- device characteristics
  - fine grained contact monitoring
  - short radio range
  - long lasting batteries (3 weeks)
- PMTR carriers' characteristics
  - profiled people
  - 44 PMTRs for 15 working days
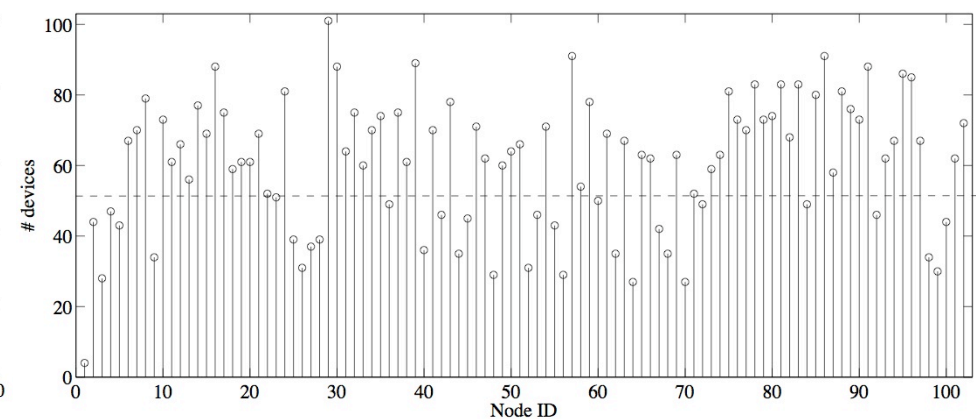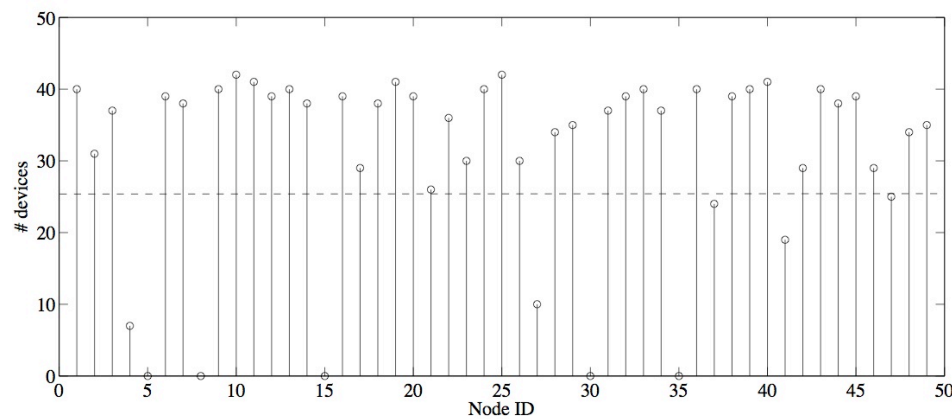- "terrain" characteristics

3.5 Km

offices and classrooms 200 x 100 m. 3 floors

other classrooms
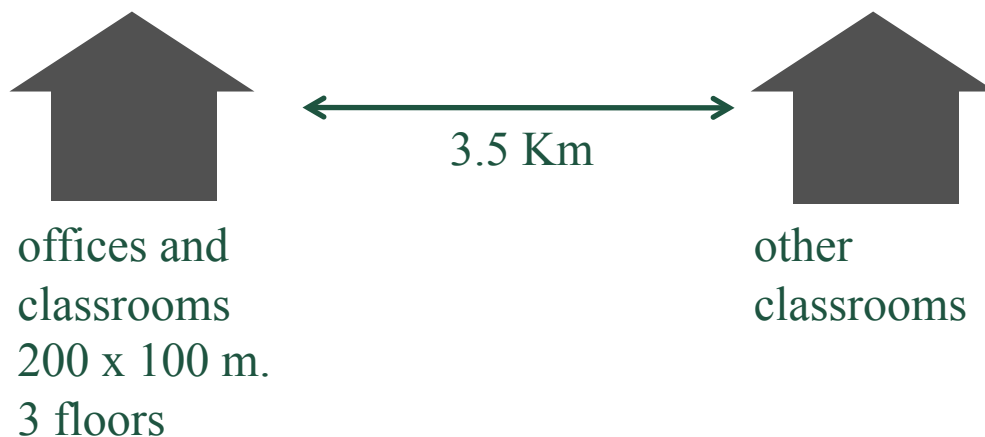
- 11895 contacts

	PMTR	MIT
% contacts within a day	80%	47%
mean inter-contact time	11 h 49'	4 days 3h
median inter-contact time	41' 29"	16 h
mean intra-contact time	8' 41"	57'
median intra-contact time	48"	32'
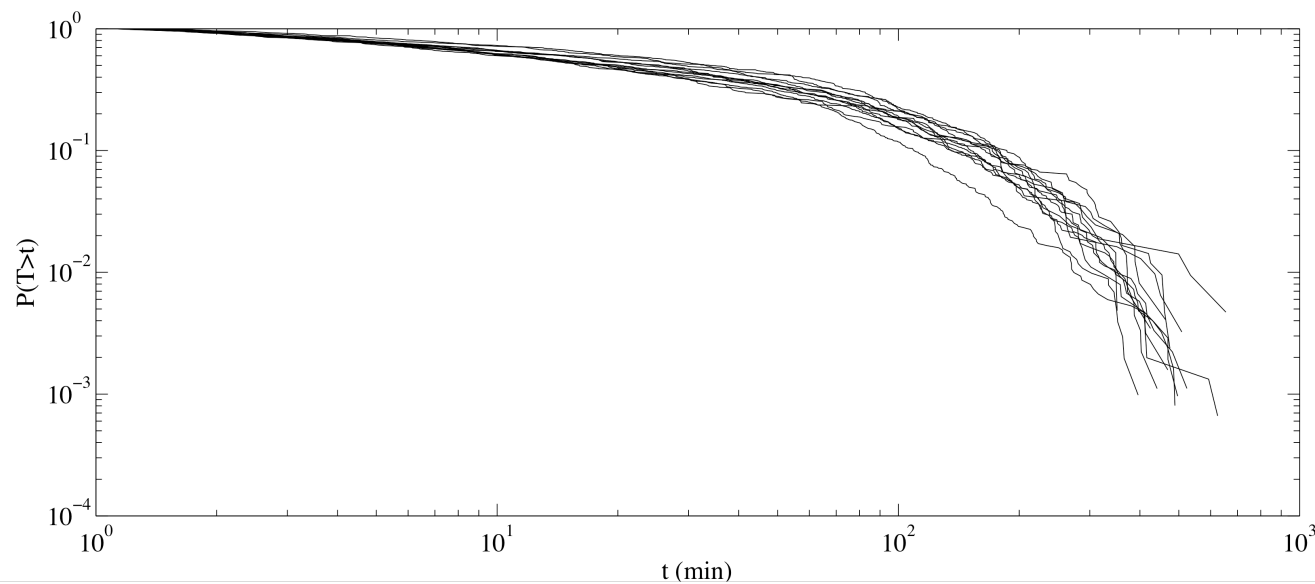
inter-contact time

intra-contact time
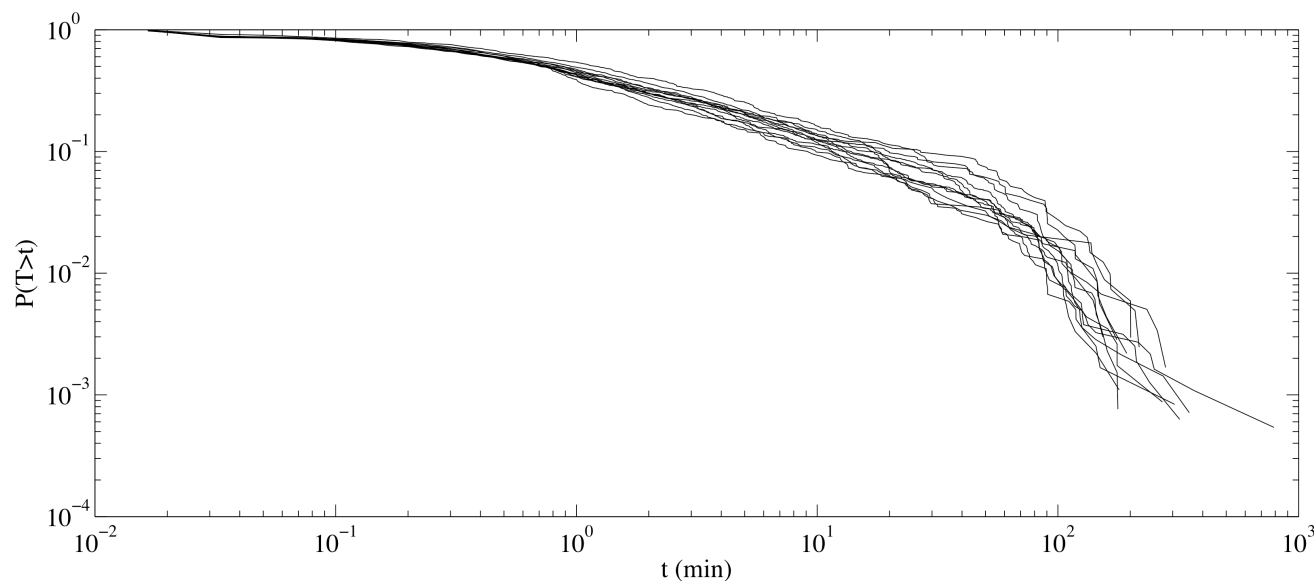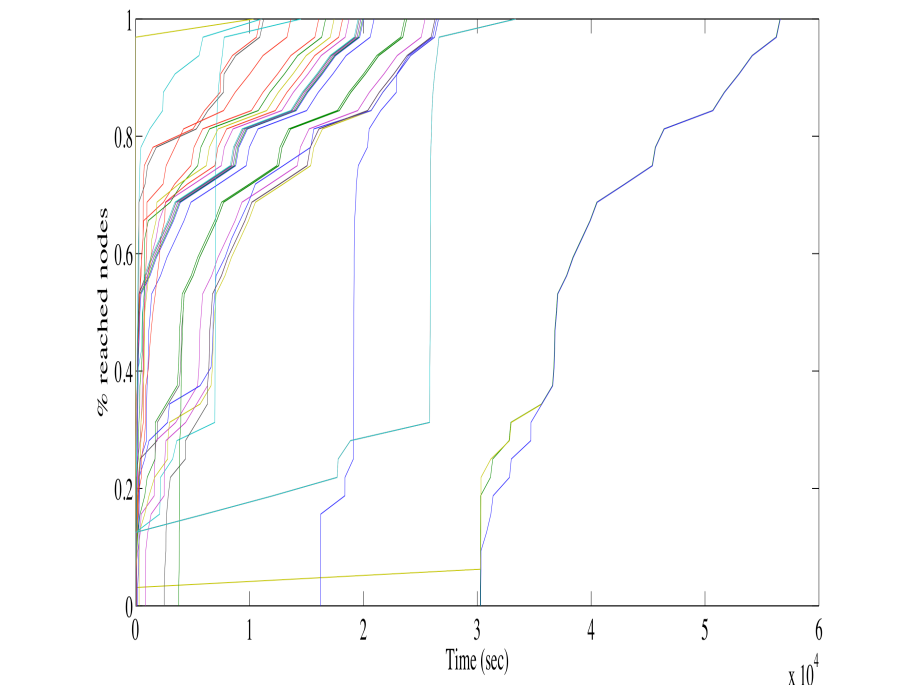
- impact of short contacts (*"one-shot"* diffusion)
  - low median inter-contact → another opportunity soon
  - large impact on coverage
  - misleading latency: computed on different sets

		all contacts	>5'
broadcast	min latency	1 h 29'	2h 50'
	mean latency	2 h 33'h	4h 44'
	max latency	5 h 2'	1d 25'
	mean # hops	5	6
	coverage	100%	44%
unicast	mean latency	40' 25"	57' 44"
	mean # hops	2.81	2.97

- impact of geography

strangers	few short
friends	few long
familiar strangers	many short
community	many long
no contact	

students

people in the same corridor
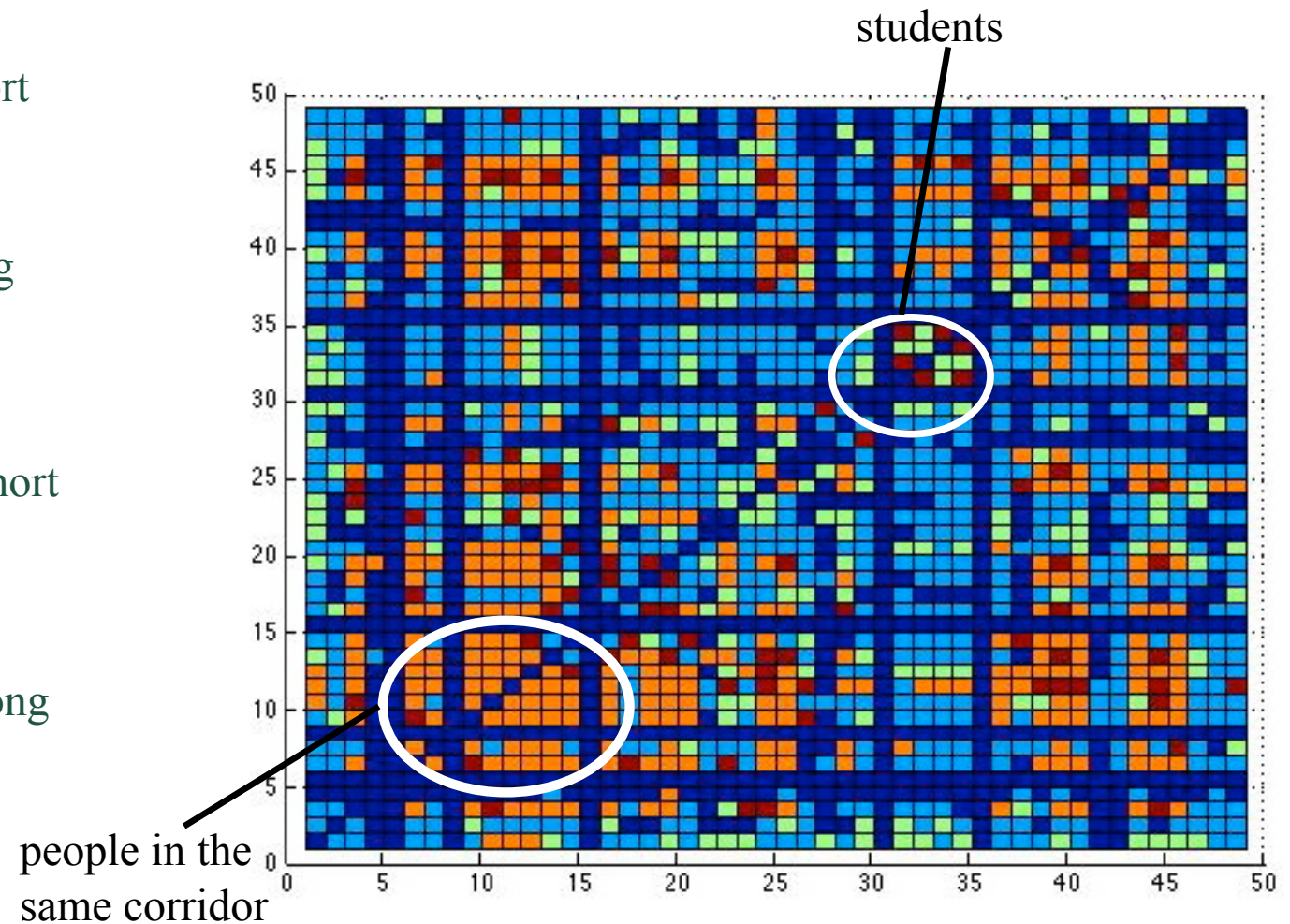
Social forwarding: environment

- encounters: #contacts between two nodes in a certain relation

- relays: #pairs of nodes in a certain relation (from map)

class	#encounters	#relays
community	311	68
fam.strangers	1012	196
strangers	392	324
friends	133	90

% RELAYS

0.0157
0.0529
0.0959
0.0245

- strangers
- friends
- familiar strangers
- community

% ENCOUNTERS

0.1429
0.2561
0.5335
0.0675

- strangers
- friends
- familiar strangers
- community
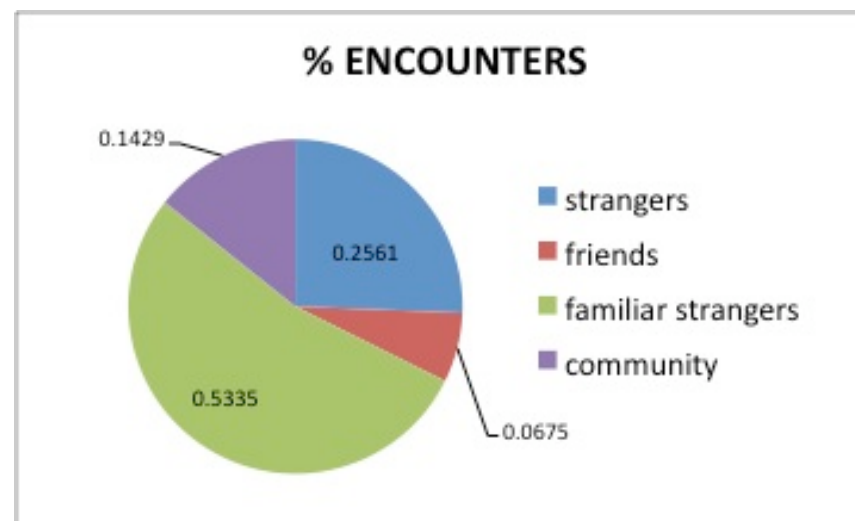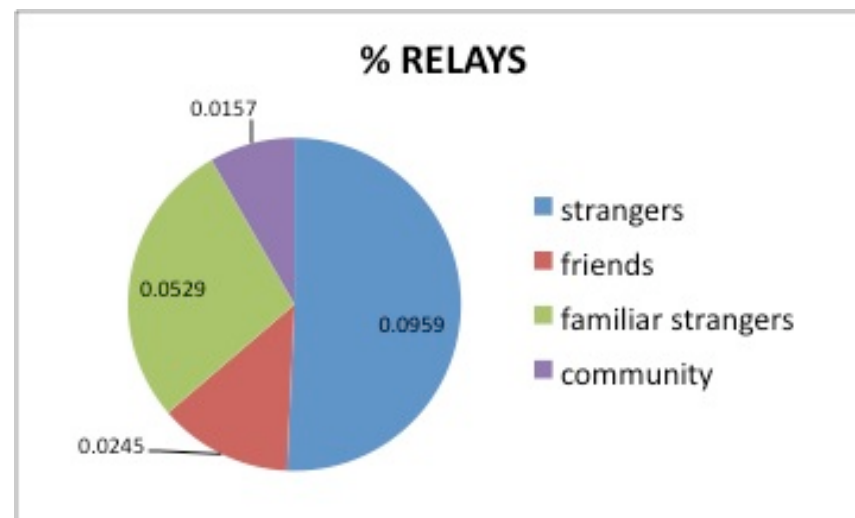
Social forwarding: results

- $P = \Sigma \,\#uses / \Sigma \,\#encounters \rightarrow$ normalized $P = P / \#people\ present$
- use: % relays of various classes

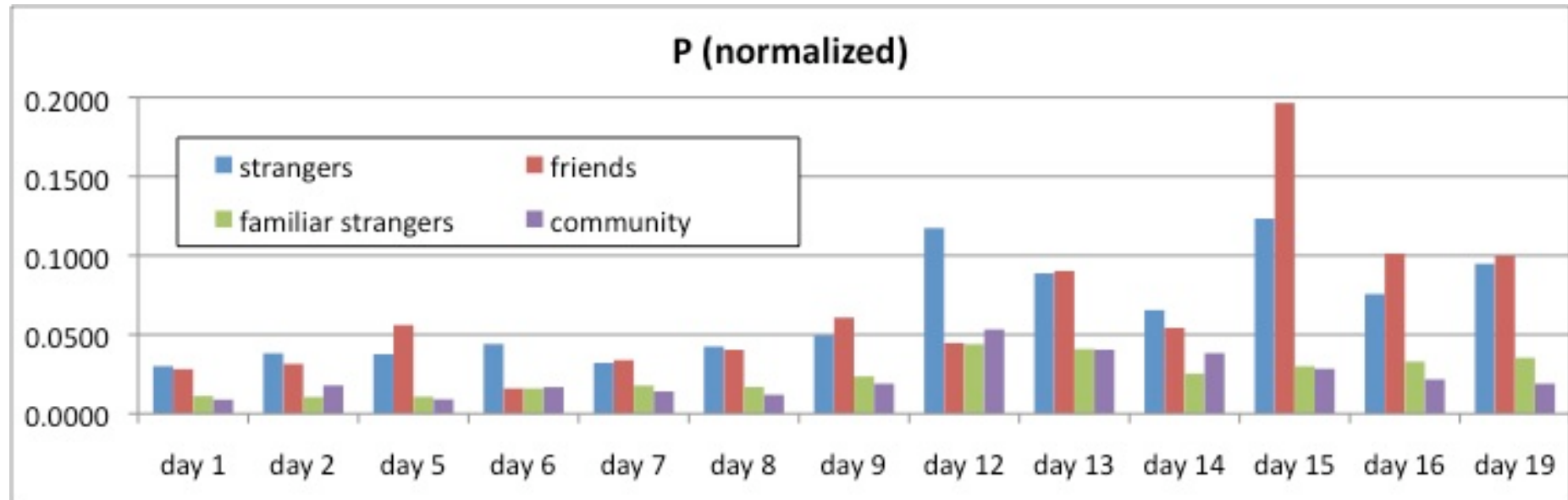|	comm	fam.str.	strang.	friends
P (all)	0.3119	0.3883	0.9949	0.9850
use (all)	10%	39%	39%	12%
use (> 1')	15%	41%	27%	17%
use (> 2')	20%	38%	26%	16%
use (> 5')	21%	32%	18%	29%
mean intra	2314	188	120	2983
mean inter	75	40	23	3040

P (normalized)

0.0230
0.0243
0.0646
0.0657

- strangers
- friends
- familiar strangers
- community

USE

0.0928
0.4410
0.3490
0.1173

- strangers
- friends
- familiar strangers
- community

P (normalized)

Conclusions

- short contacts
  - of prominent importance for message forwarding
  - beaconing → capability of detecting them
  - trade-off: detection accuracy vs. energy saving
- social forwarding
  - local/distributed characterization of friendship levels
  - use of friendship info for relay selection
  - different policy for relay selection depending on relation between source and destination?

http://nptlab.dico.unimi.it