

Université de Toulouse





Random walk meets temporal networks: applications in Opportunistic networks RESCOM - Corse, May 2014

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Basics in a nutshell

Opportunistic Networks



(Temporal) Random Walks



- We "walk" in the temporal dimension (temporal paths)
- Analogy: passing a token among contacts

Process dynamics



- Nodes pass tokens among connected contacts at each time-step
- Tokens may have their own contacts

Characterisation and monitoring in opportunistic networks

Global monitoring Complete knowledge ls it a good approximation? DTN Monitoring Partial

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knowledge



- Each node in the Node's plane keeps it's local history
- Mapping function is defined:
 - Static selection ($k \leq n$ monitors)
 - Temporal Random Walk (k tokens)

Evaluation

- Approximate Global ICT of the network
 - Synthetic traces with theOne (RWP)
 - Real traces
 INFOCOM2006
- Distance between real ICT and sampled ICT
 - Kolmogorov–Smirnov statistical test
- $\bullet \quad \text{Limit when } k \to n$



Results

- It is possible to approximate with statistical significance
- Static: 78% control
- TRW: 15% control



Number of monitors

	Static	Last	All	Any
Average case	> 17%	> 98%	> 95%	> 3%
Worst case	> 78%	> 98%	> 95%	> 15%
Memory	O(1)	O(N)	O(NT)	O(NT)

TRW as a lightweight communication infrastructure for opportunistic networks

Simplest analogy*



*and not so crazy: http://deaddrops.com/fr/

Evaluation

- Synthetic traces with different node density
- Real traces Haggle traces and RollerNet
- Delivery ration/Average Delay for different number of tokens
- Different token strategies:TRW,TRW-M
- Baseline with BSW

RWP Simulation



Real traces analysis



Results

- TRW/TRW-M always deliver
 - We may pay with an increase of delay
 - For similar delivery ratio, we have similar delays
 - TRW-M is in the high end of delivery for all traces with a similar cost in delay
- BSW message drops impacts the DR
 - Bigger buffer version for BSW ("shape" boost)
 - An even bigger buffer can beat TRW

Conclusions

Conclusions

- It is possible to monitor (ICT) on a DTN
 - Being statistically significant
 - Inherent trade-off: Approximation/Cost
- We propose a lightweight communication infrastructure
 - Acceptable performance in terms of deployment cost

Open Questions

- How can we model the interaction of temporal random walks on DTNs?
- How can we reason about distributed information? (memory/collected data)

Publications

- Temporal random walk as a lightweight communication infrastructure for opportunistic networks
 V Ramiro, P Sénac, E Lochin, T Rakotoarivelo. (2014)
 In: AOC2014, WoWMoM Conference, Sydney, Australia.
- On the limits of DTN monitoring
 V Ramiro, P Sénac, E Lochin, T Rakotoarivelo. (2013)
 In: AOC2013, WoWMoM Conference, Madrid, Spain.
- On the feasibility of monitoring DTN: Impacts of fine tuning on routing protocols and the user experience
 V Ramiro, P Sénac, E Lochin, T Rakotoarivelo. (2012).
 In: UXwIT 2012, JCC Conference, Valparaiso, Chile.
- DTN Monitoring (Poster)
 V Ramiro (2013)
 In:Algo-GT 2013 Workshop, Grenoble, France.