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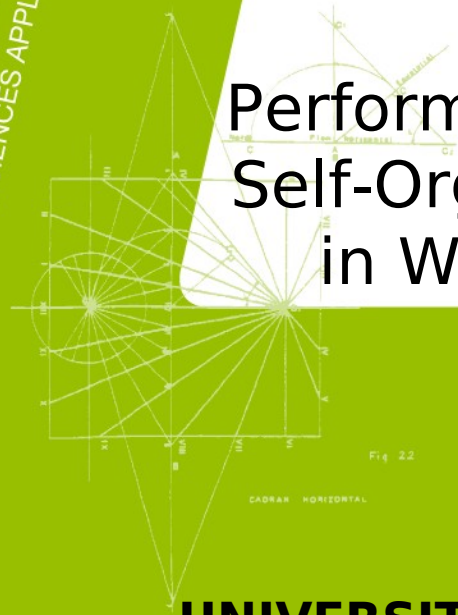

Performance Evaluation of Distributed Self-Organization Protocols in Wireless Sensor Networks

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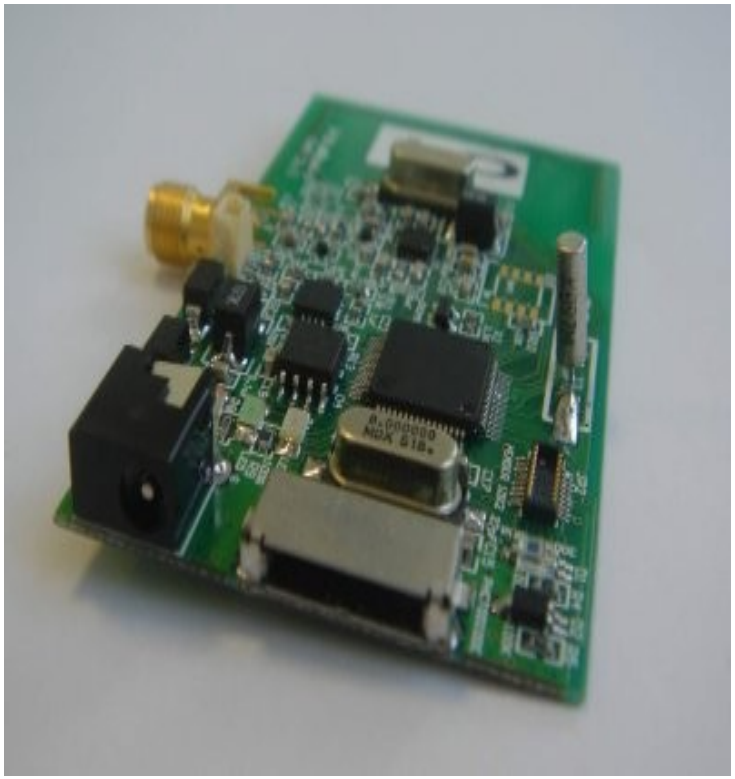


Worldsens, a small sensor node developed in the CITI lab
http://worldsens.citi.insa-lyon.fr/

Motivations

- Wireless Sensor Networks

  Large collection of low-cost and low-powered sensing device in interested environment.

- Goal

  link physical word and digital data netwo

- Challenges

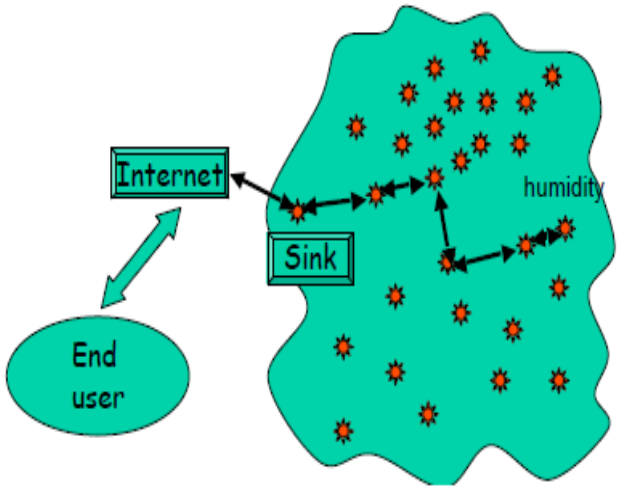
  Scalability

  Adaptive

  Auto-configuration

  Efficient resource sharing

  Maximize the network lifetime



Motivations

- Evaluate the performance of two families of self-organization protocols
- Investigate their characteristics according to some qualitative criterion during both **chaotic** and **sporadic** node deployment and WSN life.
- Investigate the design paradigms that can help the development of an efficient communication protocol in WSN.
- Interesting Questions

  What is the impact of node **deployment phase** on the performance of these protocols?

  What is the **capacity**, which can be achieved by each protocol?

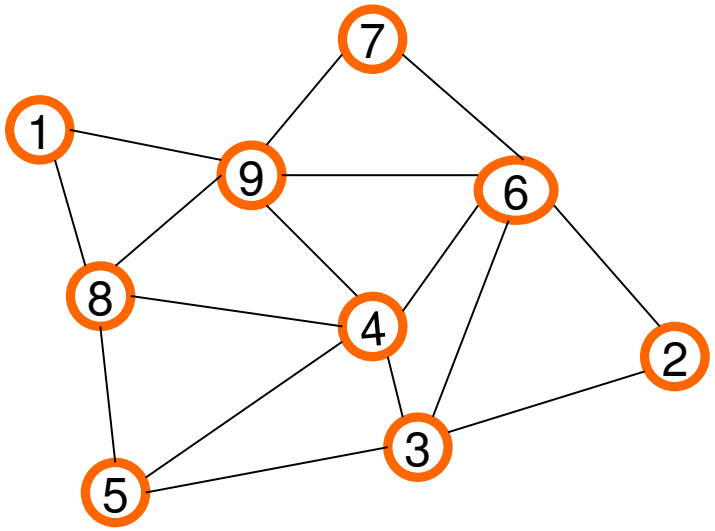
  Given some caracteristics of self-organization protocols, what should be an important design paradigms to follow?

Protocols overview

Connected dominating set (CDS)

- Each node is either in the subset of dominating set or neighbor of node in the subset of DS.
- Node of dominating set is connected.

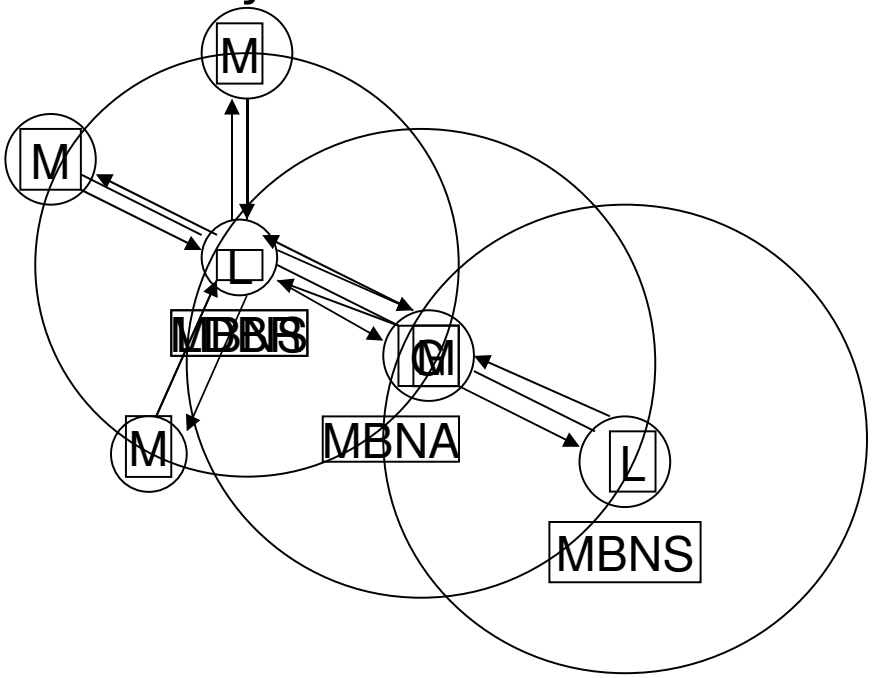
selection strategy: Marking process & rule k

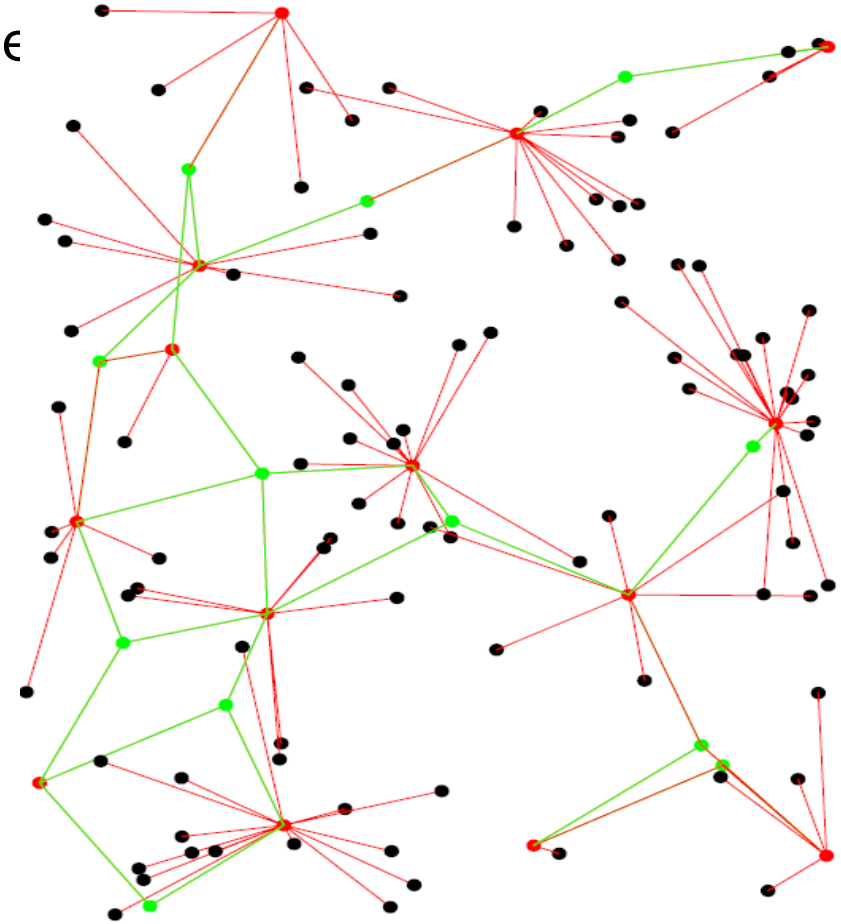


Protocols overview

Event driven low-energy self-organization scheme (LEGOS)

Node can be in three states : Leade Gateway or member

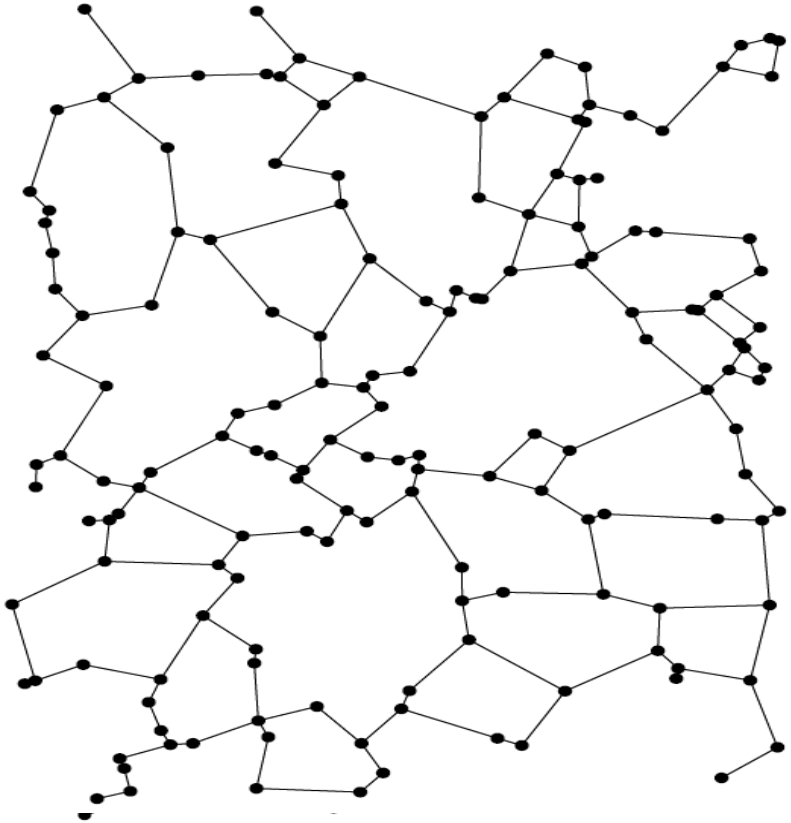




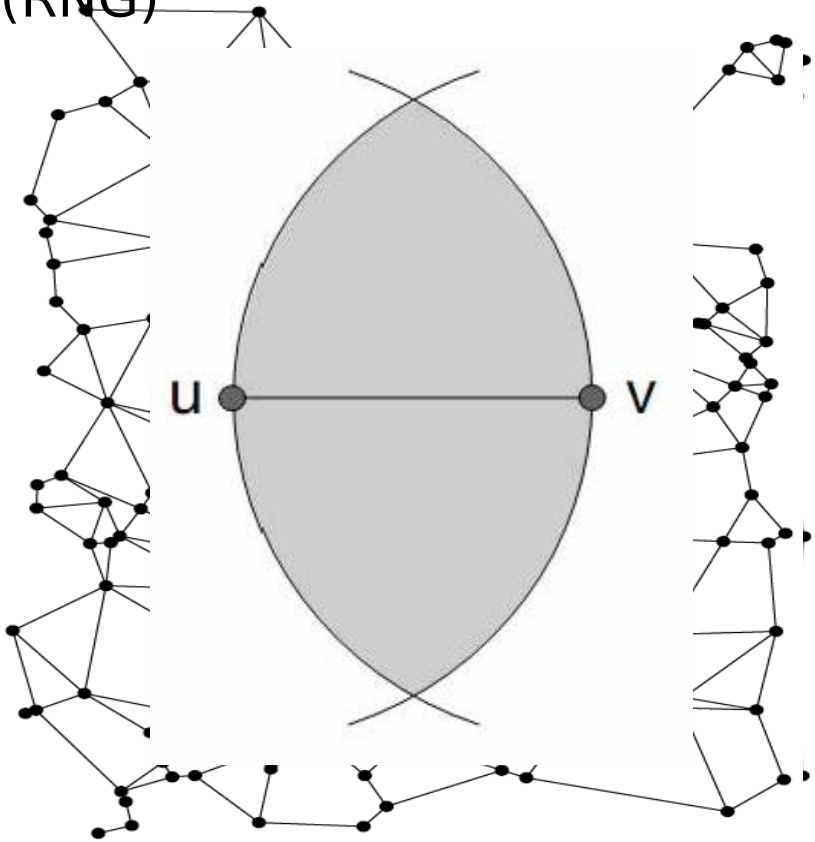
Protocols overview

Link pruning protocols (LP):

Gabriel graph (GG)



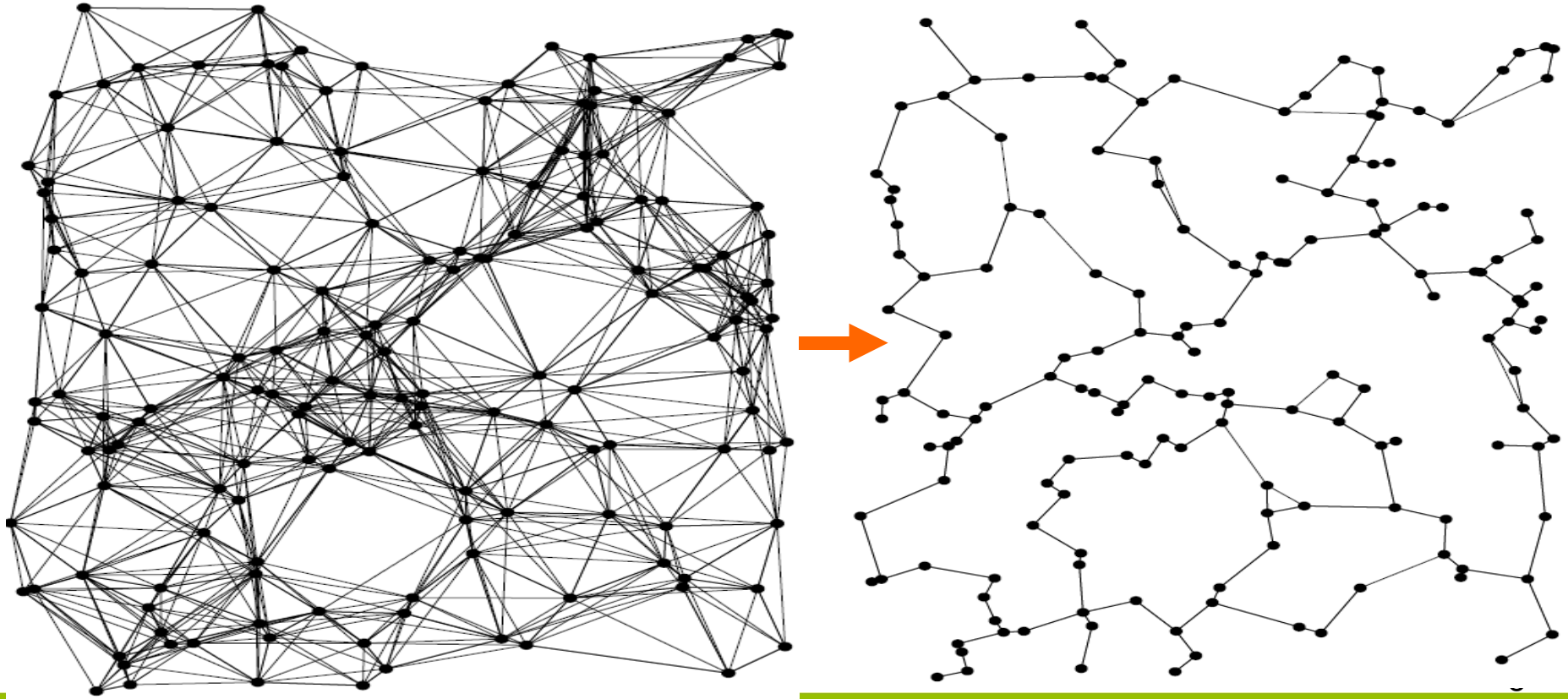
Relative neighborhood graph (RNG)



Protocols overview

Local minimum spanning tree (LMST)

1. Each node calculates its MST in neighborhood
2. Link (u,v) is in the final LMST iif v is in the MST(u) and u is in the MST(v).



Performance evaluation

- Framework:
  - 3 sinks are deployed
  - Convergecast traffic according to queries (query period= 10s)
- Assumptions and parameters:
  - Confidence interval 95%

Parameters	Value
Bandwidth	500 Kbps
Transmission power	0
Reception Sensitivity	-92 dBm
MAC layer	802.11
p-LEGOS LDBR/GWBR time interval	2 s
Hello MSG interval	2 s
Propagation	$\beta = 4.7\ \sigma = 4$
Simulation time	800 s
Inter-arrival time of nodes	[0, 50] (s)

- Event-drivent network simulator: Wsnet[http://wsnet.gforge.inria.fr]

Simulation results: *Simulatenous nodes deployment*

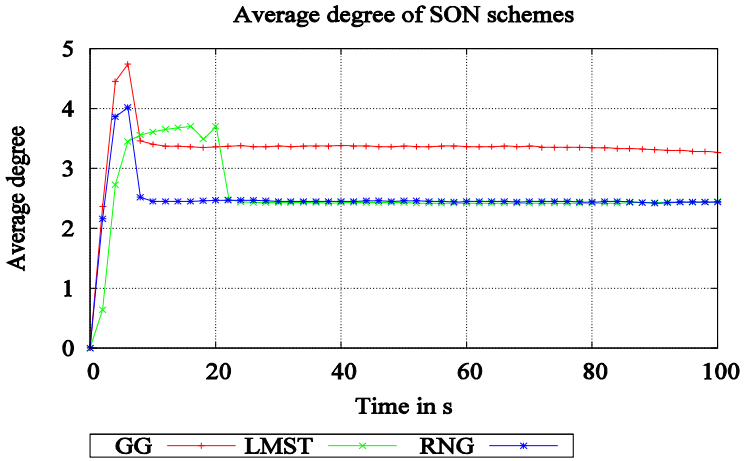


Fig.1: Latency of construction for LP

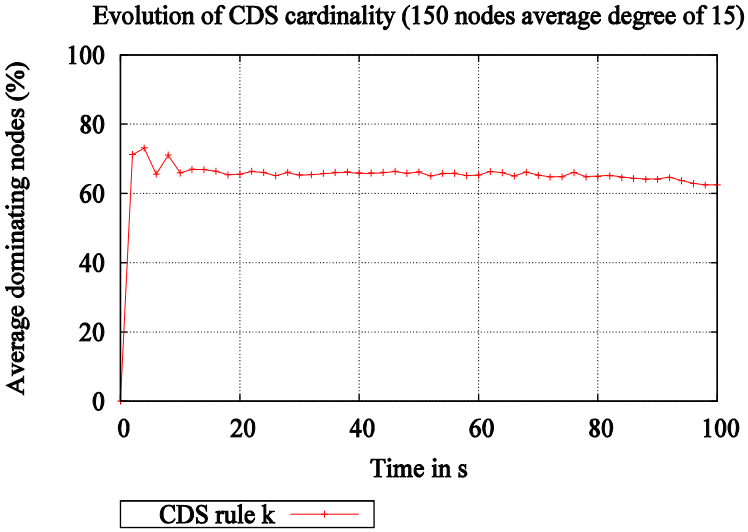


Fig.2: Latency of construction for CDS

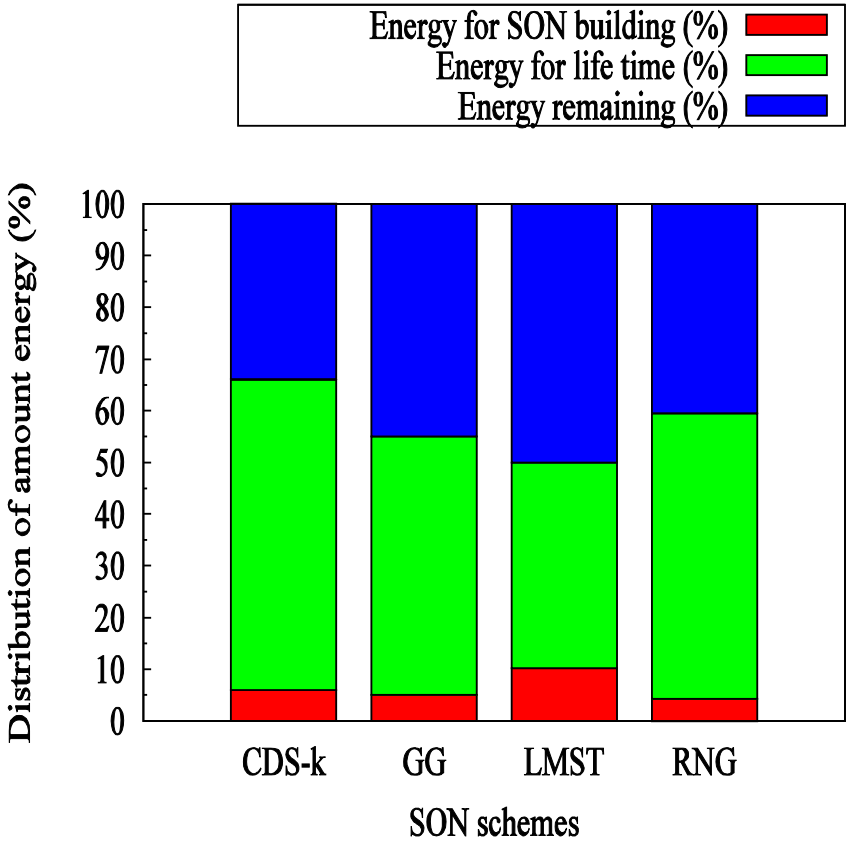


Fig.3: Energy dissipated

Simulation results: *Sporadic nodes deployment*

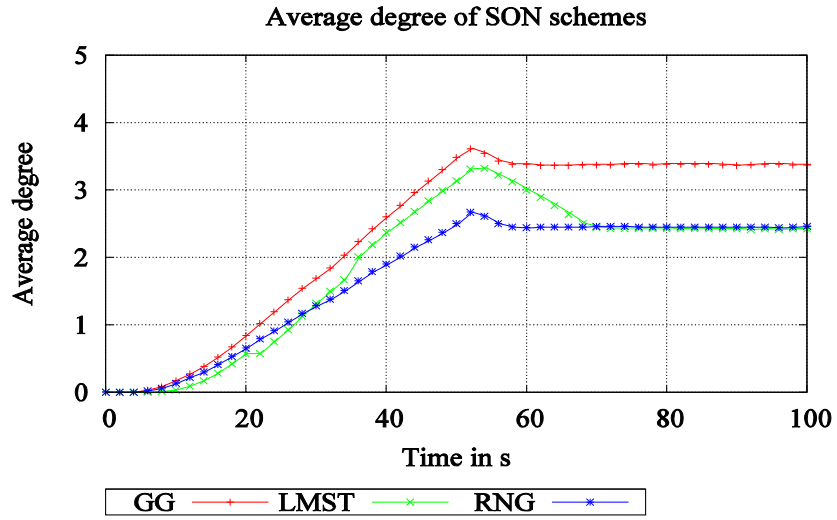


Fig.4: Latency of construction for LP

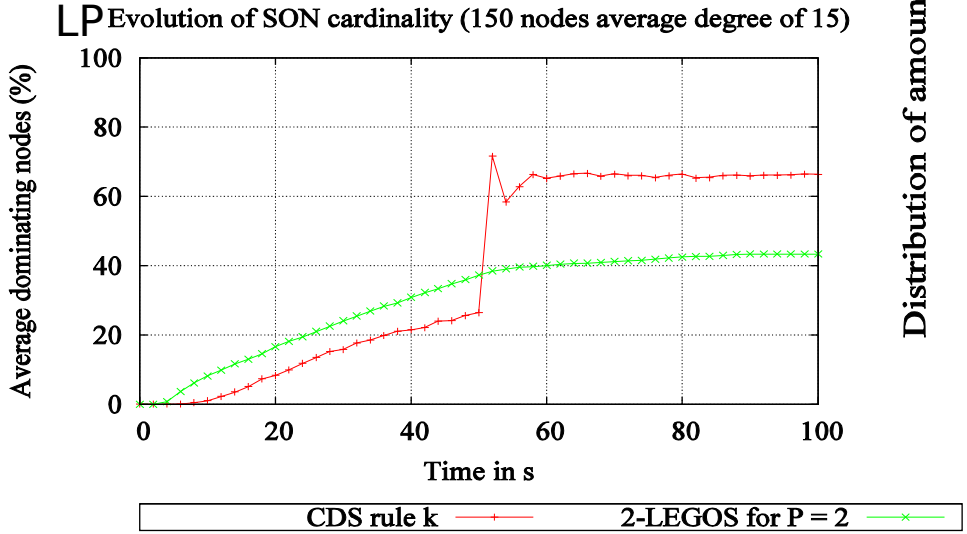


Fig.5: Latencey of construction for DS

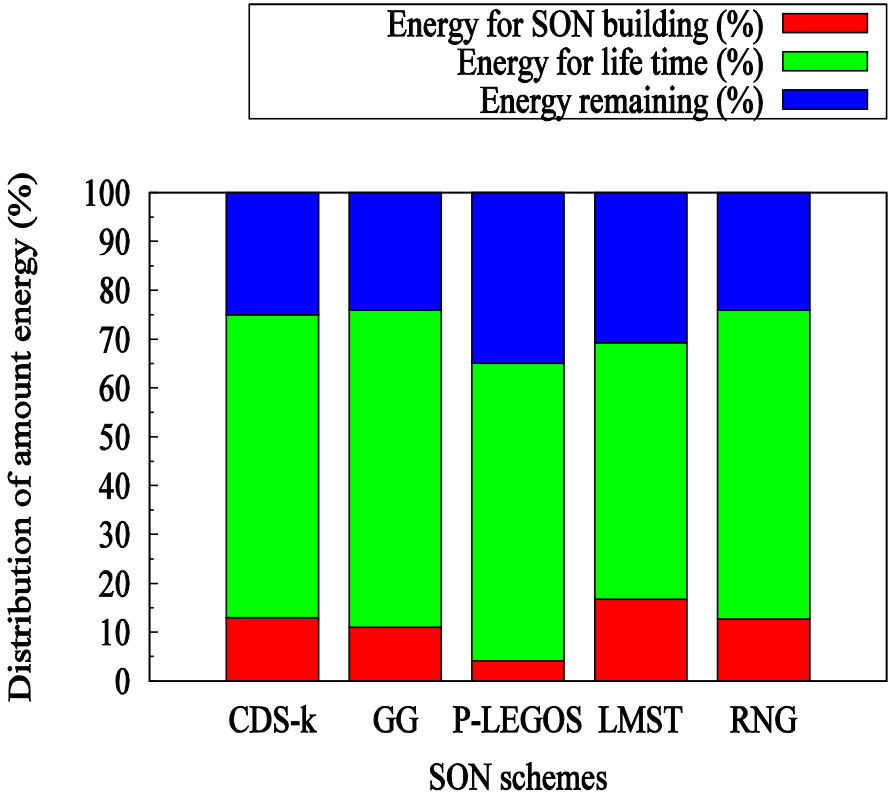


Fig.6 Energy dissipated

Simulation results

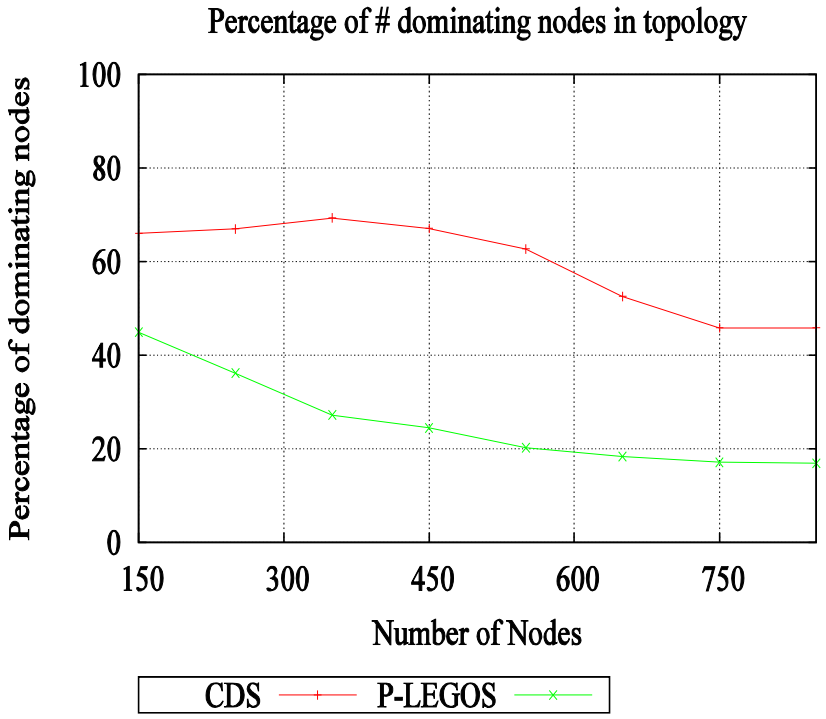


Fig.9: Cardinality of dominant sets

Table 3: Link pruning average SON node degree

Number of Nodes	RNG	GG	LMST
150	2.52	3.36	2.48
250	2.59	3.64	2.63
350	2.63	3.74	2.63
450	2.65	3.81	2.66
550	2.68	3.84	2.69
650	2.69	3.86	2.70
750	2.69	3.87	2.69
850	2.71	3.88	2.67

Fig.10: Average node degree

Simulation results

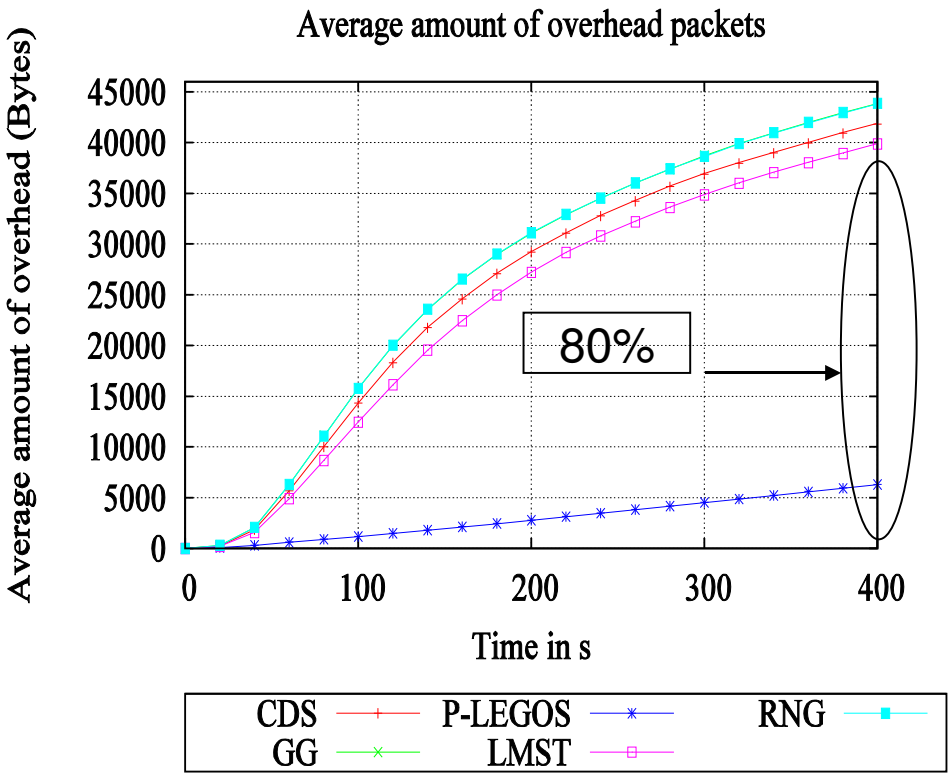


Fig.7: Control packet overhead

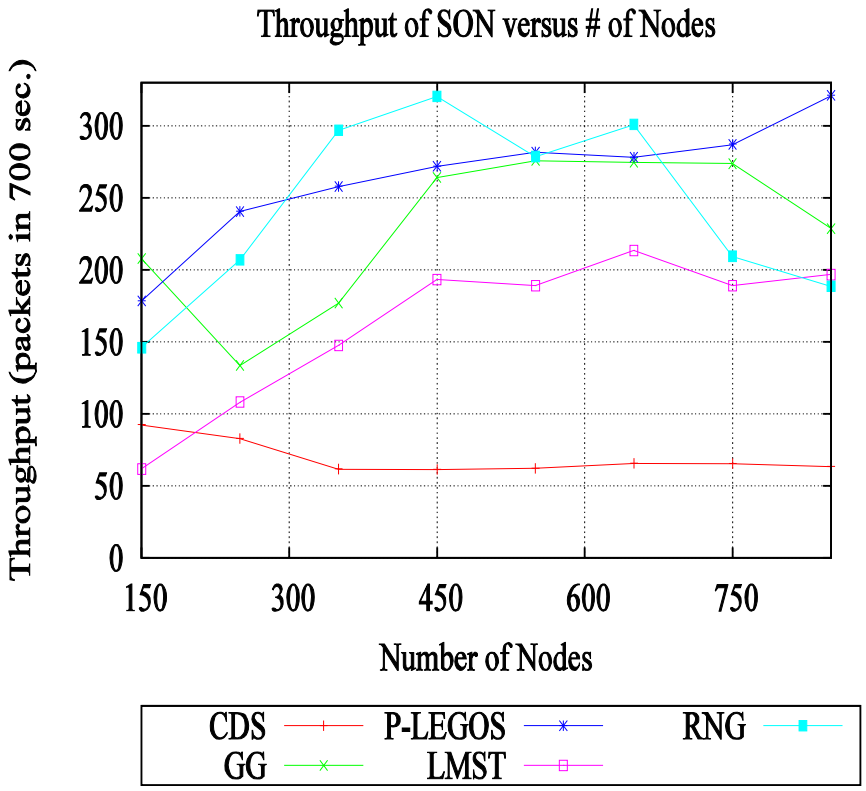


Fig.8: Throughput

Conclusion & perspectives

- Evaluation of **link pruning** and **dominant-based** self-organized Network protocols is proposed.
- **Chaotic deployment** impacts more on the performance of link pruning and k-CDS protocols than p-legos.
- The results show that p-LEGOS outperforms all remaining in terms
  of: Energy, latency, overhead and network **capacity**.
- For our point of view the design paradigms of an efficient SON protocols should follow the p-LEGOS design approach.
- To be more efficient, we plan to propose a data aggregation scheme in our future work.

Thank you !

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