Efficient Retransmission Algorithm for Ensuring Packet Delivery to Sleeping Destination Node

Ali Medlej, Eugen Dedu,
Dominique Dhoutaut, Kamal Beydoun

Univ. Bourgogne Franche-Comté, FEMTO-ST Institute, CNRS, France

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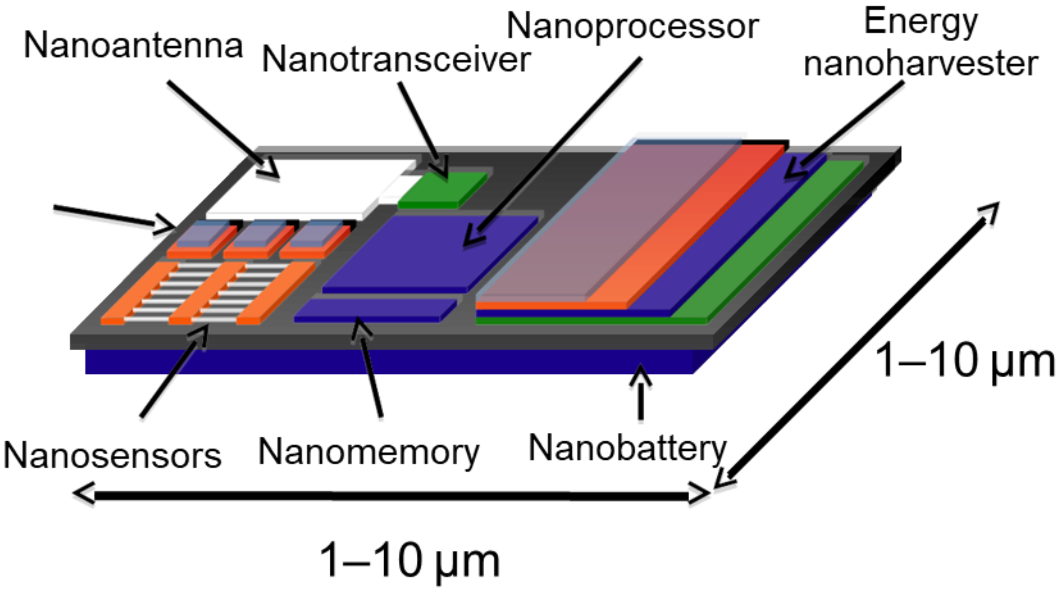
Wireless Nanonetwork Characteristics

- Nano-thing size ➔ 1..1000 nm (< 1 µm)
- Wireless nanonetworks built from tiny nodes
- Nanonodes have limited embedded computing, sensing and actuating devices



Already proposed algorithm: "Sleeping Mechanism"

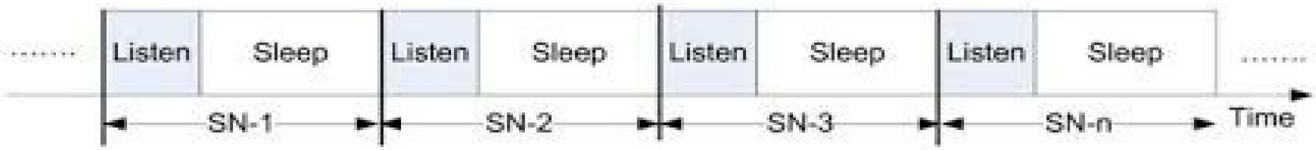
- Keeping nodes awake all the time leads to quick resource depletion

- The technique where the nodes periodically sleep and awake for a short period is called duty-cycling

- Our proposed mechanism differs from those used in macro-scale network on two main aspects:

  - Fine granularity

  - Asynchronism, decentralization



Sleeping mechanism paper link DOI: 10.23919/SoftCOM50211.2020.9238149

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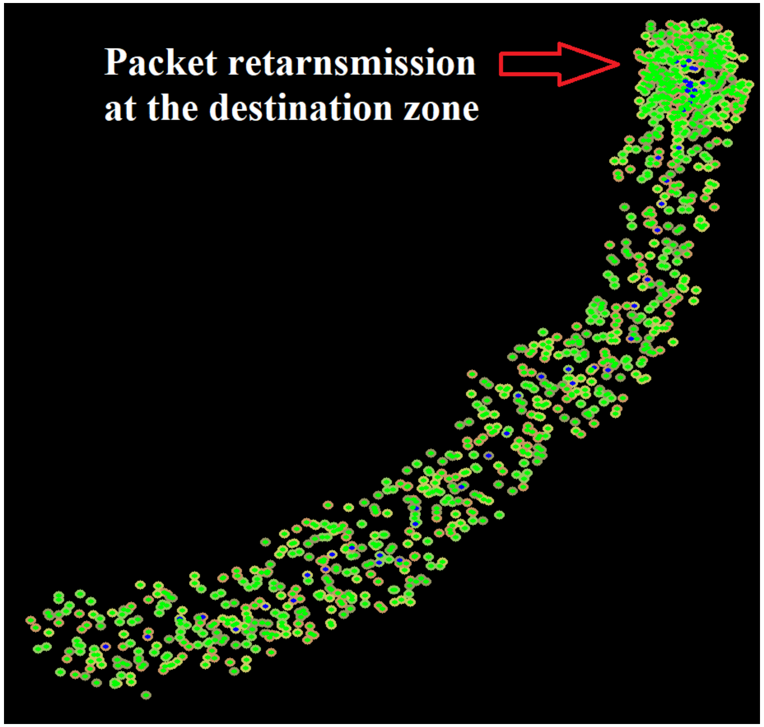
Problematics and Enhancement

- When a packet arrives at the destination zone, if the destination node is asleep, it will miss the packet
- Retransmitting the packet will increase the intended node chance of receiving a packet even if it was asleep when the packet reached the destination zone
- The algorithm is to be used only by nodes at the destination zone


Packet retarnsmission at the destination zone

Retransmission algorithm paper link
DOI : **10.52953/FIEM4995**

Problematics and Enhancement

- Making all nodes at the destination zone retransmit the packet might lead to:

  a)Congestion occurrence

  b) Increasing nodes hardware resources consumption

- The goal is to ensure that the destination node receives the packet, while reducing the number of packets exchanged at the destination zone

The probabilistic retransmission algorithm is the solution.

Our proposed algorithm

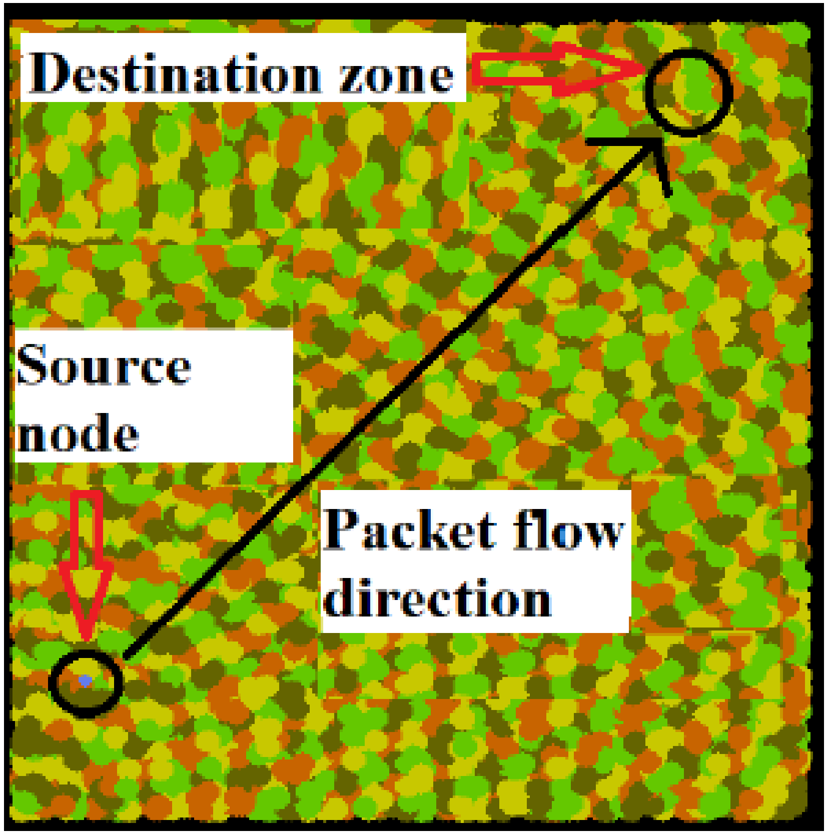
Efficient retransmission algorithm for ensuring packet delivery to sleeping destination node

- ❖ Allowing all nodes at the destination zone to retransmit the packet leads to nodes' resources being exhausted, and the congestion occurrence
- ❖ The probabilistic retransmission algorithm, will not allow all the nodes participate in the retransmission mechanism
- ❖ The number of participating nodes is determined based on a probability, calculated as follows:

Probability = 1 – (aD / Ts)

aD: node awaken duration
Ts: The time between two consecutive bits
aD/Ts = percentage of awake duration

Evaluation and Results

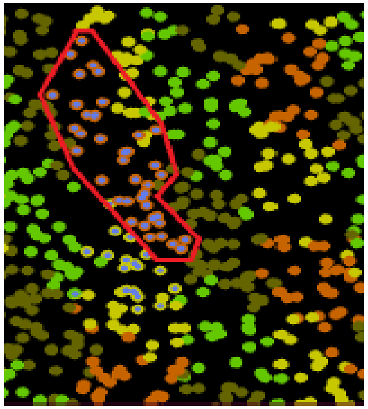


Simulated area size	6 mm * 6 mm
Number of nodes	25000
Communication Radius	500 µm
β	1000
Tp	100 fs
Packet Size	1000 bit

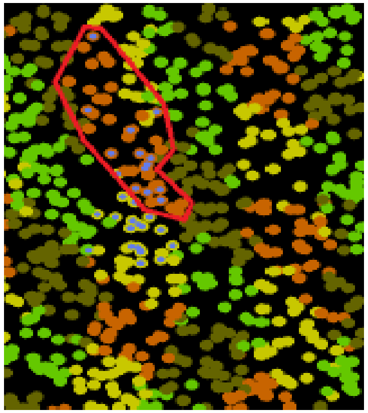
Evaluation and Results

Awaken duration (%)	Full retransmission	Probabilistic retransmission
6	35	35–38
10	41	34–37
20	41	32–35
30	41	28–32
40	41	25–28
50	41	21–25
60	41	15–21
70	41	11–15
80	41	7–11
90	41	3–7
100	41	0

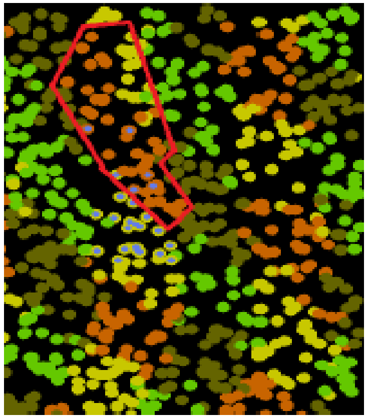
- The relation between the awaken duration and the probability is inversely proportional
- When awaken duration increases, then probability decreases, participating nodes decreases too



(a) Full retransmission, all nodes paticipating at the destination zone.

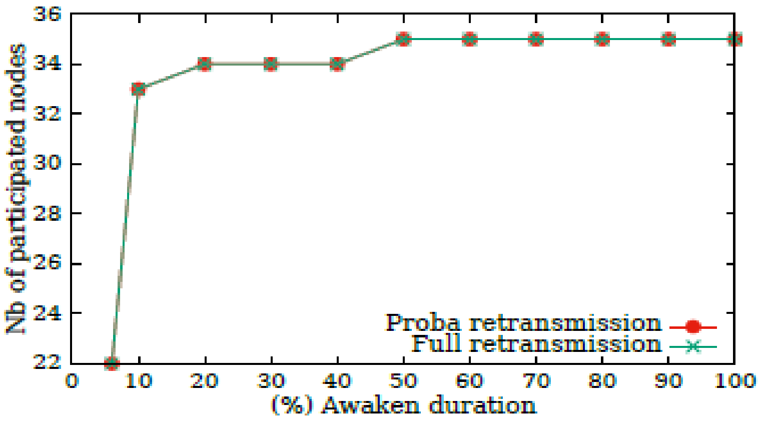


(b) Proba retransmission applied for 70% of node awaken duration.

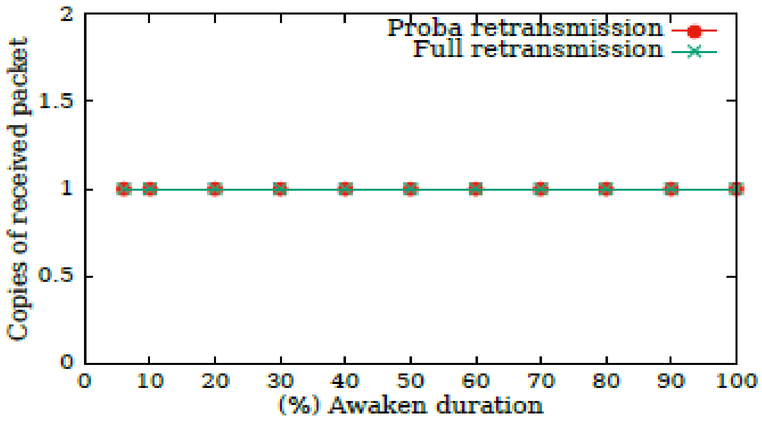


(c) Proba retransmission applied for 90% of node awaken duration.

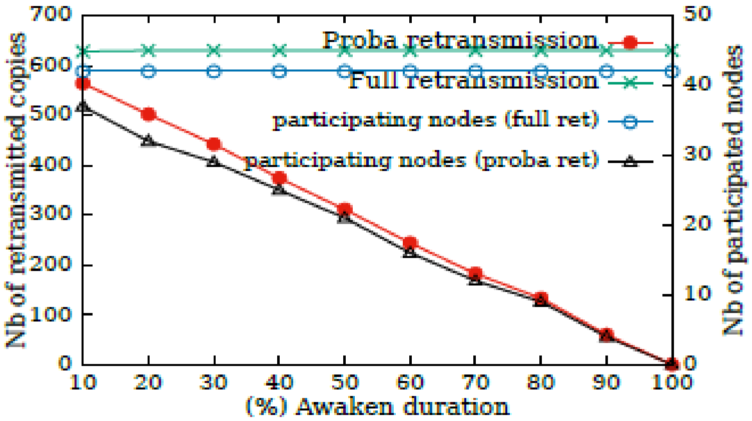
Evaluation and Results



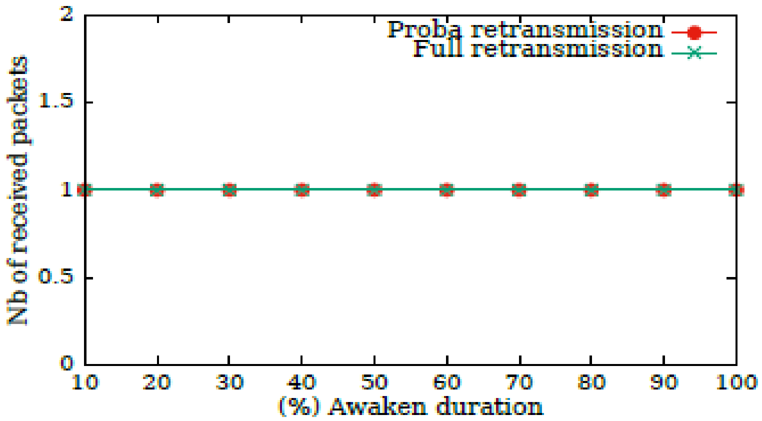
(a) Retransmission mechanism does not affect the previous zone.



(b) The reliability of receiving at least 1 copy of the packet by the destination node.



(c) Number of retransmitted packet copies and nodes handling.



(d) The destination node success to receive at least 1 packet copy of each flow.

Summary

The probabilistic retransmission algorithm:

- Reduces the number of the participating node in the packets retransmission process

- Ensures packet reception by the destination node, even if it was asleep when the packet reached the destination zone

- Preserves nodes resources (energy, CPU, memory, ...)

- Decreases the congestion occurrence at the destination zone

Questions ?