Self-Stabilizing Counting in Mobile Sensor Networks

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Mobile Sensor Networks

- SIVAM project: The impact of the climate evolution
- Wireless Distributed Sensor Networks for In-situ Exploration of Mars: Mars exploration
- Wireless Sensor Networks for Habitat Monitoring: Studying of Leachs Storm Petrels
- A wireless sensor network For structural monitoring: Effect of the wind or of an earthquake on a building

The Model

Modelization

- A group of penguins evolves on an island, carrying on their body a small sensor.
- Whenever a penguin is close enough to the antenna, its sensor interacts with the antenna.
- Depending on the hypothesis, the sensors may or may not interact with each other when two penguins approach close enough.

Population Protocols

Limitation of the sensors

- Small amount of memory
- Low power
- Carried on unpredictably moving supports (animals)
- May be resetted or corrupted

Population Protocols are well adapted

- Inspired by papers from D.Angluin, J. Aspnes and D. Eisenstat in DISC and PODC
- New goal: Find Self-Stabilizing protocols to count the number of penguins.

Two different scenarios

- The penguins-To-Antenna-Only model (TA)
- The penguins-To-Antenna-And-To-penguins model (TATP)
  - The symmetric one (STATP) : two penguins meeting in the same state have to change to the SAME state.
  - The asymmetric one (ATATP) : two penguins meeting in the same state don't have to change to the SAME state.

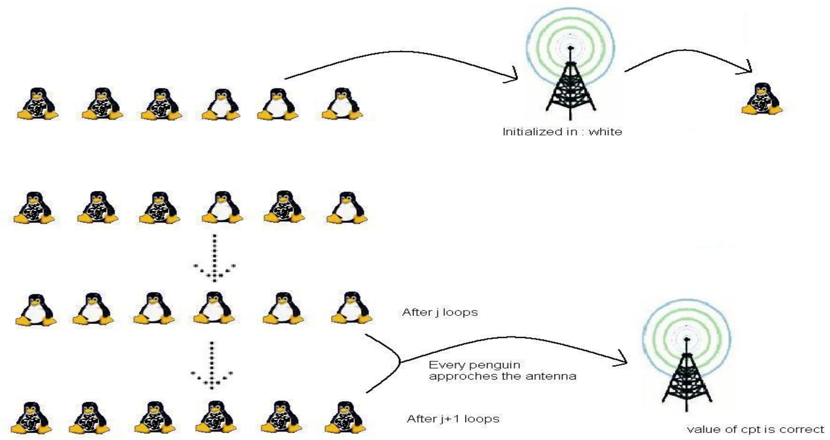
The TA model

model \ memory	**Finite**	**Bounded**	**Bounded,k-fair daemon**	**Unbounded**
deterministic	impossible	impossible	Algorithm 2	Algorithm 1
convergence time			4k events	depends on initialization
probabilistic	impossible	impossible	Algorithm 3	unneeded
convergence time			exponential in k	

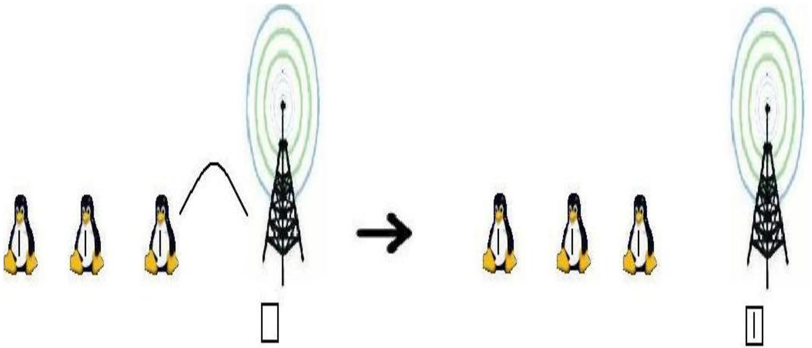
The TATP model

model \ memory	**Finite**	**Bounded,** $\alpha(P) < P$	**Bounded,** $\alpha(P) \geq P$
symmetric deterministic	impossible	impossible	Algorithm 6
convergence time			$\alpha(P) = 4P$, 3 rounds
asymmetric deterministic	impossible	impossible	Algorithm 4 or 5
convergence time			$\alpha(P) = P$, P+1 rounds $\alpha(P) = P + 1$, 3 rounds

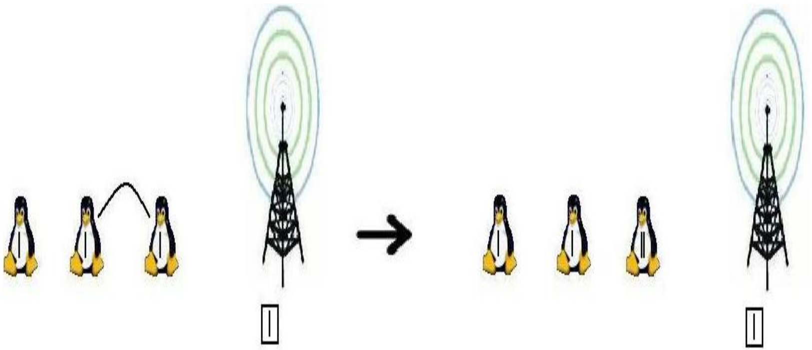
Algo 2 : TA model, k-fair adversary



Algo 4 : ATATP model



Algo 4 : ATATP model



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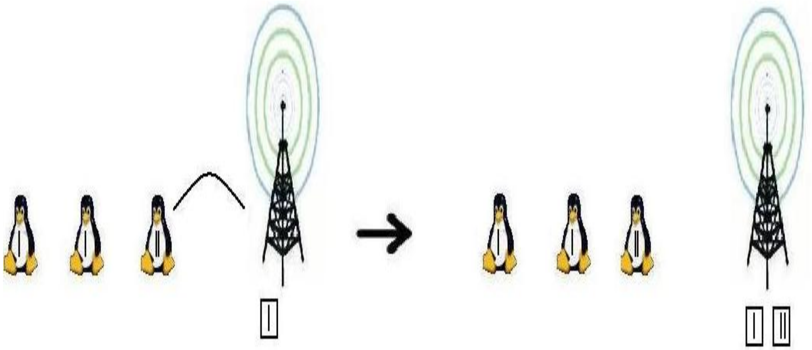

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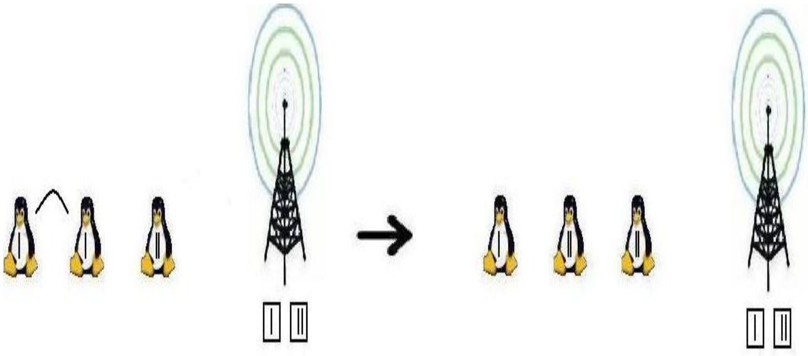

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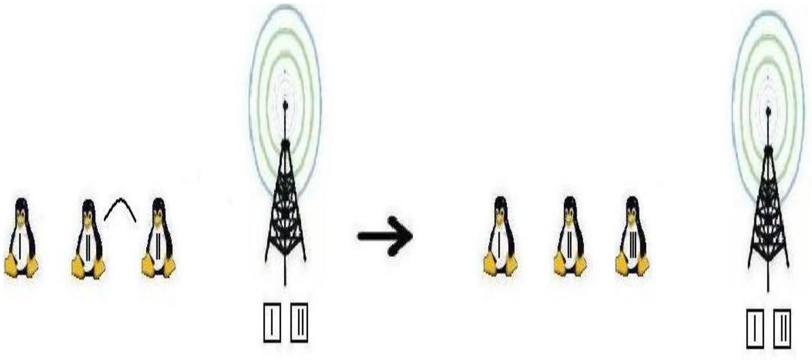

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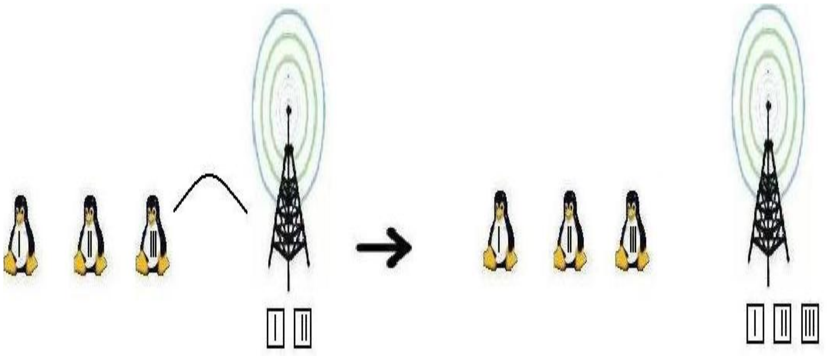

Future works

- Find "'message passing"' algorithms
- Fix the movment of the penguins
- Improve complexity bounds
- Implement the protocols