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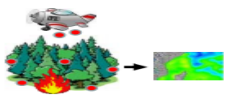
Wireless Sensor Network Dependability Benchmarking : MAC Layer Instance

General Context

Nowadays, the use of the WSN is facing a very big development in various domains as the military sector, medicine, environment and security.

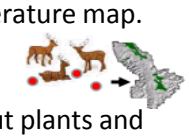
Exemple

Disaster relief operations



- Wildfire detection.
- Sensor nodes with thermometers are dropped from an air plane.
- Various temperature measurements are collected to produce a temperature map.

• **Biodiversity Mapping**

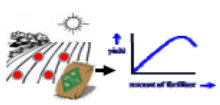


- Gain an understanding about plants and animals.

• **Intelligent Buildings/Bridges**

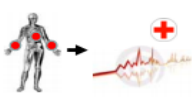
- Measurements about temperature, energy wastage.
- Monitoring of mechanical stress levels.

• **Precision Agriculture**



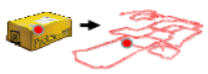
- Precise irrigation and fertilizing of fields.
- Temperature and brightness monitoring.

• **Medicine and health care**



- Postoperative and intensive care.
- Long-term surveillance of patients.

• **Logistics**



- Tracking of parcels during transportation.
- Inventory tracking in stores or warehouses.

Challenges

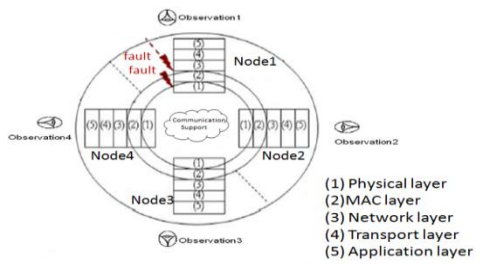
- Limited amount of Energy
- Vulnerable structure

⇒How to quantify the trustworthy of the wireless sensor network ?

Dependability Benchmarking

Is a specification of a standard procedure to measure the dependability and the performance of components (or target system) [1].

We need in the first stage a benchmark system, a profile execution composed by the workload, the faultload and the observation to estimate the desired measures.



Interfaces of faults injection

Realization

Workload

•The topology of nodes
•The movement of nodes

Faultload

•Battery depletion
•Sensing hardware failure and recovery
•Communication failures[2]
•humidity sensor
•disconnection failure [3]
•Node failures :
Sensor board : stuck at zero, Null Reading, Out of Scale Reading, Stuck at N
Power Supply : stuck at zero, Reset.
Routing : packet loss

Mesures

•**Connection resiliency**, defined as the maximum number of node failures that can be sustained while preserving a given number of nodes connected to the sink.

•**Coverage**, the longest time interval T the WSN can operate, while preserving a given number of nodes connected to the sink.

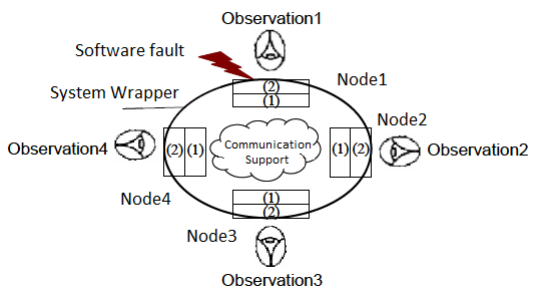
•**Data delivery resiliency,** defined as the maximum number of node failures that can be sustained while preserving a given fraction of correct packets delivered to the sink, with respect to the total number of packets produced by nodes.

•**Data delivery efficiency**, the longest time interval T the WSN can operate, while preserving a given fraction of correct packets delivered to the sink, with respect to the total number of packets produced by nodes[2].

MAC layer benchmarking

We make to project the dimensions of a dependability benchmark on the MAC layer of the WSN and to realize this we use NS-3 [4] .

At first time we are going to proceed, to use the interface of the MAC layer to inject faults.

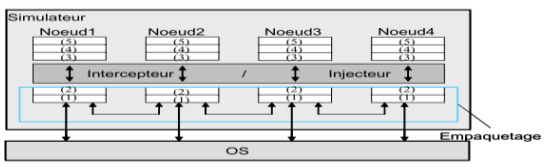


Injection software faults at the MAC layer

Results

Interceptor/Injector

Intercepts requests at the layer (2) for different nodes to observe the behavior of the MAC layer. Also, it injects faults at the interface of the layer (2) to simulate a faulty behavior of the Node1.



Integration of Interceptor/injection

Results

The results of these experiments represents the basic data for the construction of the dependability benchmark for WSN.

Our objective is made observations at the MAC layer in the different nodes to evaluate the dependability of MAC layer.

•When we delete all continuous of payload, we can observe the packet in the different nodes at the MAC layer and the packet reaches the node at the Application layer. We obtain the same result when we delete some content.

•After studying the fault injection in LLCHeader, IPV4Header and UDP-Header, we conclude that when these latters are deleted, we are able to observe the packet through the different nodes at the level of MAC layer but this packet is lost in the Application layer.

Conclusion

We have presented in this poster a new experimental methodology to construct a dependability benchmark for WSN.

References

[1]. A.E Rugina. Etalonnage de la sûreté de fonctionnement de Systems d'exploitation. Institut National de Polytechnique, Toulouse(2004).

[2]. Marcello Cinque, Domenico Cotroneo, and Catello Di Martino, Automated Generation of Performance and Dependability Models for the Assessment of Wireless Sensor Networks, June 2012.

[3], CATELLO DI MARTINO,RESILIENCY ASSESSMENT OF WIRELESS SENSOR NETWORKS: A HOLISTIC APPROACH, November 2009.

[4]. Thomas R. Henderson, ns-3 tutorial. presentation at wns3 2009: Workshop on ns-3 in conjunction with simutools 2009. March 2009.

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