# Modeling Wireless Sensor Network for Performance Measurement and Optimization

With the increase in the size of logistics systems, the complexity of the control system has also increased. In order to reduce this complexity and to analyze and control the system, it could be divided into small units. On the other hand, the unification of small units is necessary for increasing capability and protecting against economic fluctuation. Autonomous control is considered as a solution for retaining the independency and liberty of the units as well as the avoidance of complexity. One of the issues related to this control system is how the units interact with each other. In a central structure all units send their data to the center, and the center makes the decisions and sends orders to the units. In autonomous control systems, the units are able to control themselves and make decisions in a collaborative way by themselves. If they need any information or awareness of another units' situation in order to reach a decision, they will acquire information and will have access to the necessary data directly from the other units without intervention on the part of a central unit. A question arises here; Which control system is suitable and why? An autonomous control system or a non-autonomous one? Under which conditions can we choose between these systems? The objective of this project is to find answers to these questions.

A logistics system comprises logistic objects, like warehouses, stores and containers. In an autonomous approach for a logistics system, the objects should be able to control themselves and interchange the data between themselves. But the autonomous system is not only desired over objects layer but also inside the objects. For autonomous decision making, it happens that one object needs some data from inside of other objects; therefore an automation system should be established for preparing such data and controlling the object by itself. An object's automation system could have different layers. The sensor layer as lowest layer is for gathering information, and layers above it are for communication, processing the data and making decision for actuators. If the autonomous policy is applied in the sensor layer, the total logistics system would be autonomous in all layers from object layer to the sensor layer. The objective of this project is to answer the question of autonomous and non-autonomous options in sensor layers.

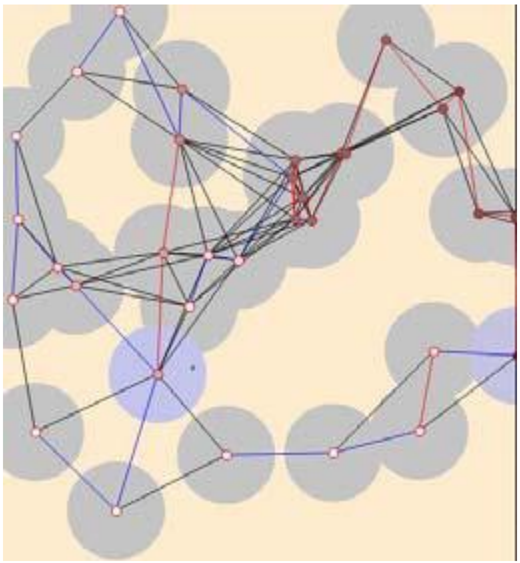

Figure 1: Graphical view of wireless sensor network

Inside the logistics system for objects like containers, the wireless sensor is proposed for the sensor layer of automation system. Using the wireless sensor has many advantages, such as mobility, extendibility, reliability and ease of installation. The communication network is formed via connection of the nodes. A bilateral data exchange between the nodes is important for establishing an autonomous network. This fact leads to finding and implementing a special routing algorithm. Based on the autonomous property, the routing algorithm must be target-oriented; this means that each node should be able to send data to any other arbitrary node.

Developing this kind of algorithm is in the same direction

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as autonomous and non-autonomous options, because any model for this network is deeply related to the routing algorithm.

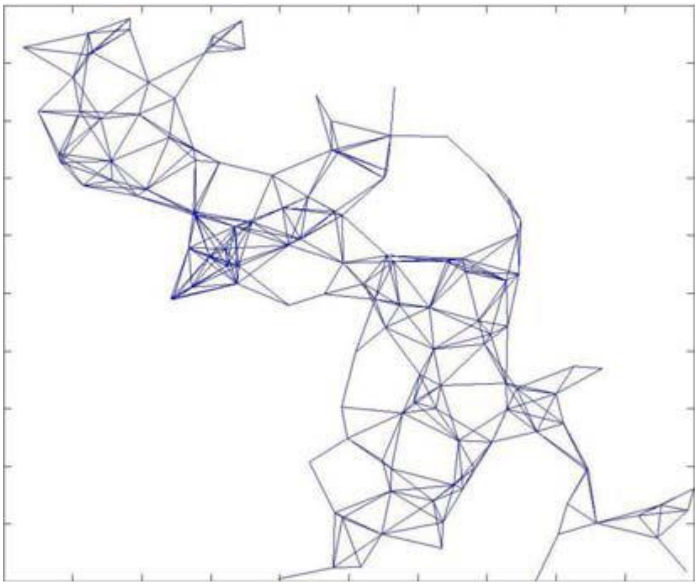

Figure 2: Network Graph

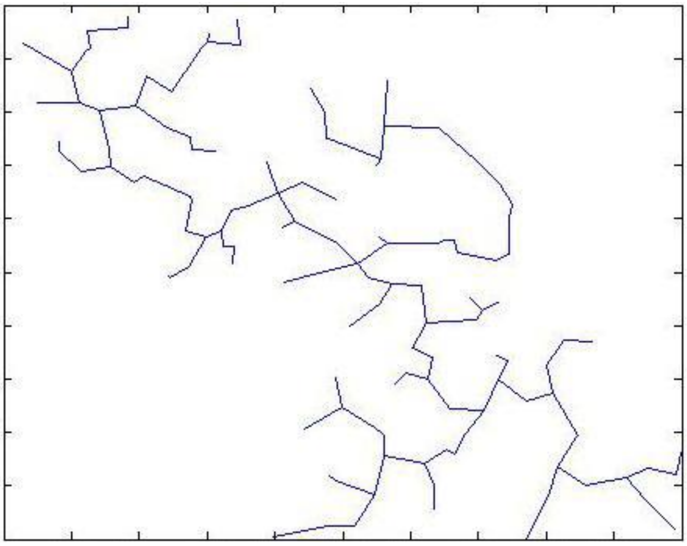

Figure 3: Minimum Spanning Tree for routing

Many surveys have been conducted on the advantage and disadvantage of autonomous and non–autonomous systems. In a nutshell, some factors like reliability and robustness and faster reaction response to the environment and extendibility are considered as advantages of autonomous systems, but what about the performance? By means of a performance comparison of the autonomous sensor layer with a non-autonomous one, we will be able to answer the question about the best option. The prediction says that when the volume of control tasks increases, the non-autonomous performance decreases faster than for the autonomous system. The behavior of these two networks would be assessed by modeling a wireless sensor network and simulation. For modeling, the usual approach is to use stochastic process and queue theory; however, since in this case the network has deterministic behavior, graph theory has been chosen for modeling and simulation. Graph theory introduces the idea and tools for shaping a mathematical description of the network and routing algorithm. The concepts and elements of graph theory such as connectivity, spanning tree and graph matrices are useful for describing the network. Following this, Matlab software is used for programming and implementing the mathematical concepts of the graph theory for modeling and simulation.

After development of a routing algorithm and simulation of the network, a sample network would be established. The routing algorithm would be implemented and after running the network in autonomous and non autonomous features, the result of simulation will be verified. It is expected that the autonomous network has better message delivery and better energy consumption in comparison with non-autonomous networks. In an autonomous network, due to reduction of energy consumption the average life time of the network increases and the maintenance expenditure will be reduced. On the other hand, due to better message delivery in an autonomous network, the sensor layer could be applied to bigger networks and higher network traffic.

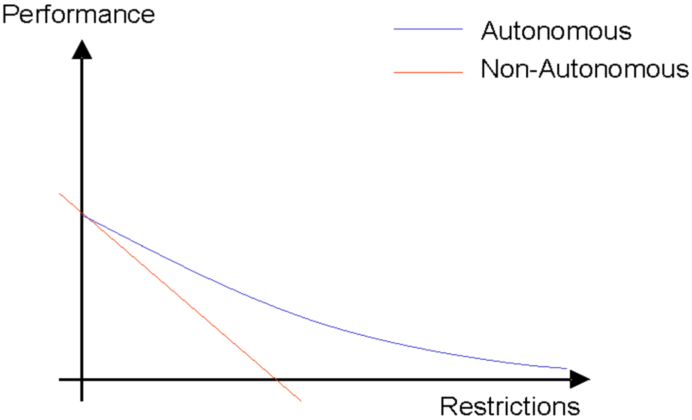


Figure 4: Expected result

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