# - Sensor network description and algorithm(In progress…)

The scenario under consideration here is a network of sensors spread out over an area. The components of the network are:

Coordinators: The coordinators are computer systems which directly interact with the network through motes. One or more coordinators are present throughout the network depending on the network size and density. The coordinator manages the entire layout of the network. Maintaining the layout enables the coordinator to figure out isolation in case of node failure. It also serves as a global directory for the motes. The coordinator also collects the data from the network.

Motes: Motes are the actual the sensor components. The primary functions of a mote are sampling sensor readings, computation and internetwork communication.

Data mule: The data mule/ rover is a mobile device which is deployed in case of isolation due to node failure. It can form a temporary link in the network and/or collect the last batch of data from isolated node before the node is shut down.

Network design:

The network will consist of motes spread over an area. The motes will form an ad-hoc network with the neighboring motes. One of motes will be connected to a workstation which will serve as the coordinator. As mentioned above the duties of the coordinator include serving mote requests, maintaining network layout, detecting isolation, and collecting readings.

Distributed network design:

There are a few problems with the single coordinator design. Since the duties of a coordinator are to serve requests and collect readings, it can become a bottle neck as the size of the sensor network increases. Also if the mote connected to the workstation or the workstation goes down the recovery will involve either rebooting the workstation or manually shifting to another workstation which would take time. To counter these shortcomings this algorithm uses distributed networking in which the networks will have more than one coordinator. These coordinators will be connected over LAN and will be in constant communication with each other. Such an arrangement will help reduce traffic over the entire network and in case one of the coordinators goes down, the packets from the corresponding motes can be diverted to another coordinator.

Backup nodes:

The backup motes will be implemented for motes which are in critical path. The critical motes are defined as the motes whose failure will result in isolation of one or more motes from the rest of the network. These motes will have an accompanying mote which will be the backup mote. The role of backup mote is to remain dormant until either the accompanying main mote goes down because of software or hardware error or it runs out of battery. The backup mote will send and receive a heartbeat signal to the accompanying mote every 30 seconds. If the reply is not received it will assume the accompanying mote to have failed and get activated in its place. The reason for keeping the backup mote dormant and not allowing it to be active till the accompanying mote goes down is the scenario in which batteries of both the nodes might go out simultaneously in which case recovery is not immediately possible. By making the

backup node dormant most of the time we can ensure that its batteries will last much longer than the accompanying mote.
Inter-network communication

The motes will maintain a table of connected motes in their memory. The coordinator system will maintain a graph of the entire network. The path of communication from one mote to another and from one mote to the coordinator will be determined by the coordinator. The mote will send a request to the coordinator for a path and the coordinator will reply with the calculated path. The path will consists of the motes in the communication path in sequence. The path will be put into the header of the message packet. At every mote on receiving the message, the mote shall pop the top element in the path which is its own address and check if the remaining path length is 0(i.e. message has reached its destination.). If not it will read the next element in the path and send the packet to the concerned node. This mechanism can create a bottle neck at the coordinator if all the motes keep requesting for paths. To overcome this we will use path caching in all the motes. Each mote will have a cache which can cache upto 2 paths(list of motes from source to destination). The node connected to coordinator will have a larger cache since it has to communicate with almost the entire network.

The reason for having a kind of centralized approach to figure out communication pathways is to enable re routing the packets on a certain motes request which might be running a high priority task and would like not to be interrupted for packet routing. In such a case the mote will inform the coordinator not to route any packets through it. The coordinator will make sure that the requesting mote does not lie in any of the communication paths it sends out to the other requesting motes.

Failure identification:

In progress….

Isolation and recovery:

Consider a scenario where 3 motes form a triangle and they are connected to one another. Two of the motes of the triangle are connected to the larger network. Due to some occurrence , both the nodes fail at once. The third node which is still alive is now isolated from the network and cannot communicate with the network. The node in this situation can do one of the following things:

1) Power down and keep alert for any incoming packets sent by the nodes starting up again.
2) Keep on taking the readings till memory is full and then power down and wait for help(the memory utilization can be optimized by introducing some loss in the sensor readings .. .e.g increasing the duty cycle.

For isolation detection, the role of coordinator is as follows. Whenever a node fails a message is sent to the coordinator with the id of the node. The coordinator will update the network graph and mark the node as failed. Then it will do a depth first search to find the nodes connected to the failed node and try to trace path back to the coordinator. If that fails, the coordinator will detect an isolation and start the recovery process.

For recovery, there will be a data mule/rover positioned near the coordinator. The data mule/rover will have a mote mounted upon it. Once the coordinator detects the isolation it will send the rover to the isolated node. Here there are two possibilities for the coordinator

1) Send the data mule/rover to the isolated location. On reaching the mote mounted on the rover will collect all the data gathered by the mote(s) since the time of isolation and ask them to power down till the network connectivity is restored and come back to the coordinator with the readings.
2) Use the data mule/rover to go the isolated location and place the mounted mote in such a way that the connectivity is restored. With advance rover construction, the damaged mote(s) can be retrieved and new ones replaced in their place for motes placed at relatively simple positions.