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Project ASTRA – Asset Tracking for hospitals

Final Presentation

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Agenda

1. Motivation and Objective.
2. Overview.
3. Architecture.
4. Routing protocol – How?
5. Application.
6. GUI and Targeted outcomes.
7. Future improvements.

Motivation, Objective

An average hospital can lose $4,000 per day in lost wages due to time spent searching for mobile medical equipment, not to mention the over-procurement of assets to ensure availability - Versus [1]

- Motivation
  - To track mobile medical equipments in the hospitals
  - Increased patient volume, increased health care devices which are prone to misplacements by humans.
  - Misplacements, time to track, central inventory management(out of date, over ordering, needs maintenance or disposal).

- Objective
  - To implement a homogenous, scalable real time asset tracking system by constructing a robust , minimum hop, energy aware routing algorithm.

Overview

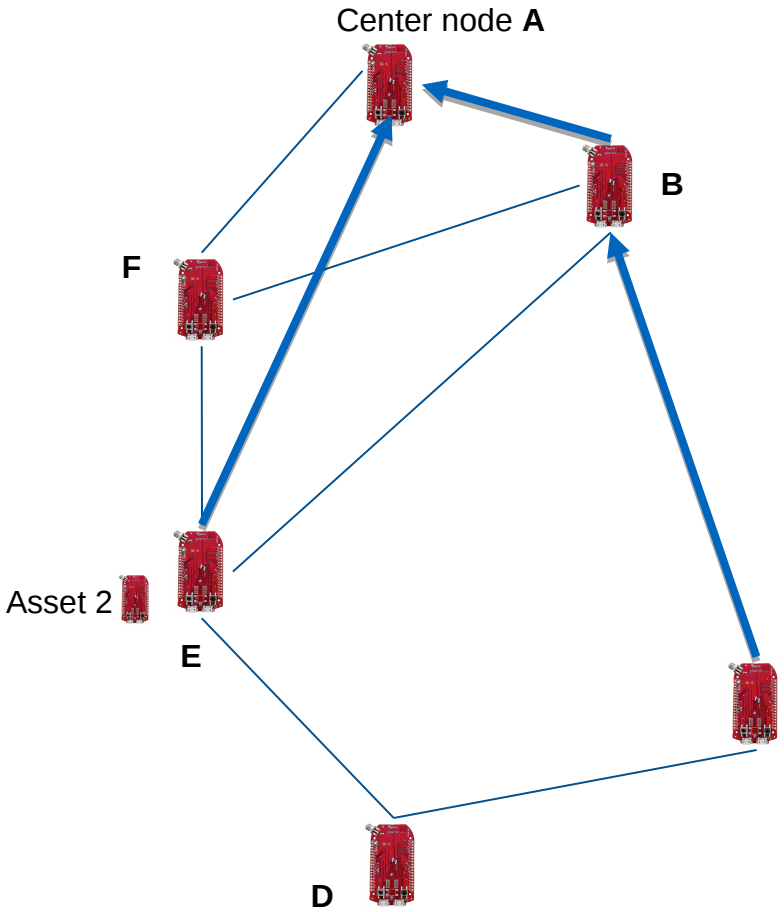
- Approach
  - 2 asset motes and 6 tracking motes with one being the Gateway mote.
  - Application has 2 modes of operation
    1) Neighbour discovery and maintain routing table with cost to Gateway.
    2) Asset tracking – Periodic information to the Gateway mote.

- Routing protocol
  - Ad-hoc distance vector Routing for minimum cost route.
  - Cost is the estimated based on hop count and available battery life.

- Sensors and Actuators
  - Battery level sensing – Periodic ADC read
    - Button to emulate Battery drain.
  - Sounder – Asset out of the network.
  - LEDs – Minimum cost route.

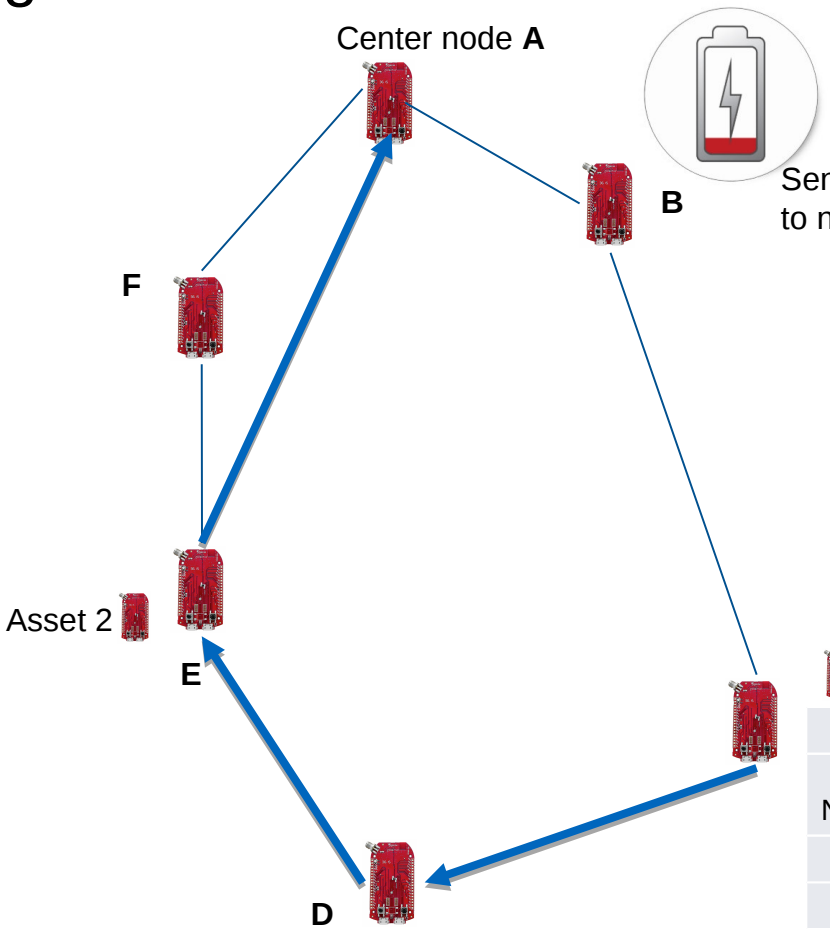
- Topology Features
  - Self organization – Adding new nodes to the network/Find next efficient route.
  - Failure Recovery - Node failure in the network - Table updated at the neighbors.
  - Dynamic topology – Update Routing tables with changed cost.

Architecture/ Working – Minimum hop, Energy aware Routing



NODE **C**	
Neighbour	Hops to A
B	2
D	3

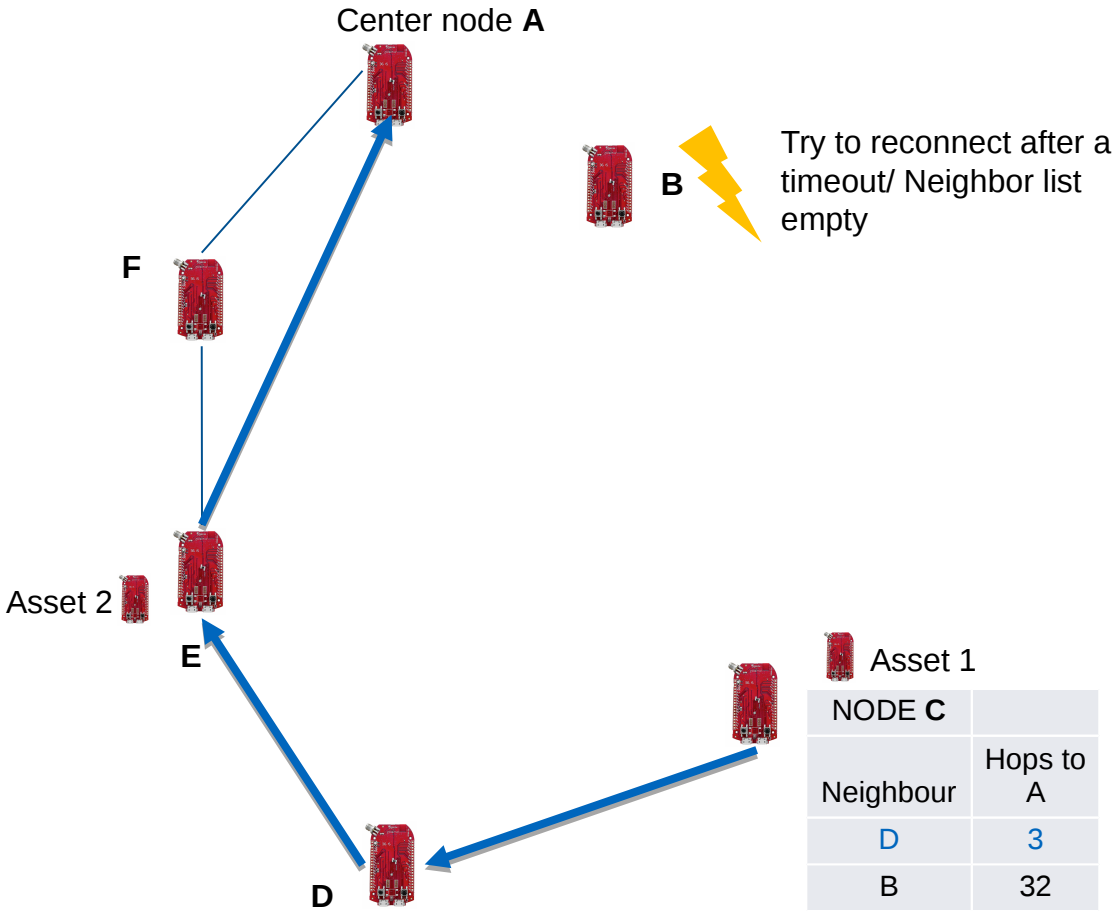
Architecture/ Working – Minimum hop, Energy aware Routing



NODE **C**	
Neighbour	Hops to A
D	3
B	5

Updated table

Architecture/ Working – Minimum hop, Energy aware Routing

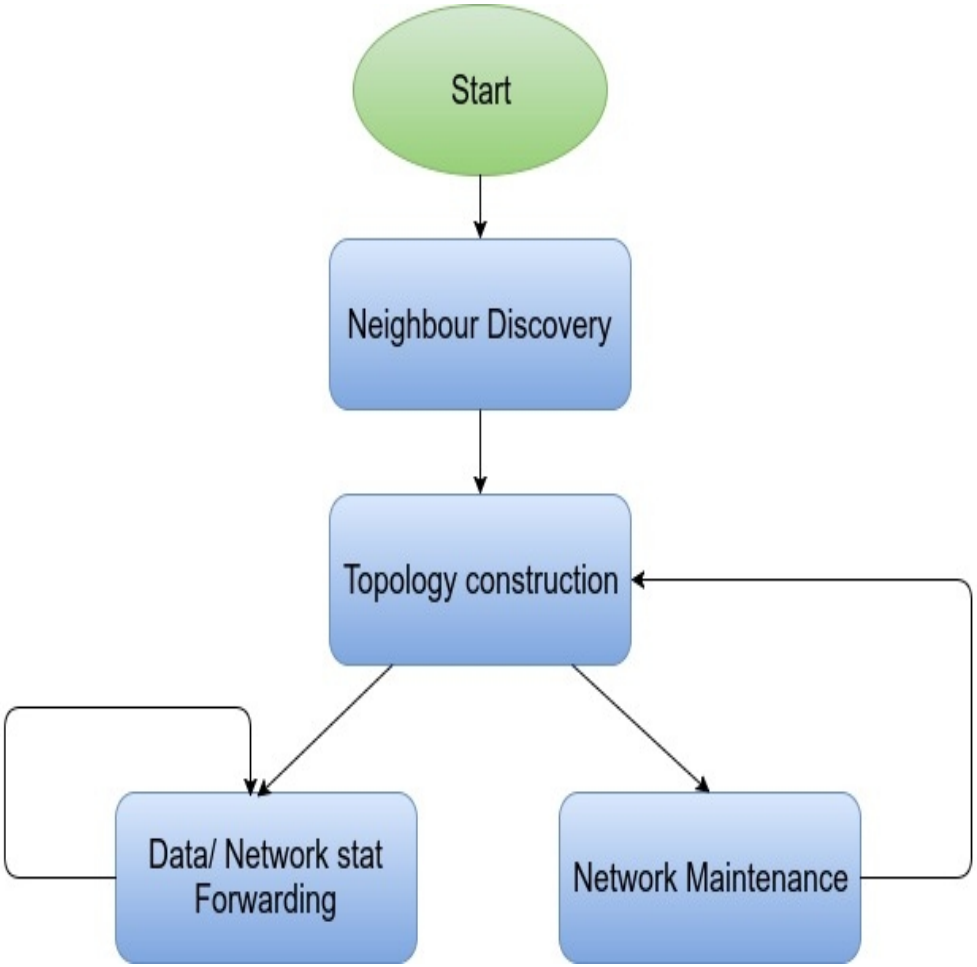


NODE **C**	
Neighbour	Hops to A
D	3
B	32

Updated table

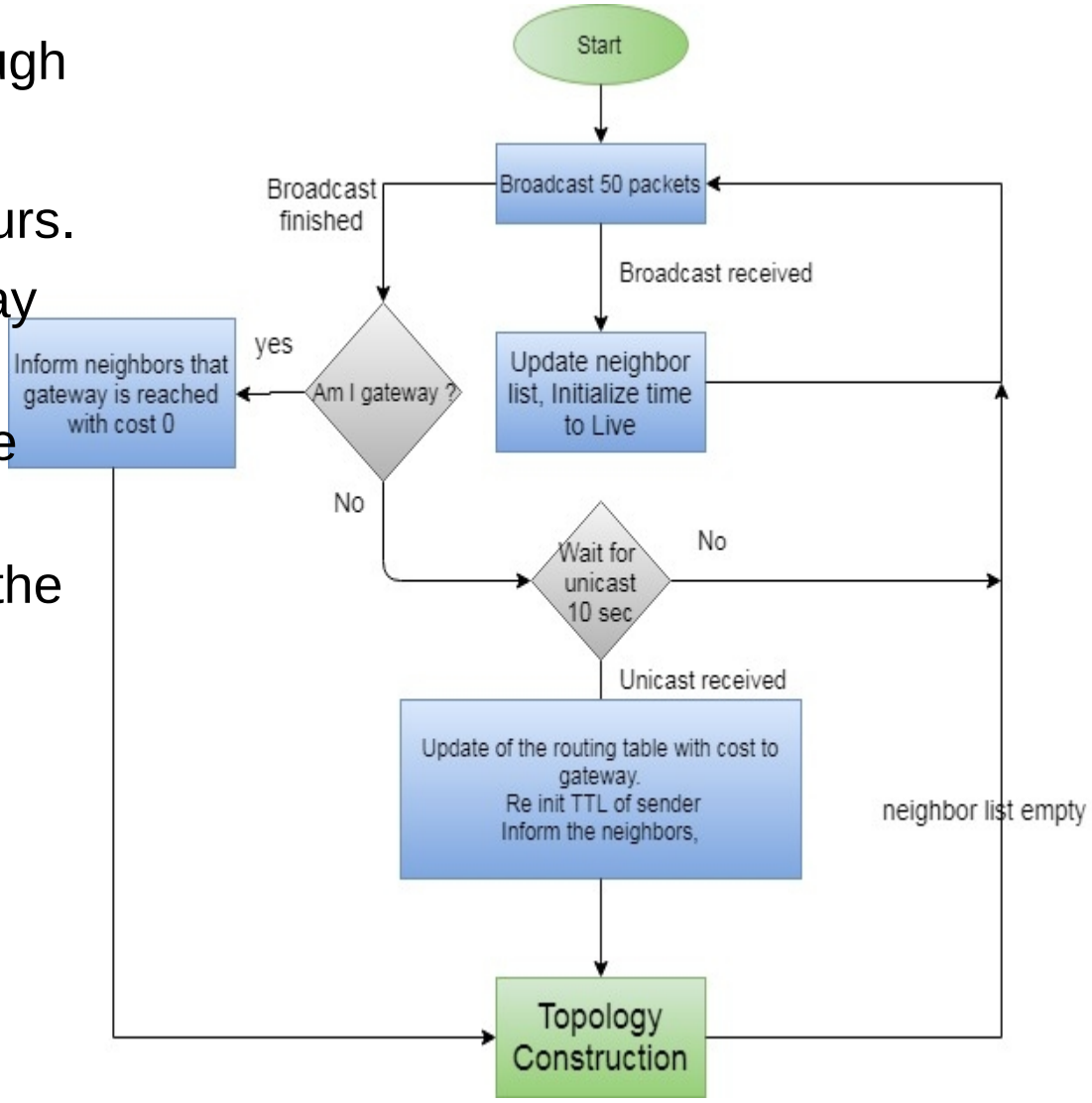
Application Block Diagram

- Neighbour discovery after boot up.
- Gateway information propagates through the network.
- Every node estimates the efficient path to gateway.
- Nodes receive periodic updates from neighbours.
- Nodes forward network statistics and Asset information to gateway.



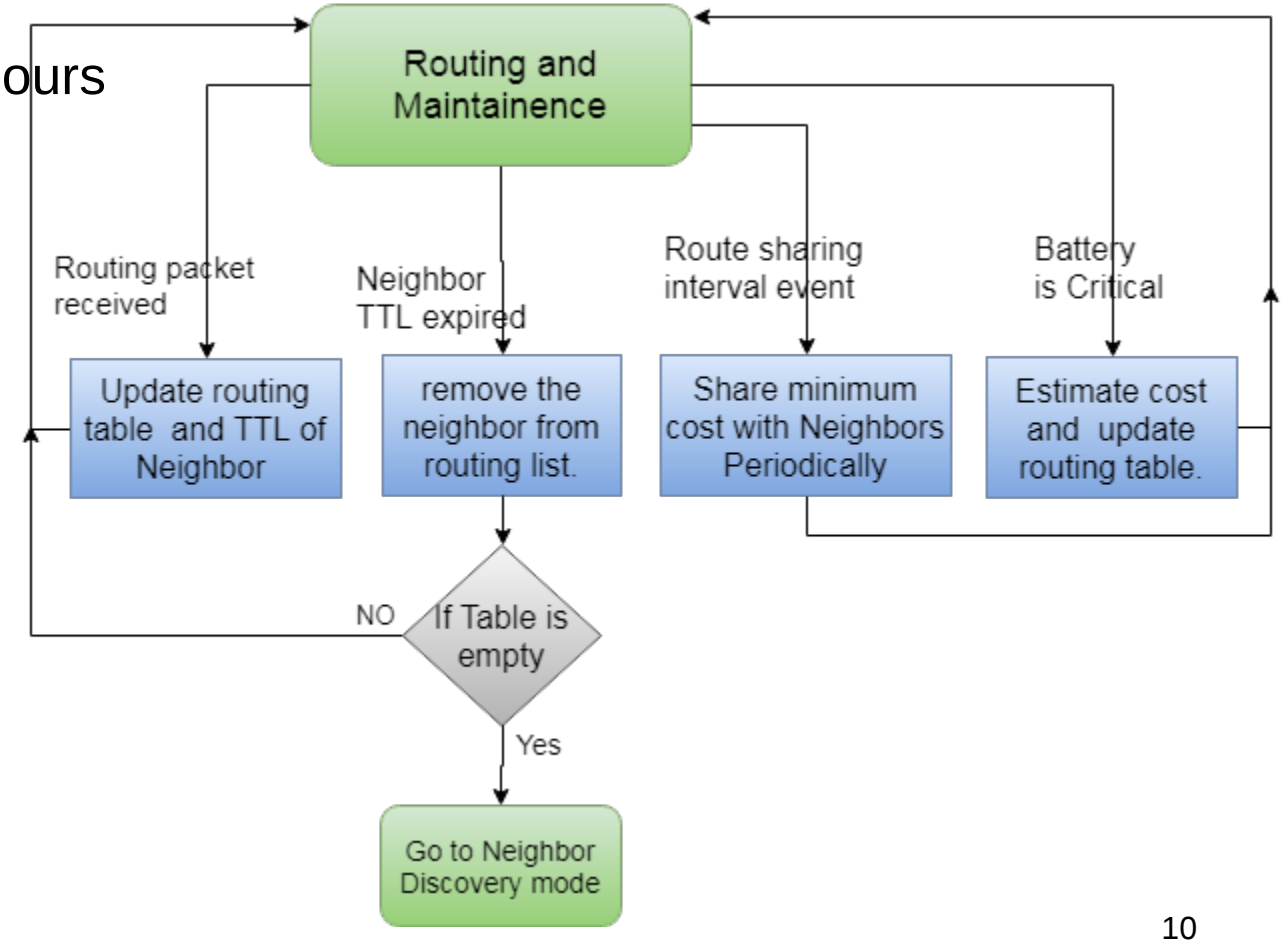
Neighbour discovery

- Discovering neighbours through broadcasting.
- Gateway informs its neighbours.
- Nodes unicast cost to gateway to neighbours.
- Nodes estimate efficient route to gateway.
- Network is maintained from the periodic updates of the neighbours.

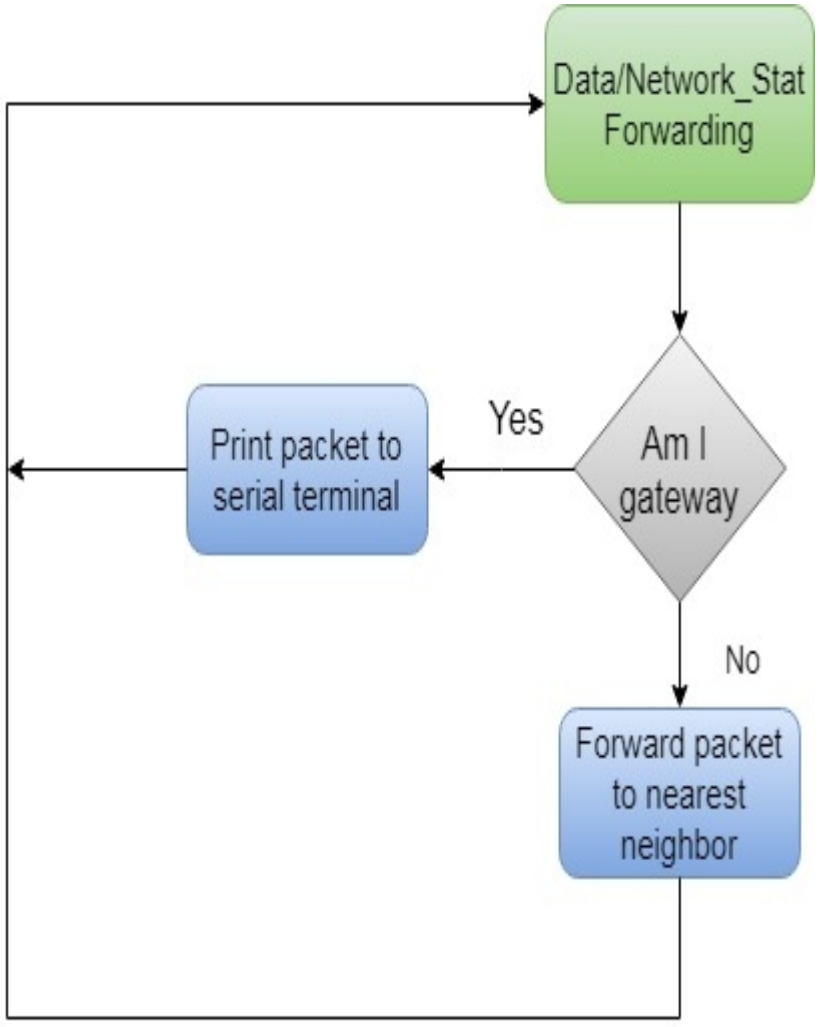


Topology construction and Maintenance

- Routing Table
  - Vector of Minimum distances to Gateway node(only).
- If neighbour TTL expired, remove neighbour from table.
- If battery level is low, inform cost to neighbours
- If Routing table is Empty, enter into Neighbour Discovery mode.



Application- Asset tracking



- Asset always Broadcasts
- Path to the Asset- So location.
- Dynamic Routing
  - Node failures.
  - Impact of battery life.
- Routing Table information of Node to Gateway(for demo purpose)

GUI and Targeted Demo

- All the nodes are positioned on the window. Address and Battery level of each node is displayed besides the node.
- *Routing Table* of the nodes in a message box.
- *Routing path* – Route *of asset packet from the nearest node to the Asset.*
- *Dynamic routing* - Change in path due to
  - Change in cost.
  - Change in asset location.
  - *Node failure* - Failure along the path.
- *Battery sensing* - Battery level of nodes
- *Actuation* - Sounder when asset goes out of the network.

Room for improvements

- Correlation between available Battery life and dynamic cost assignment.
- RSSI filtering to remove noise in RSSI signals to better estimate the location of the asset.
- Localization and Indoor positioning.

Questions?

References

[1] http://www.versustech.com/rtls-solutions/asset-tracking-healthcare-hospital/
[2] Asset Management - Manage and protect valuable mobile medical equipment with the ultimate location platform by Centrak
[3] J.-E. Garcia et all - A Novel DSR-based Energy-efficient Routing Algorithm for Mobile Ad-hoc Networks.

- Gradually increase the forwarding time in relation to the lifetime.
- In our network, gradually increase the HOP information relative to the lifetime.

Timeplan