Energy Saving Protocols for Multi Channel Multi Radio Wireless Mesh Networks

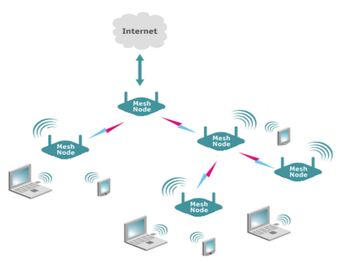
Samreen Umer
Supervisors: Cormac J. Sreenan Kenneth N. Brown

Insight
Centre for Data Analytics

Problem Statement

Designing energy saving protocols for multi radio multi channel wireless mesh networks while maintaining the network performance within desired bounds.

Figure: A Multi Radio Mesh Network



Background

Conventional energy saving methods for single radio networks are not straight forwardly implementable for multi radio scenarios and face many challanges:

- Complex Synchronization.
- Additional switching costs due to dynamic channel assignment.
- Inefficient resource utilization.

Contributions

We proposed distributed energy saving protocols for MRMC where each node can make a decision to switch radios into AWAKE or SLEEP mode based on desired delay thresholds for traffic. Delay threshold is a maximum time delay allowed for any flow to wait before its next transmission.

In first protocol Enhanced Energy Saving Mechanism (EESM)[1] we defined a fixed delay threshold for all the traffic flows. Nodes try to minimise number of radios in awake mode while maintaining the resulting delay within this threshold bound.

In Advanced Energy Saving Mechanism (AESM)[2] a dynamic threshold is estimated for each traffic flow based on its traffic type and route length. Radio resources are assigned to the flow while keeping minimum possible number of radios in awake mode without exceeding the desired delay threshold.

In our third proposed algorithm Energy Saving Routing (ESR), we implemented a cross layer energy saving protocol which assigns the routes to the flows based on their desired QoS while optimizing the energy consumption of the network. Delay sensitive traffic flows have higher priority for switching sleeping radios to wake mode and choosing shorter path lengths. Less delay sensitive flows can be routed over slightly longer but already active paths in order to avoid waking up additional radios. Simulations showed promising results when evaluated in terms of delays, packet loss and total energy consumption for different traffic types at the same time in the network.

Recent Results

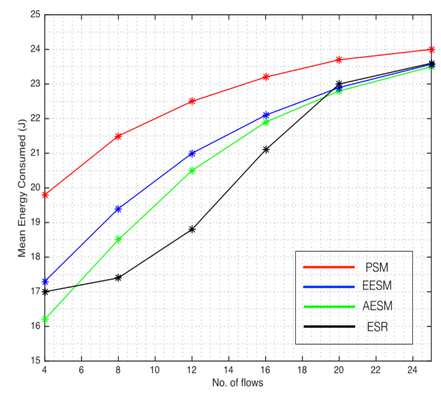


Figure: Energy Consumption Over Increasing Number of Flows

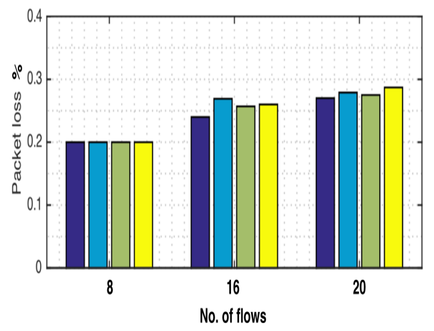


Figure: Mean Packet Loss.

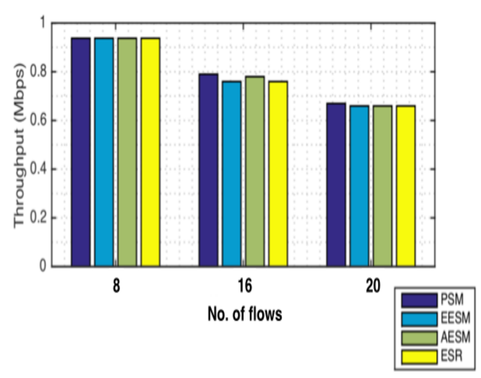
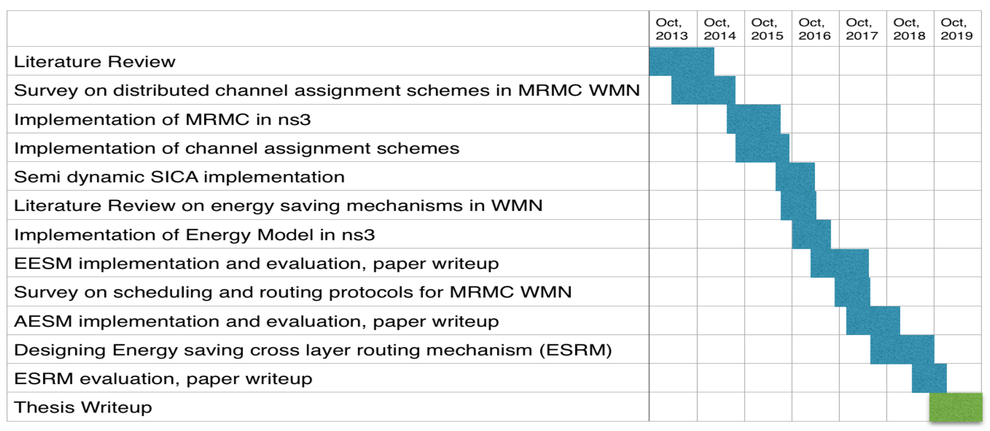


Figure: Mean Throughput.

Timeline

Figure: Thesis Timeline



References

[1]– S. Umer, K.N. Brown, and C.J. Sreenan. Enhanced Energy Saving Mechanism for multi-radio multi- channel wireless mesh networks. In Global Wire- less Summit (GWS), Aarhus, Denmark, November 2016. IEEE, 2016.

[2]– S. Umer, K.N. Brown, and C.J. Sreenan. Advanced Energy Saving Mechanism for multi-radio multi-channel wireless mesh networks. In International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), Bologna Italy, September 2018. IEEE,2018.

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