Behavior Simulation and Functional Verification of WSN Application

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Problem Space and Motivation

Problem Space

- Before implementation, **behavior simulation** and **functional verification** are essential for a sound design methodology.
- Lack of tool for behavior simulation, functional verification and performance analysis (time and energy) in WSN application domain.
- With TOSSim or OmNet needs lots of efforts!!

Motivation

- To build a framework (library) for behavior simulation, functional verification and performance analysis of WSN application.
- Using Mathworks Tools (Simulink and Stateflow).
- Reason for choosing Mathworks tool is that it has rich library for Simulation.
Methodology: Behavior Simulation and Functional Verification of WSN Application

WSN Application

Modeling using Simulink and Stateflow

Data Collection

Behavior Analysis and Validation

Need more refinement?

Yes

Extension of library by parameterized blocks of

- Radio
- Sensors
- Broad-casting Medium
- Device Drivers and ..

No

Refined Model
Data Aggregation

- Performing distributed, in network activity to reduce the overall amount of data flowing over multi-hop paths
  - Less traffic
  - Less energy consumption
  - Better network scalability

- Depending on network topology, aggregation can be useful or pointless
Clustered topology

All nodes are within radio range

Forwarding path

Controller

Sink
**Energy Efficient and Reliable In-Network Aggregation for clustered Wireless Sensor Networks (EERINA) : L. Necchi**

Diagram:

- **Initialization phase**
  - Fully randomized broadcasting (Data)

- **Contention phase**
  - Cluster Leader is elected or re-affirmed (Control)
  - Checks if any exit conditions is met.

- **Exchange phase**
  - Cluster-Leader driven broadcasting (Data)
  - Timed schedule looping

- **Termination?**
  - Yes: End
  - No: Schedule next aggregation

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Modeling using Simulink+ Stateflow
Initialization Phase  Modeling using Simulink+
Stateflow

Transmit_Packet/
entry:
nodeID=0;
sPacket;

Transmit_Node/
entry:
nextTx=nextTValue();

Receive_Mode/
entry:
plenet; ptlnode=1;

Received_Packet/
entry:
ptlnode nodeDPkt;

function z = nextTvalue()

[5z=0]

[5z=tValue]

[5timer++]

[5NextTx = NextRx & timer < threshold]

[5NextRx = NextRx & timer < threshold]

[5NextTx = 0 & NextRx = 0 & timer < threshold]

[5NextRx = 0 & NextRx = 0 & timer < threshold]

[5NextTx = 0 & timer < threshold]

[5NextRx = 0 & timer < threshold]

[5C1kCount = 0]

[5CikCount = 1]

[5CikCount = 1]

[5CikCount = 1]

[5CikCount = 1]

[5CikCount = 1]

[5CikCount = 1]
Questions!!!