A Harmony of Sensors
Achieving Determinism in Multi-Application Sensor Networks

Vikram Gupta, Nuno Pereira, Eduardo Tovar, Raj Rajkumar

Network Behavior with Multiple Applications

- Number of packets increase with number of applications
- Contention in the network increases because of more packets
- Energy consumption increases because of frequent radio switching
- Even multiple periodic applications can result in aperiodic packet behavior

Batching Transmissions at Each Node

- Align the processor usage (or packet transmissions) along periodic boundaries of a “Harmonizing Period” [1]
- Helps in saving energy by reducing the switching overhead
- Facilitates the implementation of a network protocol to support better duty-cycling

Harmonization in a Single-Broadcast Domain

- Once the transmissions from different applications are made periodic, nodes transmit in non-overlapping slots in a distributed manner
- The root transmits a beacon at t=0, and all the other nodes choose a slot equal to their id
- Just before the start of the next cycle, nodes transmit in their slot, and listen for any empty slots
- Then the nodes autonomously compress the schedule, so that the peers and the root only need to listen periodically

Multi-Hop NHS Protocol

- Divide the harmonizing period in equal time-slices
- Nodes at different hops use different slices
  At least 3 slices required to ensure 2 hop distance
- Children nodes transmit at 2/3 * Tp from the parent

Determinism and Energy-Efficiency

Average radio duty of all the nodes in a network of varying size with the increase in the harmonizing period

Percentage average packet drop for a network of fixed number of nodes with respect to the harmonizing period

References