Real-time Communication over Cluster-tree Wireless Sensor Networks

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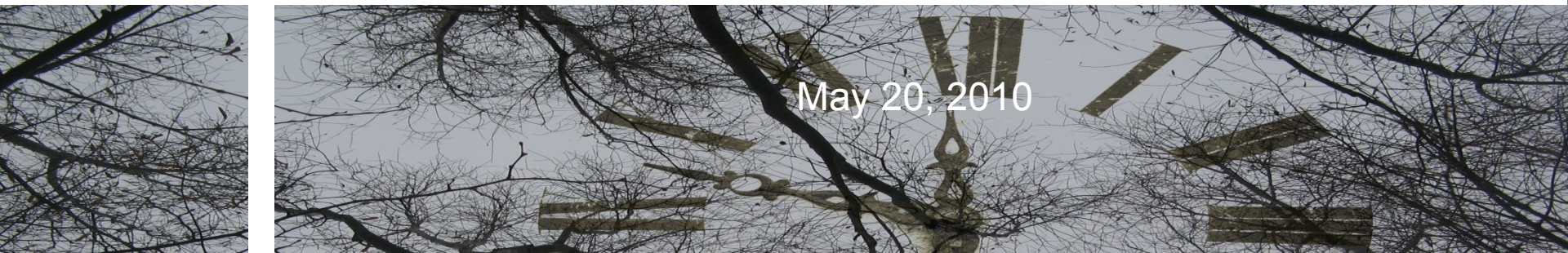
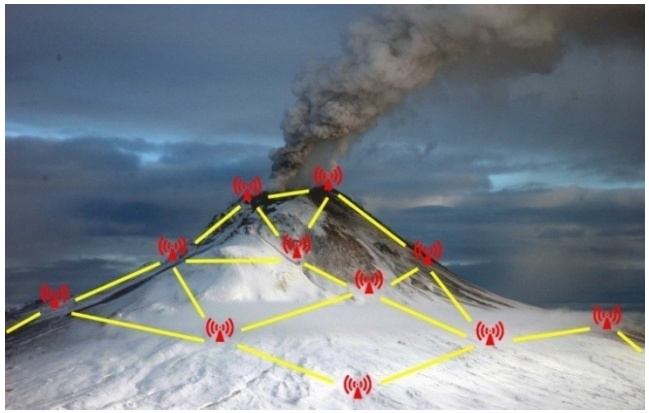


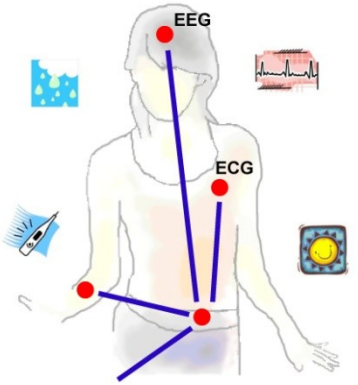
Wireless Sensor Network

A wireless sensor network (WSN) consists of distributed autonomous sensor nodes to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration.

potential application of WSNs:

- industrial automation
- object tracking and detection
- environmental monitoring
- body sensor networks





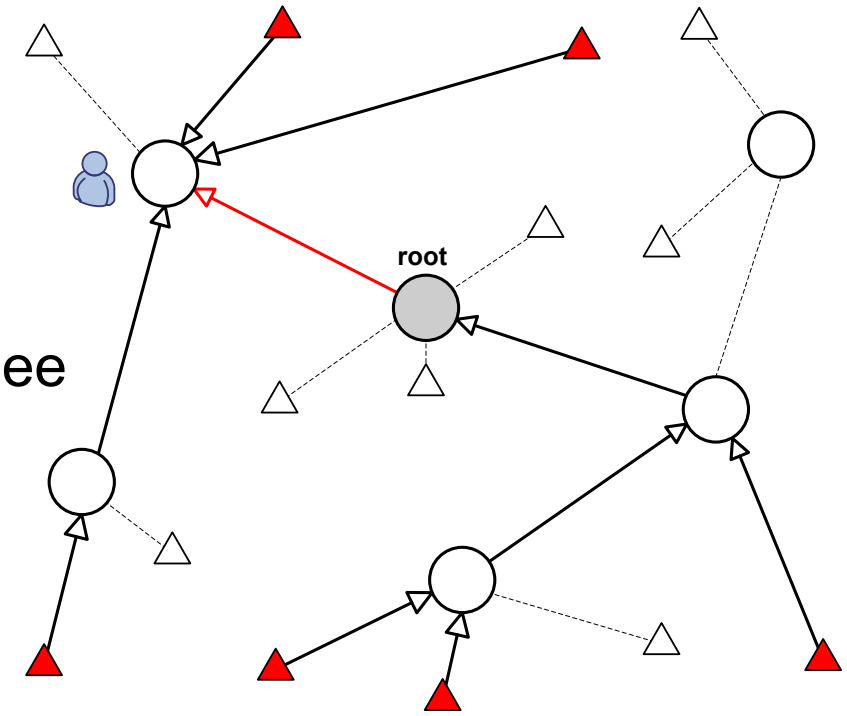
objectives:

- time-sensitive WSN applications
  - bounded e2e delay
- cluster-tree topology
  - contention-free MAC (GTS)
- IEEE 802.15.4/ZigBee

Dimensioning and Worst-case Analysis

worst-case dimensioning of network resources in a static or even dynamically changing cluster-tree WSN where a static or mobile sink gathers data from all sensor nodes

- Network Calculus based methodology for data flow analysis
  - buffer per depth
  - bandwidth per depth
  - end-to-end delay
- application to IEEE 802.15.4/ZigBee



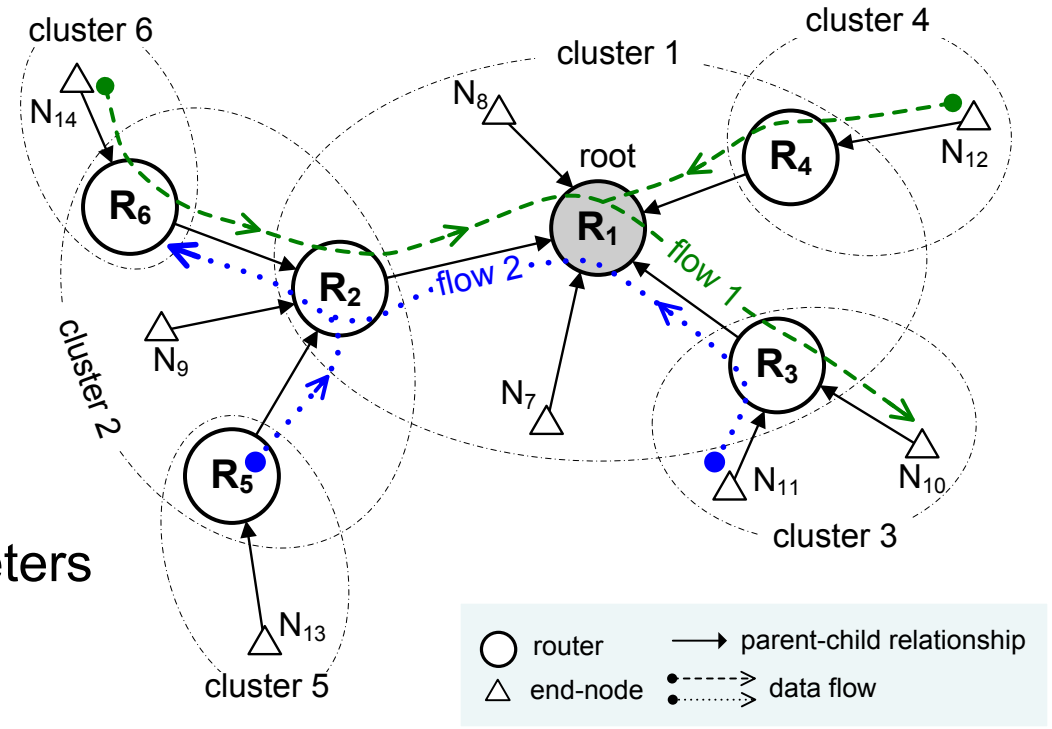
Time Division Cluster Scheduling (TDCS)

Energy efficient scheduling for cluster-tree WSNs with time-bounded flows

energy efficient clusters' scheduling in a static cluster-tree WSN with a predefined set of time-bounded data flows

- periodic time-bounded data flows
  - multi-source mono-sink
- bounded comm. errors
- collision domains

- periodic clusters' schedule
  - collision free
  - energy efficient
  - meeting data flows' parameters

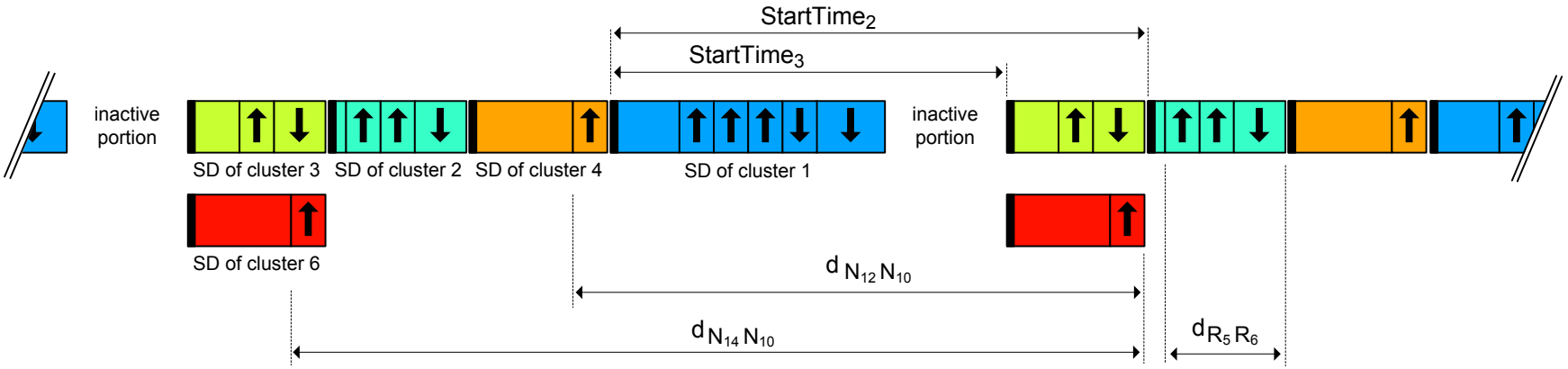


Time Division Cluster Scheduling (TDCS) II.

Energy efficient scheduling for cluster-tree WSNs with time-bounded flows

- TDCS period as long as possible → energy efficiency
- based on the cyclic extension of RCPS/TC (Resource Constrained Project Scheduling with Temporal Constraints)
- Integer Linear Programming (ILP)

- application to IEEE 802.15.4/ZigBee WSNs
- easy to use scheduling tool for network designers
  - middle-sized WSN (hundreds of nodes)



Simulation Model

IEEE 802.15.4/ZigBee OPNET simulation model

simulation model for IEEE 802.15.4 and ZigBee protocols focusing on the GTS mechanism and ZigBee hierarchical routing strategy

- Opnet Modeler simulator
- simulation model requirements
  - accuracy
  - open source
  - contention-free MAC (GTS)
  - cluster-tree topology
- http://www.open-zb.net
  - from 2007: >5000 downloads