Multicast in Wireless Sensor Networks

Gerald Wagenknecht
University of Berne
Agenda

> Motivation

> Overview over multicast

> Existing multicast approaches for wireless ad hoc networks and WSNs

> Ideas of a reliable multicast protocol for WSNs

> Discussion
Motivation

> Scenario: code update of 3 selected nodes
Multicast Overview (1)

> What means (IP-)Multicast?

> Main aspects:
  — Joining/Leaving a multicast group (IGMP)
  — Addressing (224.xxx.xxx.xxx)
  — Data forwarding (flooding, spanning tree, source-based tree, shared tree)
  — Building multicast trees (reverse path forwarding)
  — Routing protocols in transport layer
Multicast Overview (2)

> Multicast routing protocols:

- Distance Vector Multicast Routing (DVMRP)
- Protocol Independent Multicast (PIM)
  - Dense Mode (PIM-DM)
  - Sparse Mode (PIM-SM)
- Overlay Multicast
Multicast Overview (3)

> Characteristic of Multicast in WSNs
  - Source-based-trees
  - Joining/leaving?
    - Sender decides who receives the data
  - Broadcast medium
  - Multicast addresses
  - Multiple paths from source to sender (with different link quality)
  - Bandwidth, memory, energy (less control messages)
  - Node mobility?
Existing multicast approaches (1)

**MAODV**

- Multicast Ad hoc On-demand Distance Vector Routing Protocol (MAODV) [1]
  - Source-tree-based
  - Joining via RREQ/RREP
  - Forwarder nodes update the routing table
  - Activation of the tree via MACT
Existing multicast approaches (2)

VLM²


  – Adressing
    – 8bit ID for nodes and groups
  – Joining via SUBSCRIBE
  – Routing
    – Node-to-base unicast Routing
    – Base-to-node multicast routing
Existing multicast approaches (3)

**BAM**

  - S-BAM

![Diagram of BAM multicast](image-url)
Existing multicast approaches (4)

*BAM*

> BAM: Branch Aggregation Multicast for Wireless Sensor Networks [3]
  - M-BAM
Existing multicast approaches (5)

ADMR

  - Joining: sender-initiated and receiver-initiated
    - ROUTE_DISCOVERY / RECEIVER_JOIN (controlled flooding)
  - Building trees based on different metrics (hop-count, LQI)
  - Node mobility: route discovery every 15s
Existing multicast approaches (6)

**Geographic Routing**

- **GMP**: Geographic Multicast Routing Protocol [5]
  - Main focus on tree building
  - Each transmitting node builds Euclidian Steiner Trees
  - Used on each routing step

- **GMR**: Geographic Multicast Routing for WSNs [6]
  - Based on geographic unicast routing protocols
  - Uses a cost-based neighbor selection on each routing step

- Both approaches use local information, prevent broadcast or flooding to discover routes
Existing multicast approaches (7)

  - propose using of IP in WSNs
  - uses Contiki with uIP
  - but using of IPv6 is proposed???
  - MAODV over 802.15.4 implementation in NS2
Ideas (1)

> Multicast Overlay

- over TCP/IP (resp. TSS) at application level
- Source decides which node joins the group
- Tree building based on unicast routing tables
- Data forwarding via unicast connections between source, forwarders and receivers
- Multicast reliability based on unicast reliability
Ideas (2)

> „Real“ Multicast

- Design of a reliable multicast protocol affects MAC-, Internet-, and transport-layer
  - MAC protocol with multicast functionality
  - Using of IGMP for joining/leaving
  - Using of IP multicast addresses
  - Tree building (source-based-trees)

  based on unicast routing tables
Ideas (3)

- Building multicast trees / routing tables
  - Which nodes within a path should be a forwarder?
  - Energy-efficiency: one big hop vs. more small hops
  - affects also unicast routing tables
References (1)


References (2)


Discussion

> Questions and ideas are welcome …