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Distributed Event Detection and Object Tracking

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Application Scenario: Office Monitoring

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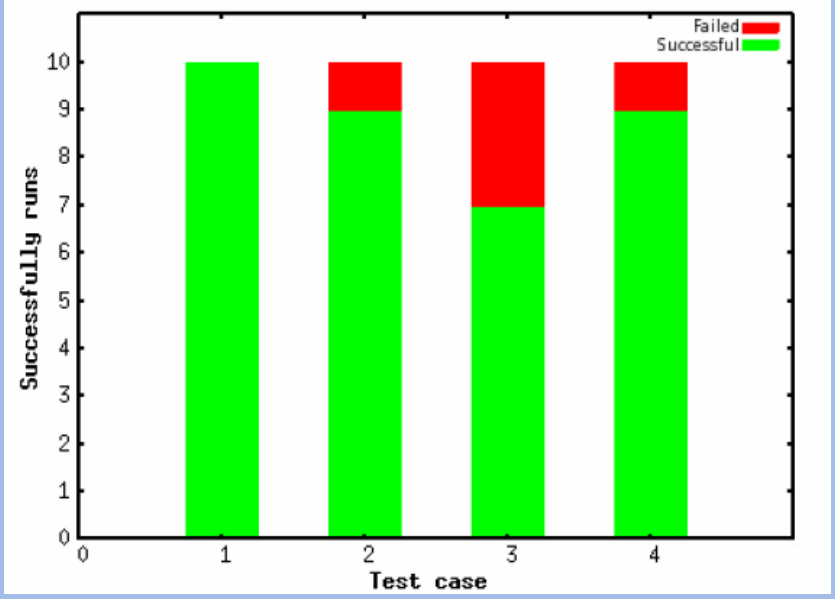
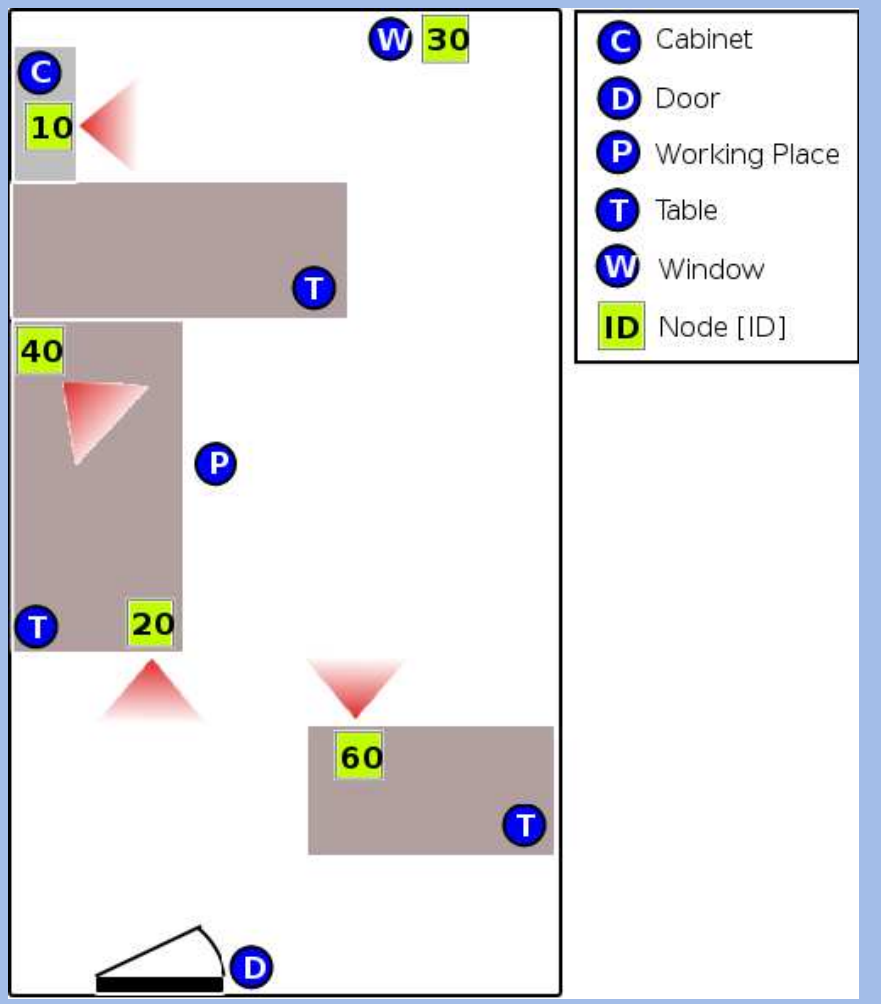
- Events
  1. Regular person working
  2. Burglar in the room
  3. Burglar during night
  4. Intrusion through window





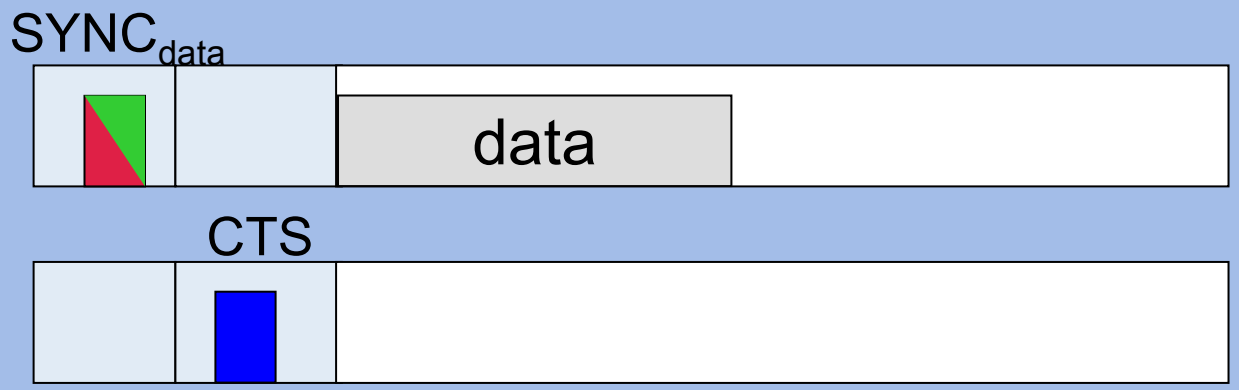
Implementation Issues

- Hardware platform: Embedded Sensor Boards (ESB)
- Used sensors
  - Passive infrared
  - Acoustic
  - Vibration
- Specification of fuzzy logic rules
- Additional components
  - Distributed event detection and object tracking framework: DELTA
  - Energy-efficient sensor MAC protocol
    - TEEM
    - LMAC

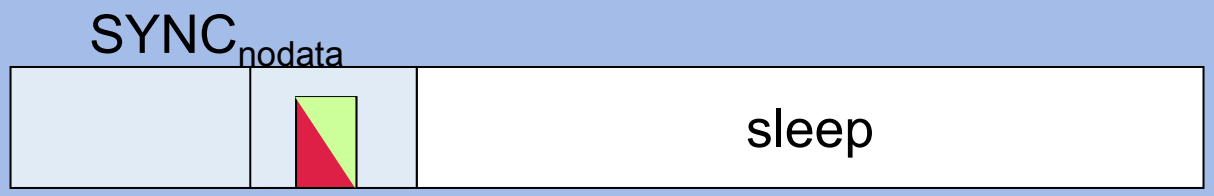
Traffic Aware Energy Efficient MAC

Optimization of S-MAC by combining SYNC and RTS, cases:

1. There is at least 1 sender.

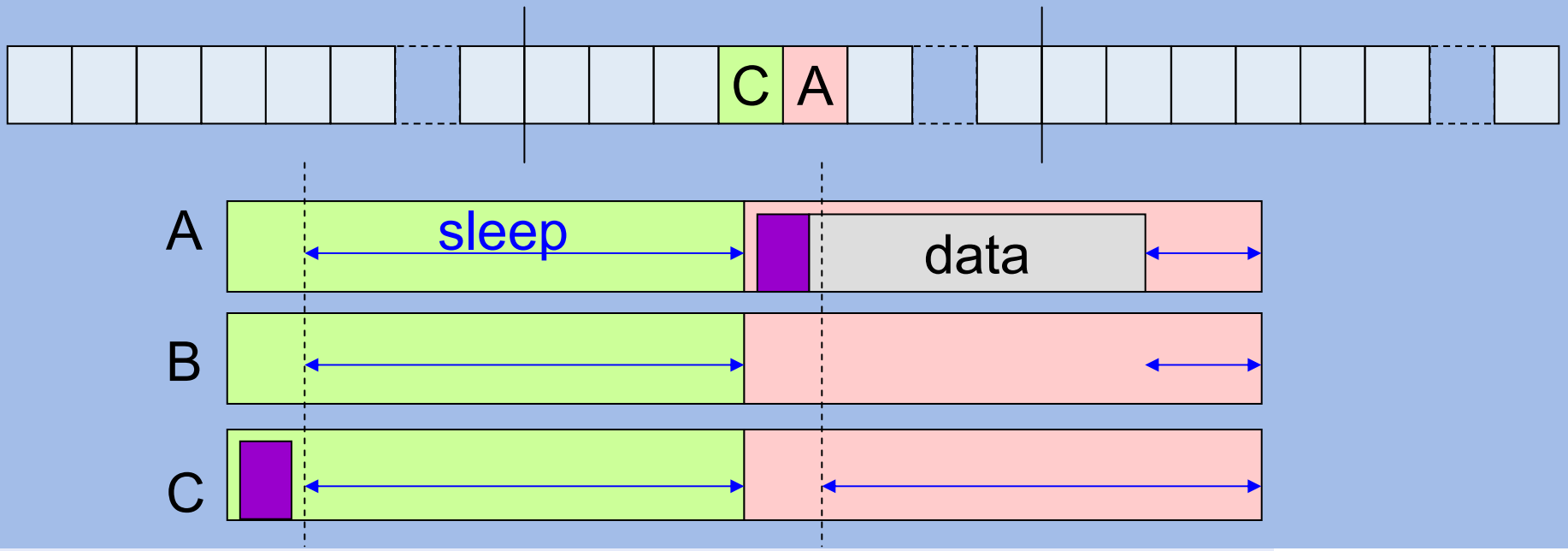


2. There is no sender.



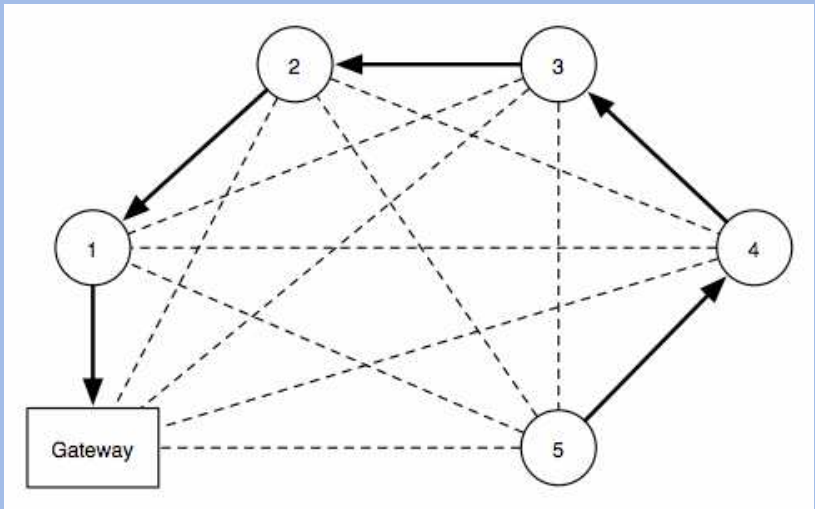
Lightweight MAC

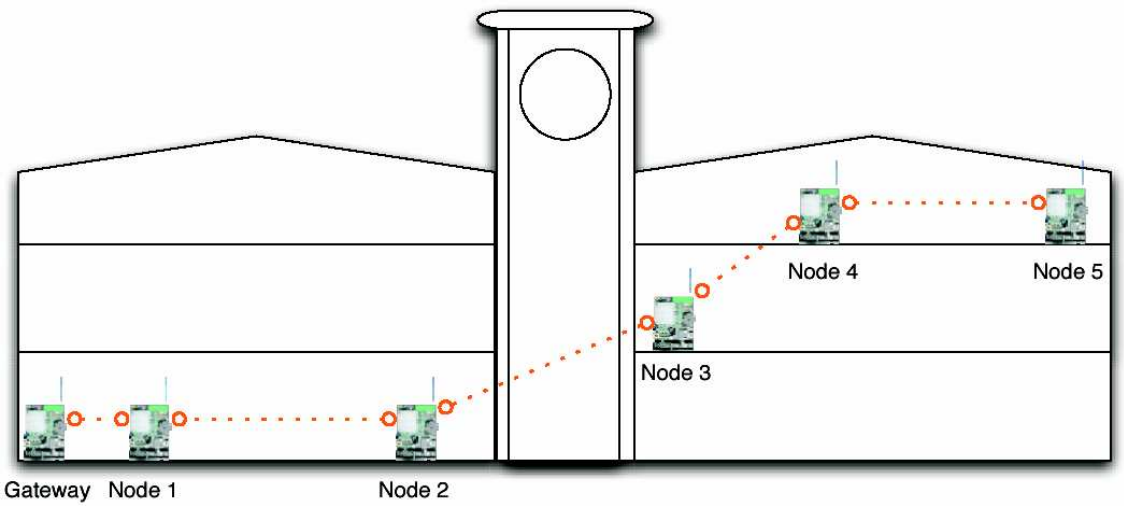
- TDMA: Assignment of time slots to nodes by distributed allocation algorithm.
- Control messages to maintain synchronization among nodes and to address the destination.



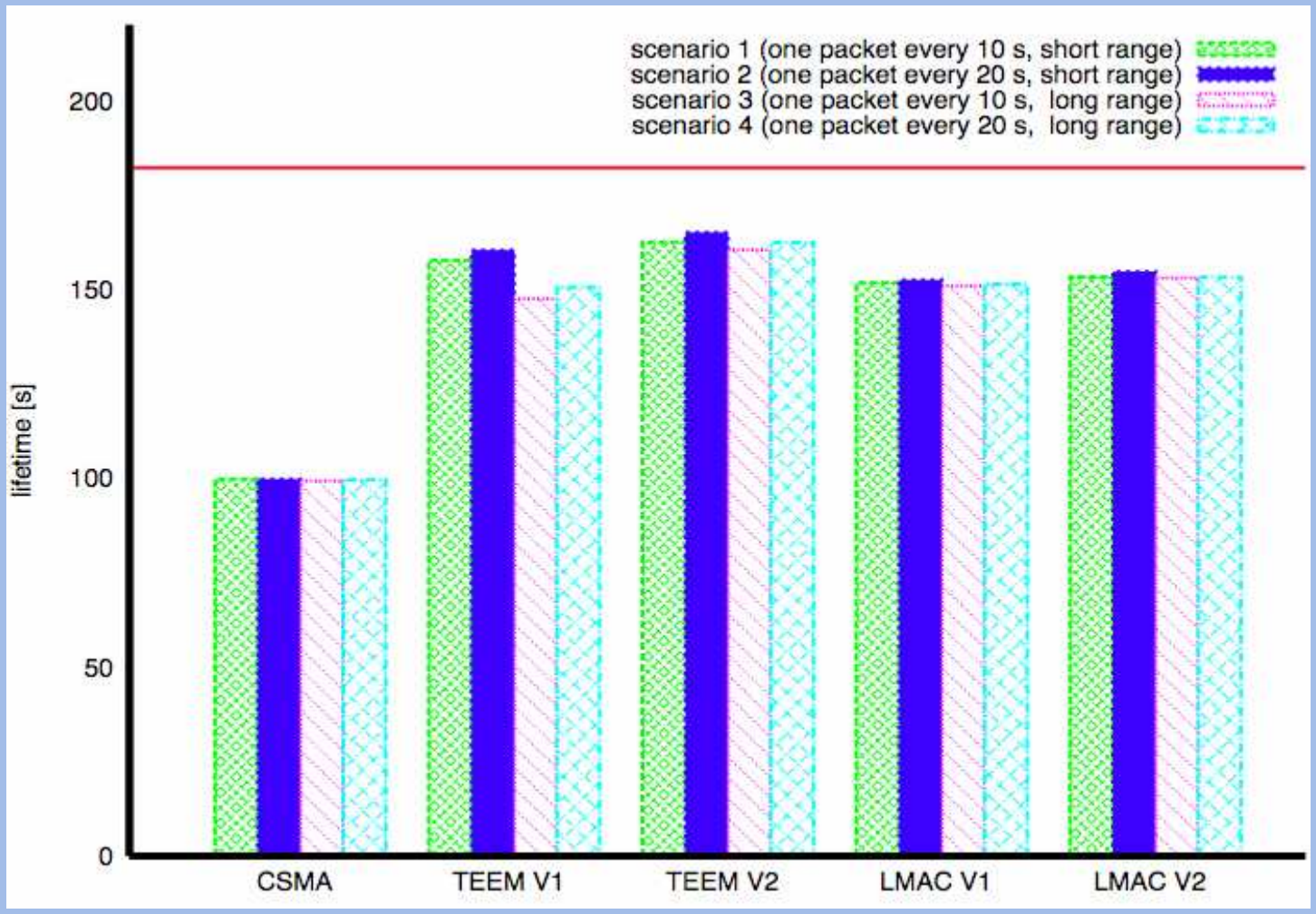
Measurement Scenarios

- Experimentation scenarios
  - Short range
  - Long range
- Node 1 is equipped with special capacitor.
- Packets every 10/20 s

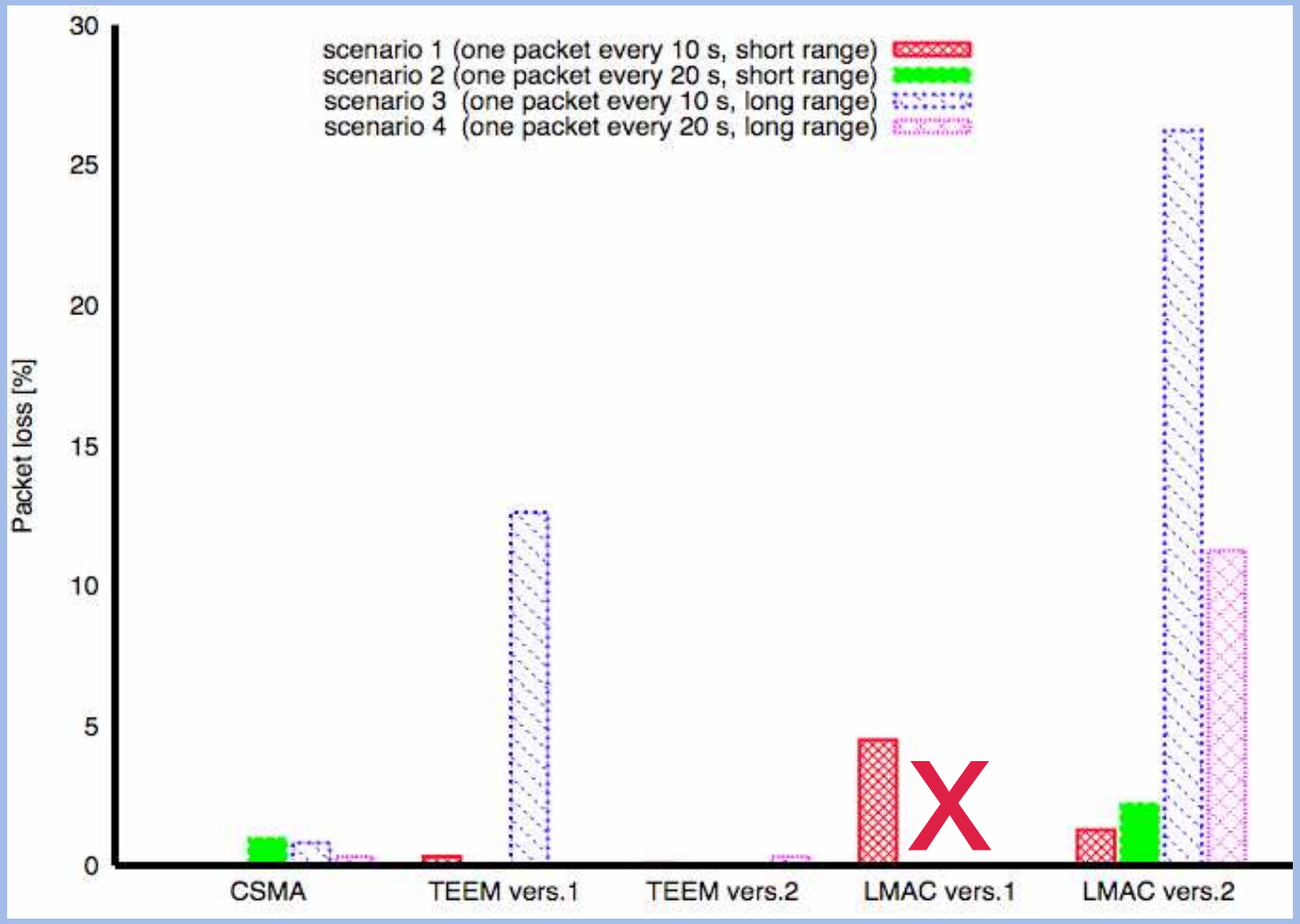




Network Lifetime



Packet Loss


scenario 1 (one packet every 10 s, short range)
scenario 2 (one packet every 20 s, short range)
scenario 3 (one packet every 10 s, long range)
scenario 4 (one packet every 20 s, long range)
Packet loss [%]
30
25
20
15
10
5
0
CSMA
TEEM vers.1
TEEM vers.2
LMAC vers.1
LMAC vers.2
X

Distributed Event Detection and Object Tracking

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- Implementation of a framework for distributed event detection and object tracking including
  - Topology control and routing support
  - Reconfiguration and code distribution
- Mechanisms
  - Distributed Event Localization and Object Tracking Algorithm
  - Receiver-based backbone support

Distributed Energy-level based Localization and Tracking Algorithm

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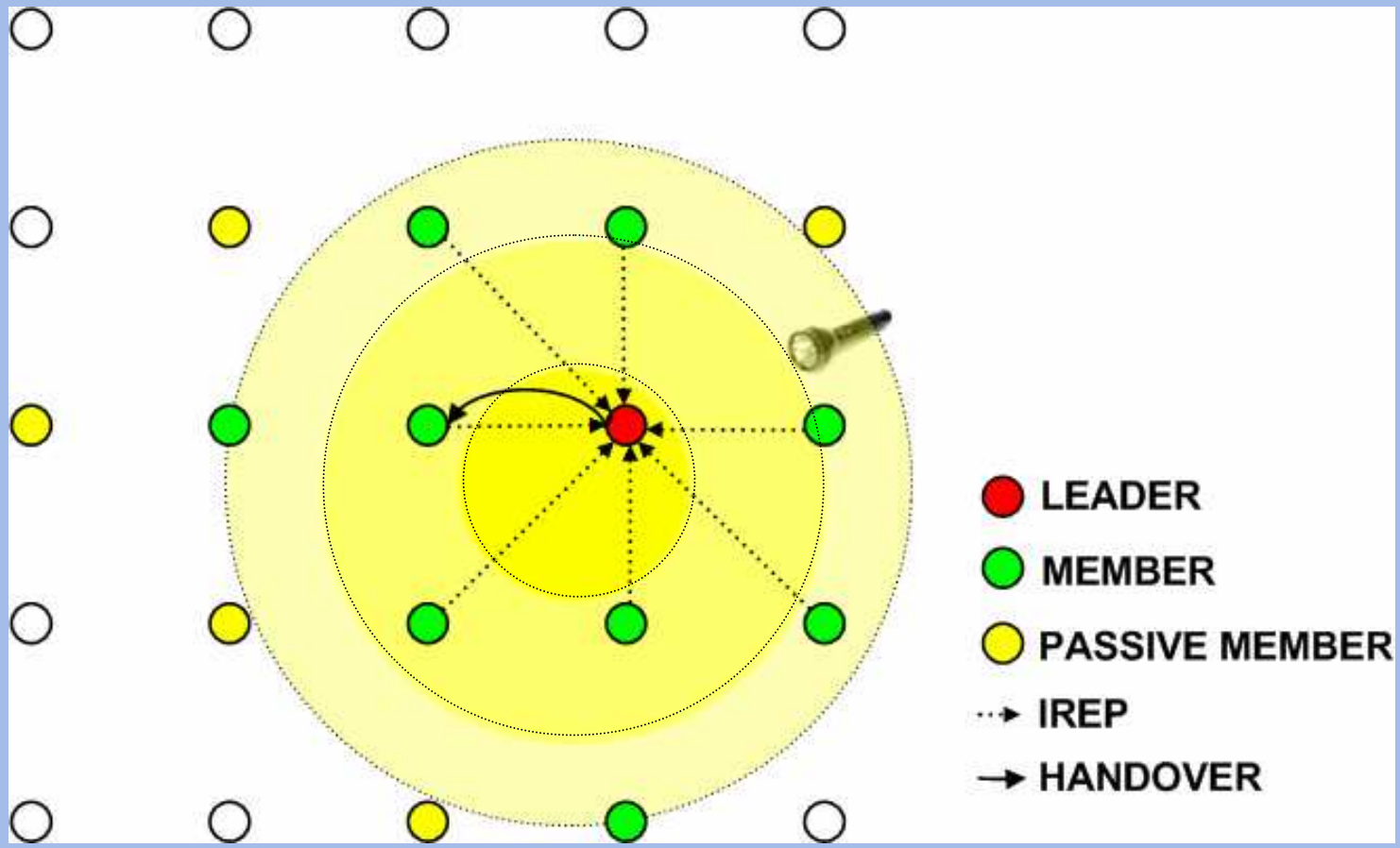
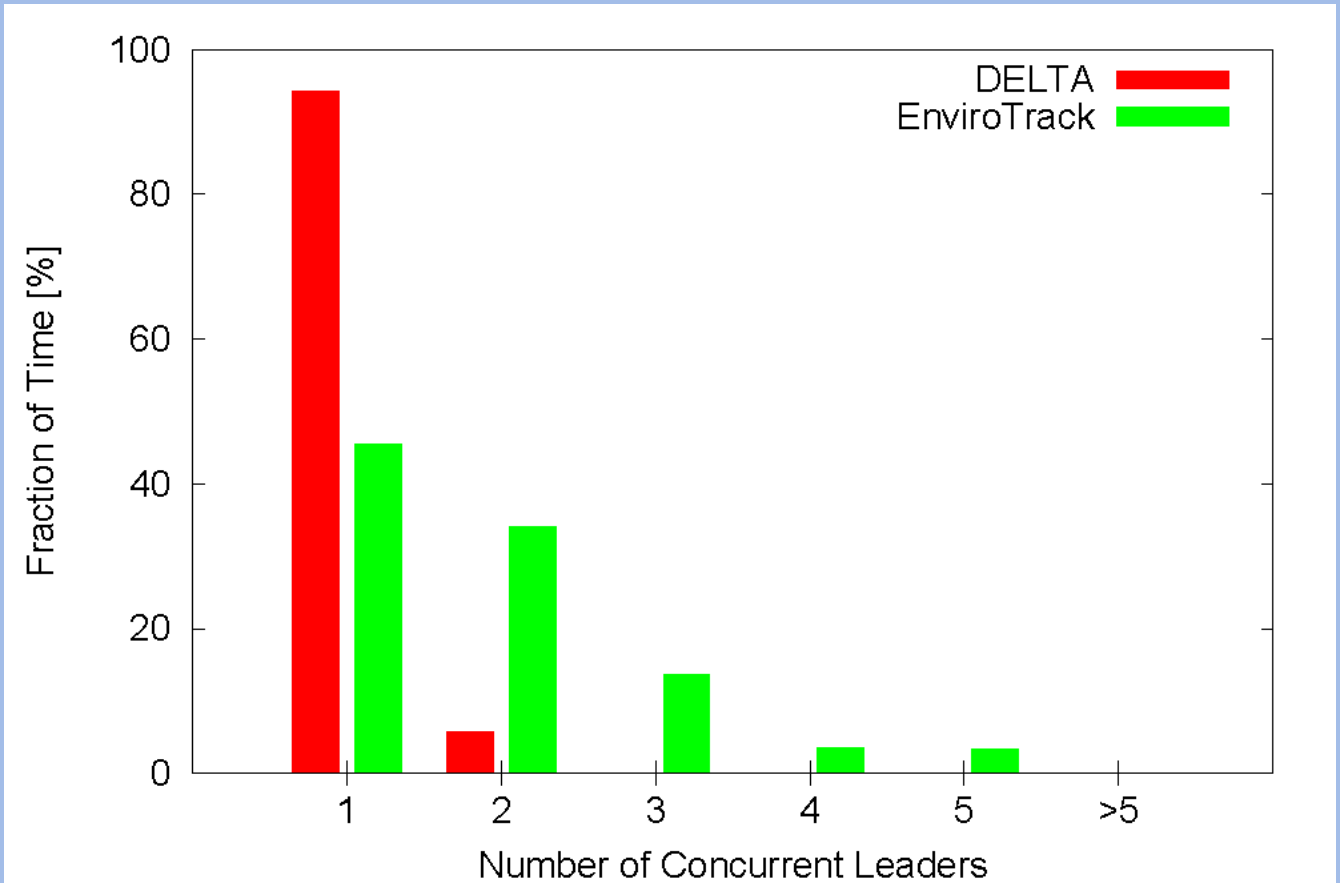
- Tracking groups with measurement based leader election



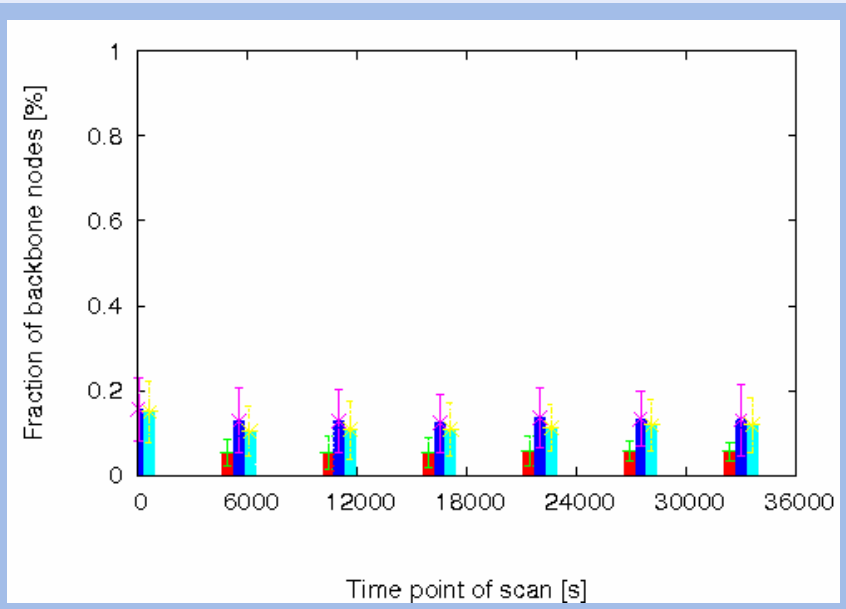
DELTA Implementation

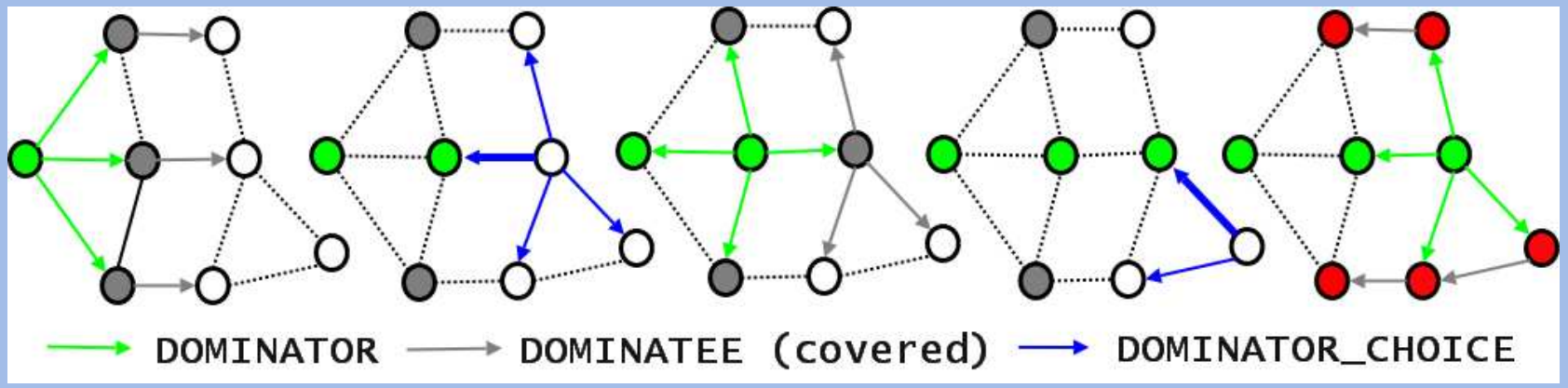
DELTA Performance

- Lower number of leaders results in less traffic



Receiver-based Backbone Support





Outlook

- Development of more advanced / improved / robust protocols and mechanisms (SNSF NCCR MICS, www.mics.ch)
- Integration of components (application, DELTA framework, MAC)
- Deployment and more tests
- Usage of advanced sensor hardware
- Artificial intelligence