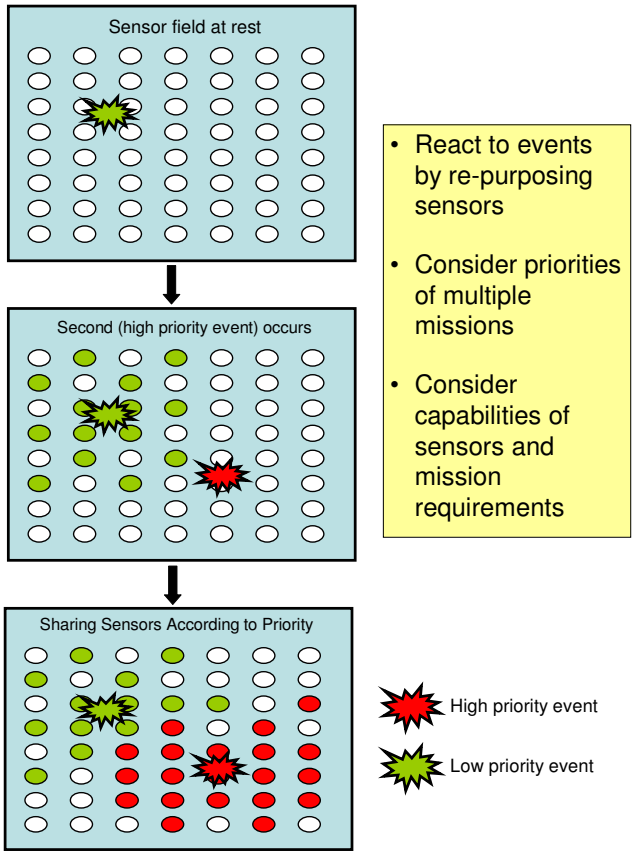
Dynamic Sensor Networks Reconfiguration for Multi-Mission Support

Hosam Rowaihy, Sharanya Eswaran and Thomas La Porta

The Problem

- **Static sensors deployed in a field**
- **Sensors have very limited resources**
  - most sensors are off
- **Events occur and are detected by active sensors:**
  - they might require additional coverage → more sensors need to be activated
  - different sensor types: video, acoustic, …
- **Main goal is design algorithms to re-purpose and turn on-off sensors around an event and support multiple missions**



- React to events by re-purposing sensors
- Consider priorities of multiple missions
- Consider capabilities of sensors and mission requirements

Solution Types

- **Deterministic**
  - better configuration and more comprehensive coverage
  - Slower convergence, requires high number of exchanged messages
- **Probabilistic**
  - **Fast convergence,** requires few exchanged messages
  - Coverage not guaranteed

Bidding Solution

- **Deterministic Solution**
- **Event is advertised as a price**
  Sensors that are willing to respond subtract their value from the price
- **Price reflects importance and/or the number of sensors we need to cover**
  Parameters reflect importance of event and required # of sensors
- **Sensor value represents capabilities, its quality of information and residual energy**
- **Detecting sensor propagate a bidding message to nearby nodes including the price**
- **Willing sensors respond with their values**
- **Detecting sensor chooses the best fit (not necessarily the highest value)**
- **Another message is propagated with new bidding price**
- **Sensors may need to adjust their values according to the newly added sensor**
- **This continues until the total value of added sensors is greater than the starting bidding price**

Evaluation Metrics

- **Ability to handle multiple missions**
  - Total number of mission completed
  - Total value of missions completed
- **Convergence time**
  - latency to meet needs of mission
- **Overhead**
  - Message complexity for reconfiguration
- **Accuracy**
  - How close to desired operating condition dictated by network management

Virtual Forces Solution

- **Probabilistic Solution**
- **Sensors around an event turn on according to a probability**
- **Define P(mode) for each sensor**
  - The closer to another sensor, the more likely to be off
  - The closer to the event, the more likely to be on
  - Parameter of probability function based on:
    - mission requirements and priorities
    - desired network operating point and
    - current capabilities of the sensors and residual energy

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