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A probabilistic approach for predictive congestion control in wireless sensor networks

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Key words: Congestion, Rate allocation, Congestion control, Packet loss, Back-off interval, Rate control

Congestion is a problem in WSN

- Congestion occurs when the offered load (incoming traffic) exceeds the available capacity of the node (buffer and outgoing traffic) and the link bandwidth is reduced due to fading channels.

- Reasons for congestion:
  - The extremely bursty, event-driven traffic produced by sensor networks results in congestion.
  - Channel quality and radio interference can change and reduce the amount of bandwidth available for data.
  - Whenever nodes are added to the sensor network, they introduce more interference and consequently congestion occurs.

- Goals of congestion control
  - Increase network efficiency
  - Avoid data loss

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Objective

The overall objective of this paper is to develop

(1) a congestion prediction method for detecting the level of congestion of a node, and

(2) a congestion control method for mitigating congestion in each node.

Congestion is mitigated by

- controlling the flow rates of all nodes including the source nodes to prevent buffer overflowing using the predicted value, and
- designing suitable back-off intervals for each node based on channel state and its current traffic

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- The level of congestion in each node is predicted using the buffer occupancy and adaptive threshold on the buffer capacity of that node; the adaptive threshold value helps the node trigger the congestion control algorithm when the total number of packets exceeds the threshold value. When the buffer occupancy exceeds the threshold value, the level of congestion increases; i.e., as the number of packets increases to more than the threshold value, the occurrence of congestion also increases.

- The congestion control techniques rate regulate (RRG) and split protocol (SP) alter the transmission rates of the nodes based on the predicted value given by the congestion prediction algorithm. These methods are combined with the back-off selection algorithm in order to avoid congestion based on both buffer and channel capacity.

The proposed method completely avoids packet drops and improves the throughput of each node.

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