Novel QoS Scheduling and Energy-saving MAC protocol for Body Sensor Networks Optimization

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BAN Requirements for medical

- **HIGH RELIABILITY & LOW LATENCY**
  - ❖ **Vital patient data** (ECG, SpO2, glucometer)
  - ❖ **Quality of Service** (guaranteed bandwidth)
- **LOW POWER CONSUMPTION**
  - ❖ **Power management** (avoid battery replacement)
- **SCALABILITY**
  - ❖ **Multi-Receiver Aggregation** (point-to-multipoint)
  - ❖ **Several Data Rates** (multi-data rate)

Problem Statement

IN SATURATION CONDITIONS:

- **IEEE 802.15.4 MAC is not throughput efficient enough**
- **IEEE 802.15.4 MAC is not energy efficient enough**
- **IEEE 802.15.4 MAC throughput decreases with the number of sensors**
- **IEEE 802.15.4 MAC energy consumption increases with the number of sensors**

IEEE 802.15.4 MAC DOES NOT SCALE TO WIRELESS AMBIENT AND BODY SENSOR NETWORKS

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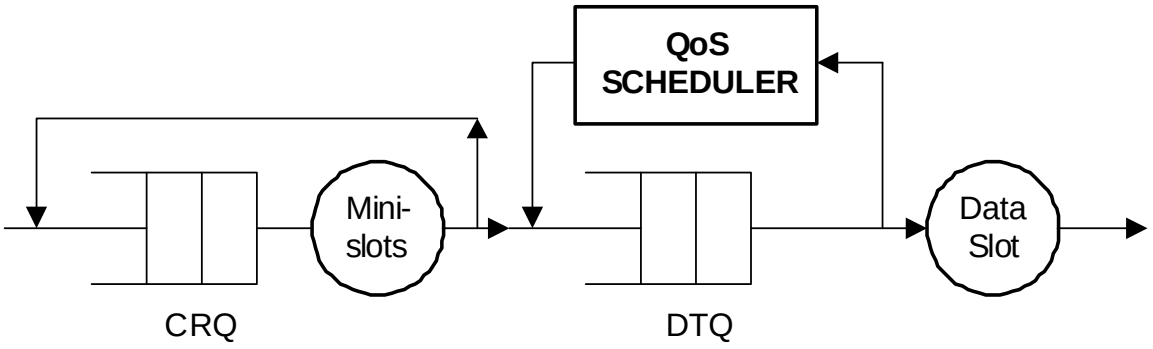
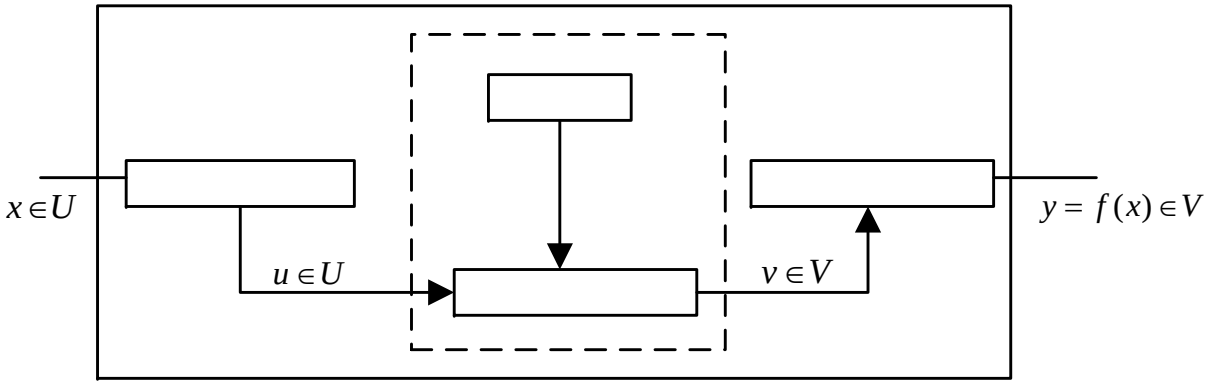
DQBAN System Characterization

- DQBAN analytical model approaches the delay and throughput performance of the theoretical optimum queuing systems M/M/1.
- The system could be represented with two queues prior to two servers:
  - **Collision Resolution Queue (CRQ),**
  - **Data Transmission Queue (DTQ).**
- **DQBAN system modeling uses a QoS fuzzy-ruled scheduler instead of keeping a First-Come-First-Served discipline.**

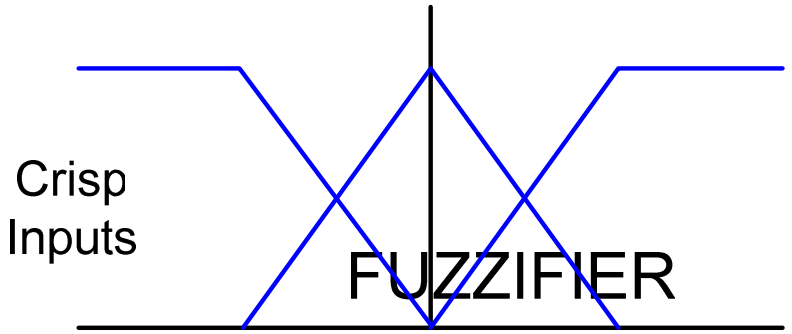


QoS Fuzzy-logic Scheduler



Fu

$$[SNR(i,t)] = SNR(i,t) - SNR_{min}(i)$$
$$[WT(i,t)] = WT(i,t) - WT_{max}(i)$$
$$[BL(i,t)] = BL(i,t) - BL_{min}(i)$$



Fuzzy input sets

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QoS Fuzzy-logic Scheduler

WT	SNR			BL
	dangerous	*poor*	*superior*	
acceptable	***delay***	***delay***	***onschedule***	*substantial*
acceptable	***delay***	***delay***	***onschedule***	*balanced*
acceptable	***delay***	***delay***	***delay***	*critical*
boundary	***delay***	***onschedule***	***onschedule***	*substantial*
boundary	***delay***	***onschedule***	***onschedule***	*balanced*
boundary	***forward***	***forward***	***forward***	*critical*
excessive	***forward***	***forward***	***forward***	*substantial*
excessive	***forward***	***forward***	***forward***	*balanced*
excessive	***forward***	***forward***	***forward***	*critical*

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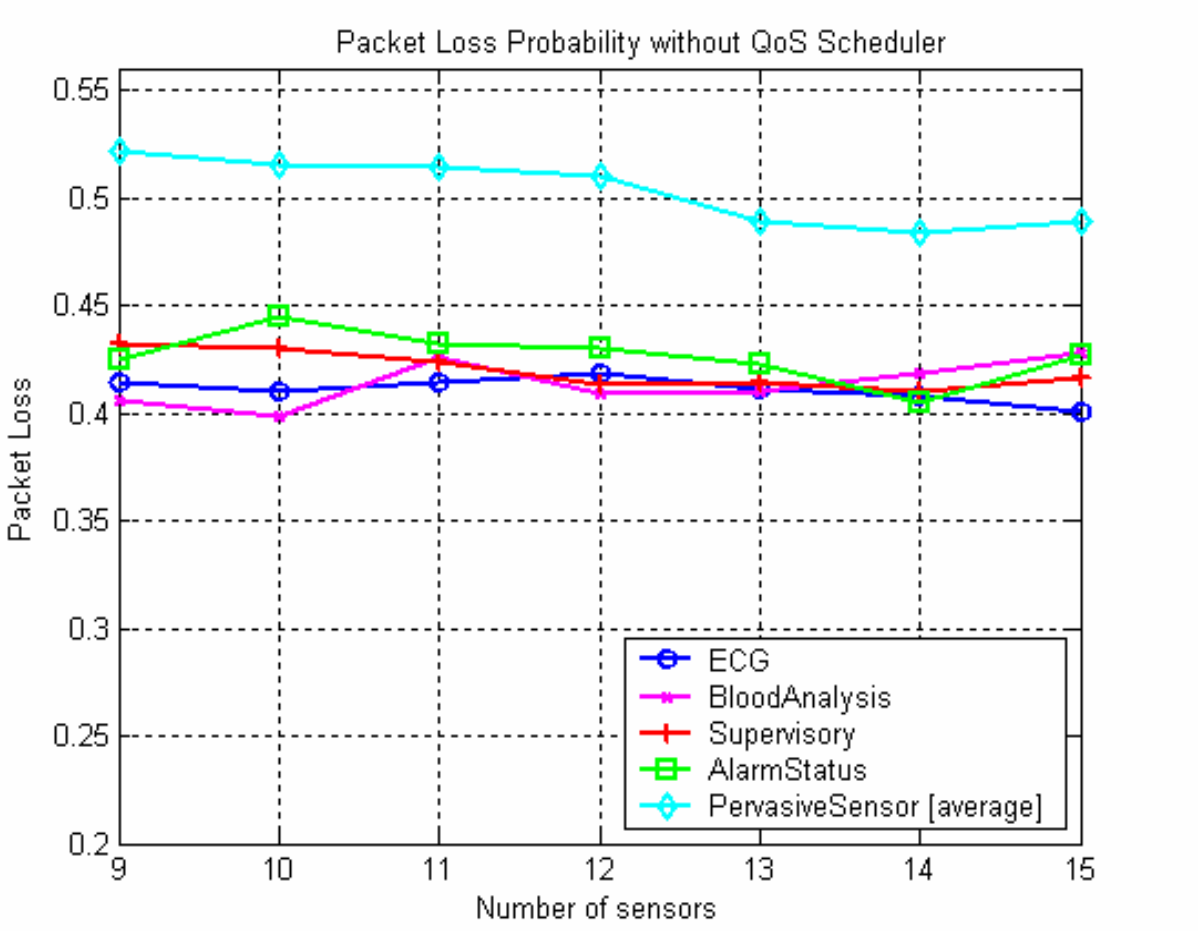
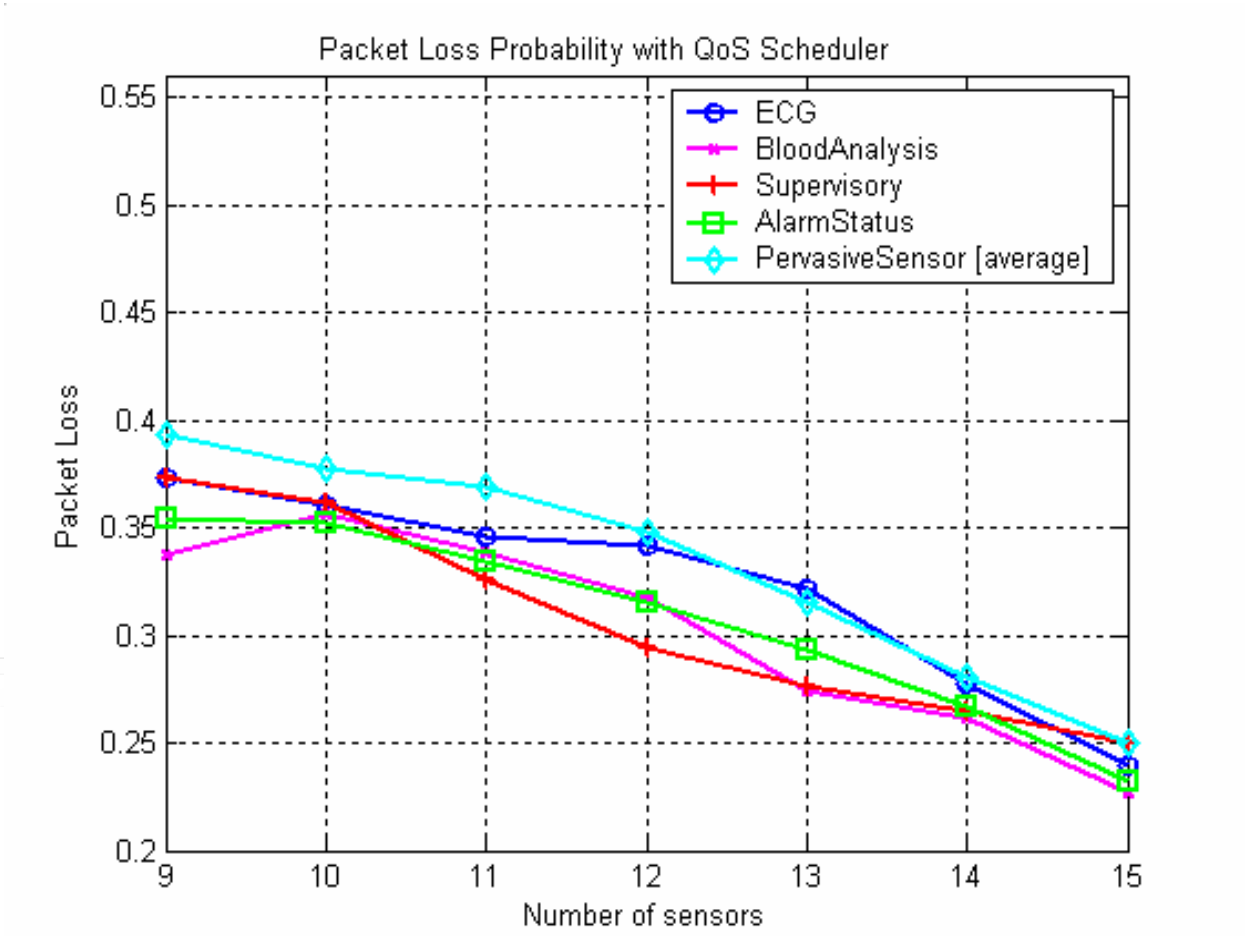
Performance Evaluation

Packet-loss probability without QoS Scheduler



Performance Evaluation

Packet-loss probability with QoS Scheduler



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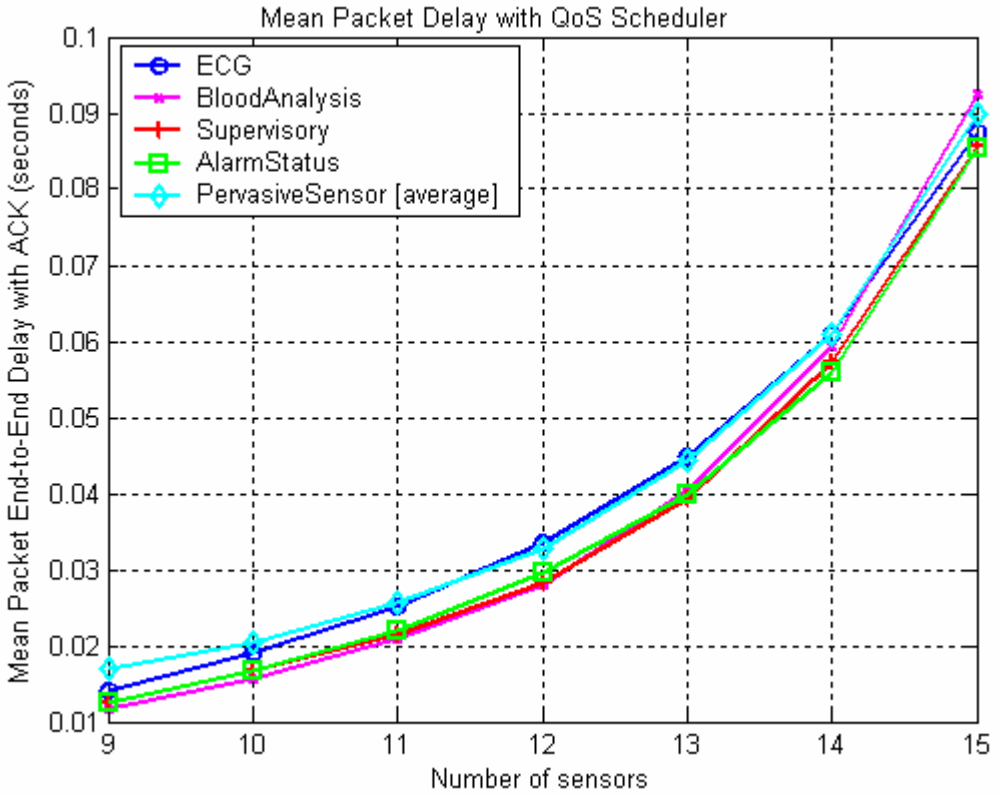
Performance Evaluation

Mean Packet Delay with QoS Scheduler



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Conclusion

- Introduction of a QoS scheduler based on fuzzy-logic rules.
- Body sensor **specific-BER** guarantee within particular **Latency limits** and without endangering **Battery lifetime.**
- Evaluation of the system performance **under certain medical scenarios.**
- **Results show that the QoS scheduler improves between 15% and 25% the overall system performance.**

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Thanks for your kind attention!