Overview of Congestion Control Mechanisms for WSNs

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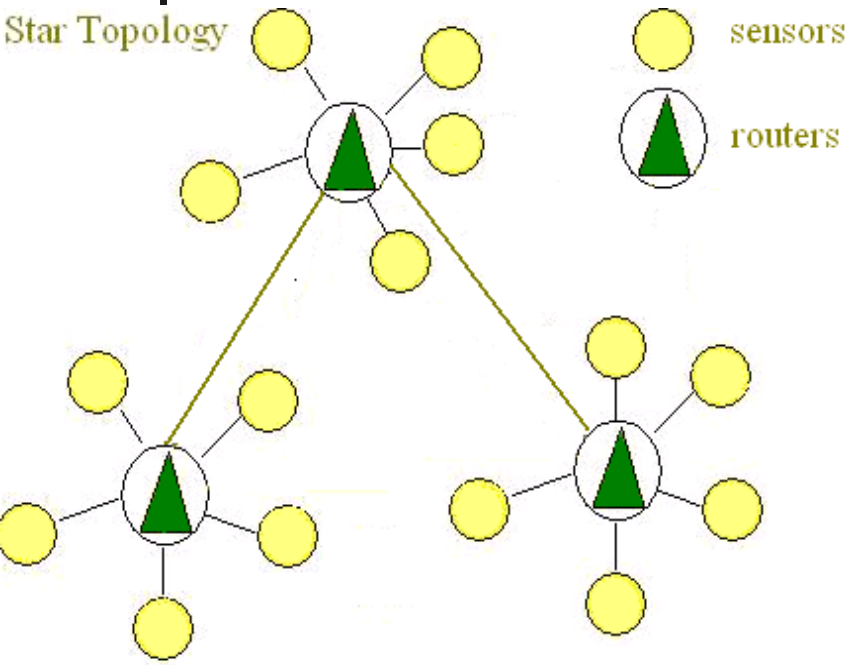
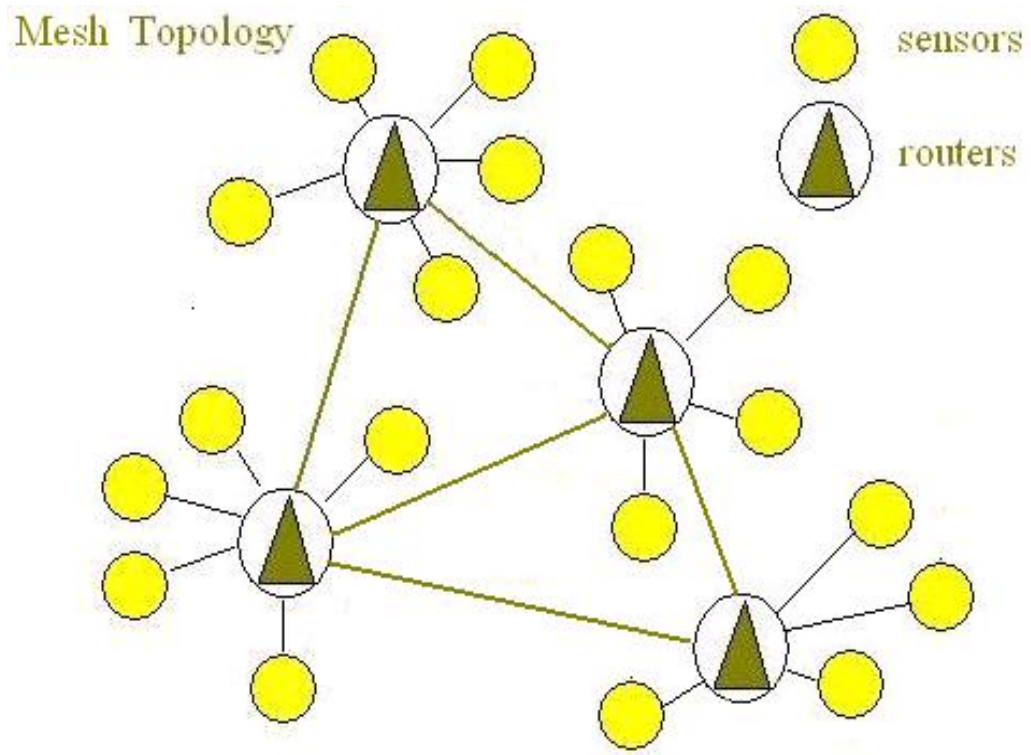
Congestion Control

- Congestion control (CC) mechanisms help to efficiently manage networks:
  - detect and avoid buffer overflow
  - improve network performance
  - detect and avoid radio collisions

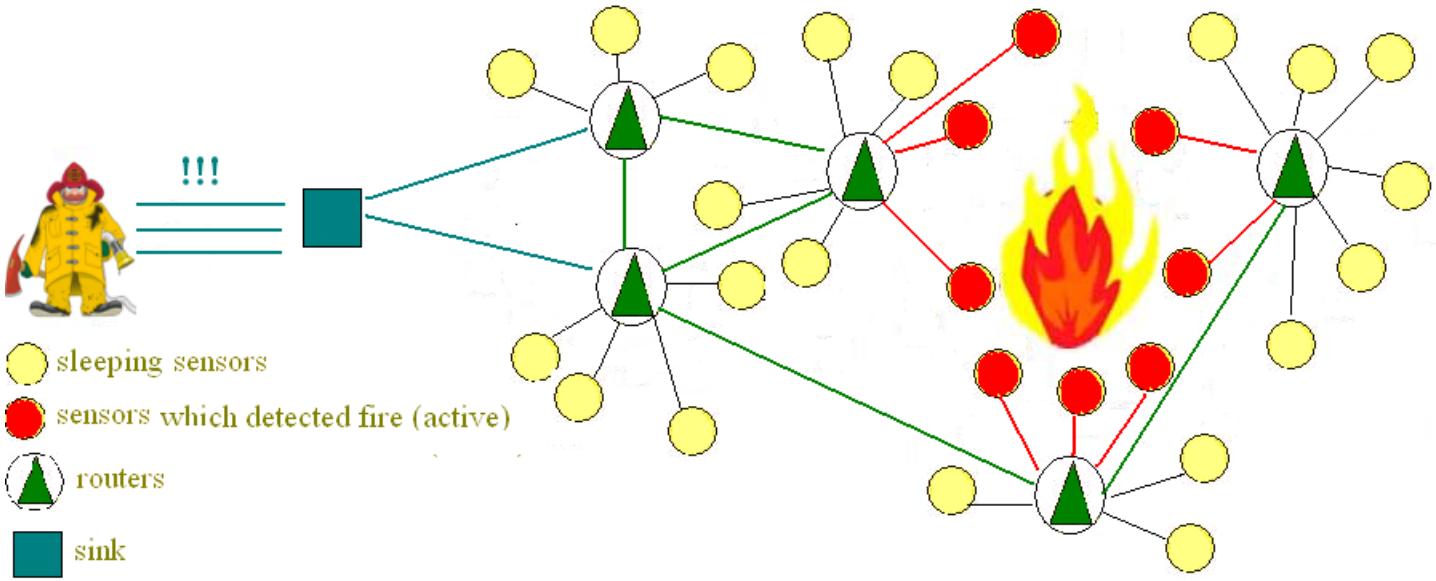
Wireless Sensor Networks

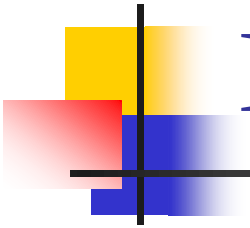




Areas of Application

- Civil area
- Healthcare
- Environmental monitoring
- Military applications





Environment

- Characteristics of WSNs links:
  - low bandwidth
  - multi-hop and single-hop architecture
  - distributed and localized
  - multicast and unicast behavior
  - dynamic and static nature of the network

Device Limitations

- Power consumption of devices
- Limited volume of RAM and ROM
- Sleeping cycles ~99.8% of the time
- Tiny processors – low computational power

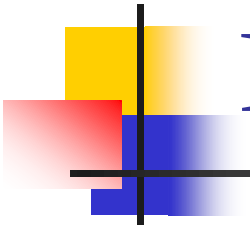
- Conclusion: traditional congestion control (CC) mechanisms (e.g., TCP CC scheme) are not applicable for WSNs

Congestion Control in WSNs

- Main problems to be addressed:
  - energy consumption
  - redundant retransmissions
- Reasons:
  - same packets are transmitted by multiple nodes
  - buffer overflow
  - many to one nature

Examples of Existing Methods

- **CSMA/CA** (Carrier Sense Multiple Access With Collision Avoidance)
- **CSMA/CD** (Carrier Sense Multiple Access with Collision Detection)
- **TDMA** (Time Division Multiple Access)
- **RDC** (Radio Duty Cycling)
- **ECN** (Explicit Congestion Notification)



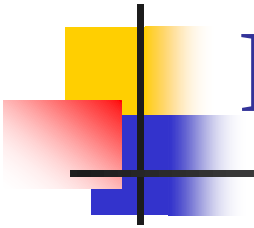
Radio Duty Cycling

- WSN nodes are battery operated
- Dissemination of nodes depends on the WSN use case and varies a lot from case to case
- With RDC schemes, nodes turn off transceiver for long period of time → helps avoiding idle listening of the radio channel → makes WSN nodes lifecycle longer

Explicit Congestion Notification

indentation in octets		0								1								2								3							
	indentation in bits	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Version				Traffic Class								Flow Label																			
4	32	Payload Length																Next Header								Hop Limit							
8	64	Source Address																															
C	96																																
10	128																																
14	160																																
18	192	Destination Address																															
1C	224																																
20	256																																
24	288																																

- **Traffic Class**:
  - six higher bits are used DSCP for packet classification
  - two lower bits are used by ECN for congestion control

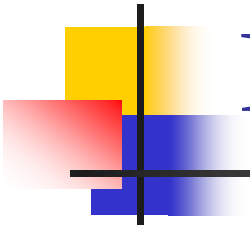


Retransmissions

- Re-transmission Timers and Counters:

  constant or variable?

  - If constant - what value satisfies
  - If variable - what characteristics influence the calculation rule



Politeness

- Broadcast transmissions are much more expensive than unicast
- Broadcast information sometimes is overkilling
- Delivering information to those nodes, which are interested in it

Conclusion

- This study is still in quite early phase and primary focused on theoretical research of the field
- Different methods and techniques have being studied and propositions and results of various research works have being analyzed
- As one of the project deliverables the model of the modified CC scheme will be designed and tested
- Our goal is to propose CC that is efficient enough to be reliable and scalable technique for WSNs