PATTERN-MAC(PMAC)

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for **WIRELESS SENSOR NETWORKS**

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LMAC (TDMA) ----- **PMAC** ---- **SMAC (ASWC)**

Issues with SMAC

- decreased throughput in high loads
- unwanted energy use in low loads (same for TDMA)

Main issues which PMAC addresses
1)Latency 2)Throughput 3)Energy efficiency

Energy efficiency
802.11 – low
SMAC - medium
PMAC- high

How PMAC works

ONLY nodes involved in current communication wake up!

- Pattern → Schedule
- Pattern generation
- Pattern exchange
- Schedule generation

What is a Pattern?

- Stream of 0's and 1's
- 0 – sleep ; 1-active
- Tentative- subject to change
- Generated for every individual node

Use-

- Mainly used to convey activity to neighbours
- Based on patterns schedules for the network is created

Pattern (2)

How is 0's and 1's determined?
0- if node has nothing to send (sleep)
1- if node has data to send (active)

Usually patterns are generated for N slots!

- If <N pattern repeats
- At the end of N pattern adjusted w.r.t traffic

*slots- sort of intervals

Schedule generation

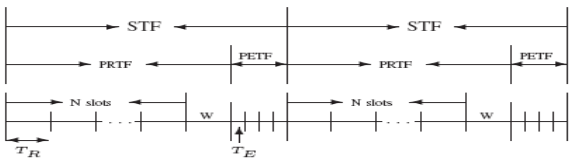
Pattern bit at node j	Packet to send	Pattern bit at the receiving node	Schedule at node j
1	1	1	1
1	1	0	1–
1	0	*	1–
0	1	1	1
0	1	0	0
0	0	*	0

RULES TO SET THE SCHEDULE BIT FOR A SLOT IN PRTF FOR NODE j

Pattern generation scheme

- Plan of the pattern → 0^m1
- m- parameter to indicate traffic
- Value of m increases by a double for idle traffic
- Follows same trend till threshold value-δ
- After threshold m increases linearly
- Very similar to TCP

Pattern exchange



Division of Time Frames

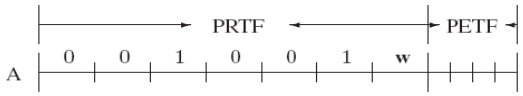
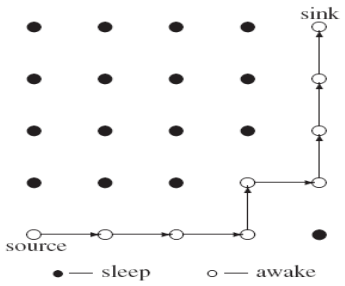


Illustration of Pattern Exchange

Comments

- **Better performance at both low n high loads**
- **Localization – only nodes involved wake up**



SMAC vs PMAC

$$E_{save}^{total} = S * \frac{E(0) * T_R * d * P_{idle}}{T}$$

E (total save)- Total energy saved in the full network
E(0)- Average no of 0's
T_R - Slot time in PMAC
d – duty cycle
P_{idle} - power consumed in idle listening
T- frame duration in SMAC
S- no of nodes

Efficiency

$$\text{power efficiency} = \frac{\text{total throughput}}{\text{total energy consumption}}$$

Higher energy efficiency → low energy consumed → higher power efficiency

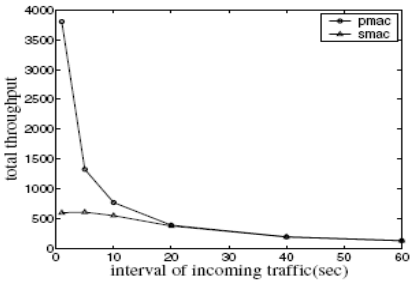
Measurement setup

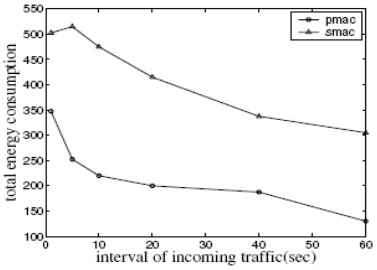
- Mesh network
- CBR traffic source
- UDP
- NS2

Parameter	Value
initial energy	100 Joules
transmission power	0.5 Watts
receiving power	0.3 Watts
idle power	0.05 Watts
bandwidth	20 kbps
data cwnd	63 ms

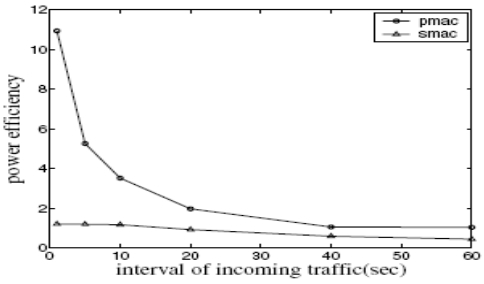
PARAMETERS USED IN THE SIMULATIONS

Simulation results-(1)





Simulation results-(2)



PMAC WINS!!


Thank You!