TSEP: Threshold-sensitive Stable Election Protocol for WSNs

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Outline

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Motivation

- LEACH being homogeneous clustering based protocol performs well than DT and MTE.

- SEP, a two level heterogeneous protocol performs better than LEACH.

- ESEP with three levels of heterogeneity is better than SEP and LEACH.

- TEEN being threshold based protocol performs well than LEACH, SEP and ESEP in this way or the other.

  So, the main purpose was to make a new protocol which would be using the best aspects of all of these protocols.

TSEP [1/4]

This protocol has two parts:

- It is reactive routing protocol:
  - Transmission consumes more energy than sensing.
  - Done only when a specific threshold is reached.
- Three levels of heterogeneity .
  1. Normal Nodes
  2. Intermediate Nodes
  3. Advance Nodes

TSEP [2/4]

Energy for Normal nodes = E_o

Energy for Intermediate nodes = $E_{INT} = E_o(1 + \mu)$,

Energy for Advance nodes = $E_{ADV} = E_o(1 + \alpha)$

The optimal probability of nodes:

$$p_{nrm} = \frac{p_{opt}}{1 + m.\alpha + b.\mu} \quad (1)$$

$$p_{int} = \frac{p_{opt}.(1 + \mu)}{1 + m.\alpha + b.\mu} \quad (2)$$

$$p_{adv} = \frac{p_{opt}.(1 + \alpha)}{1 + m.\alpha + b.\mu} \quad (3)$$

TSEP [3/4]

For calculation of threshold depending on their probabilities:

$$T_{nrm} = \begin{cases} \frac{p_{nrm}}{1-p_{nrm}[r.mod\frac{1}{p_{nrm}}]} & \text{if } n_{nrm}\epsilon G' \\ 0 & \text{otherwise} \end{cases} \quad (4)$$

$$T_{int} = \begin{cases} \frac{p_{int}}{1-p_{int}[r.mod\frac{1}{p_{int}}]} & \text{if } n_{int}\epsilon G'' \\ 0 & \text{otherwise} \end{cases} \quad (5)$$

$$T_{adv} = \begin{cases} \frac{p_{adj}}{1-p_{adv}[r.mod\frac{1}{p_{adv}}]} & \text{if } n_{adv}\epsilon G''' \\ 0 & \text{otherwise} \end{cases} \quad (6)$$

TSEP [4/4]

In case of TSEP, at cluster change time, the CH broadcasts the following parameters

- **Report Time (TR)**
- **Attributes(A)**
- **Hard Threshold (HT)**
- **Soft Threshold (ST)**

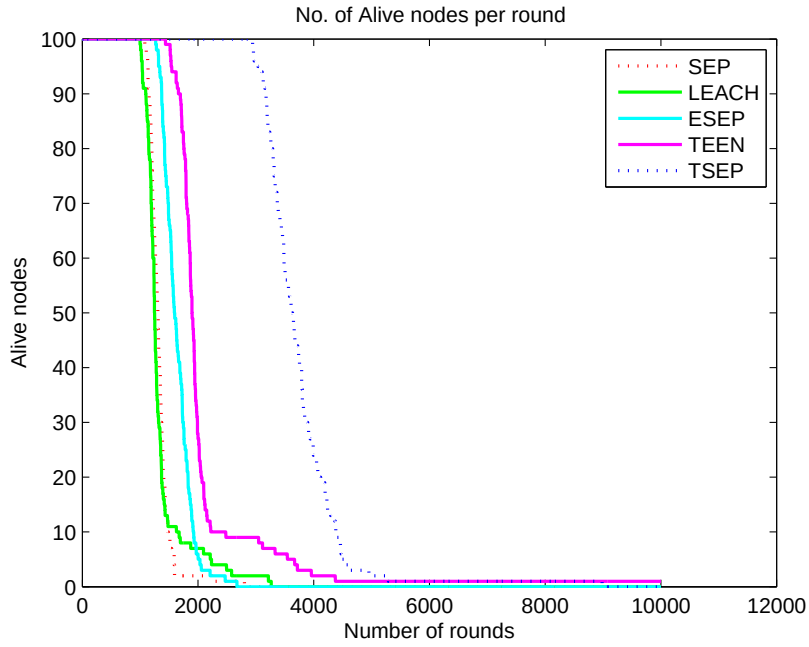
Simulations And Discussions.

Table 1. Parameter Settings

Parameters	**Value**
E_{elect}	50nJ/bit
E_{DA}	5nJ/bit/message
ϵ_{fs}	10pJ/bit/m^2
ϵ_{mp}	0.0013pJ/bit/m^4
E_o	0.5J
K	4000
P_{opt}	0.1
n	100
α	1
m	0.1

Simulations And Discussions Continued. . .

(i). Number of alive nodes per round:

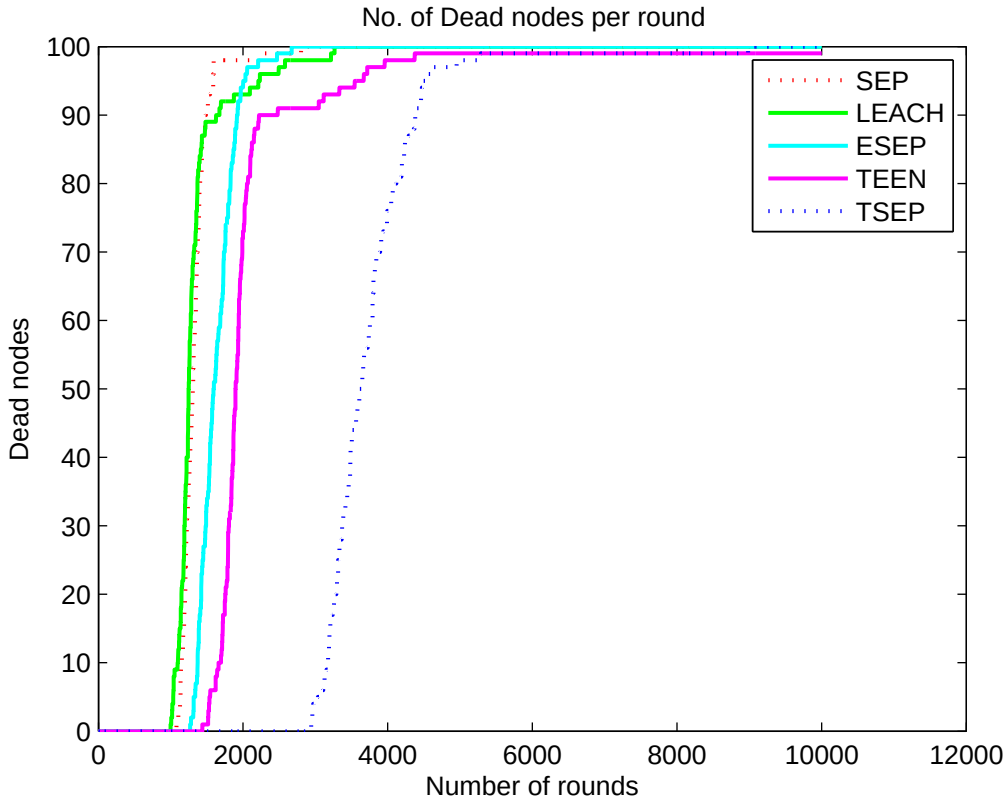


Comparing all these protocols:

- SEP and LEACH result in approximately equal stability period and network life.
- ESEP shows better results than SEP and LEACH.
- In TEEN, stability period is greater than all other protocols discussed.
- TSEP results in increased stability period and network life even greater than that of TEEN.

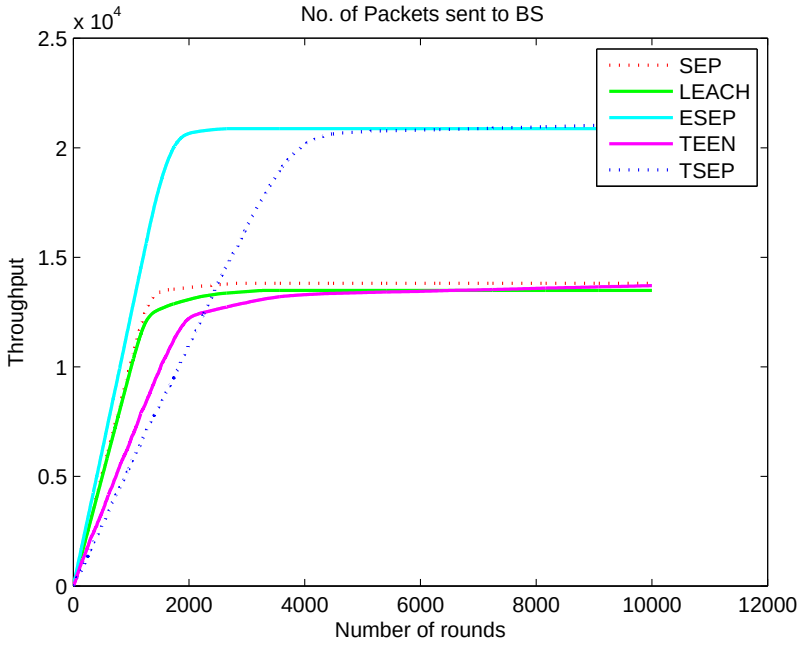
Simulations And Discussions Continued. . .

(ii). Number of dead nodes per round:



Simulations And Discussions Continued. . .

(iii). Number of packets sent from CHs to BS:



- TSEP and TEEN show better results than all others.
- ESEP and TSEP show greater throughput than SEP, LEACH and TEEN.
- TSEP is less than ESEP.

By performing simulations in MATLAB, it is observed that:

- TSEP has enhanced stability period than all other protocols.
- The network life for TSEP was increased as compared to others.
- Increase and decrease in number of alive and dead nodes respectively.
- Decreased throughput as compared to others.

Conclusion:

In comparison with SEP, LEACH, ESEP and TEEN, proposed protocol TSEP, due to three levels of heterogeneity and being reactive routing network protocol causes increase in stability period and network life.