Hybrid Energy Efficient Reactive Protocol For Wireless Sensor Networks

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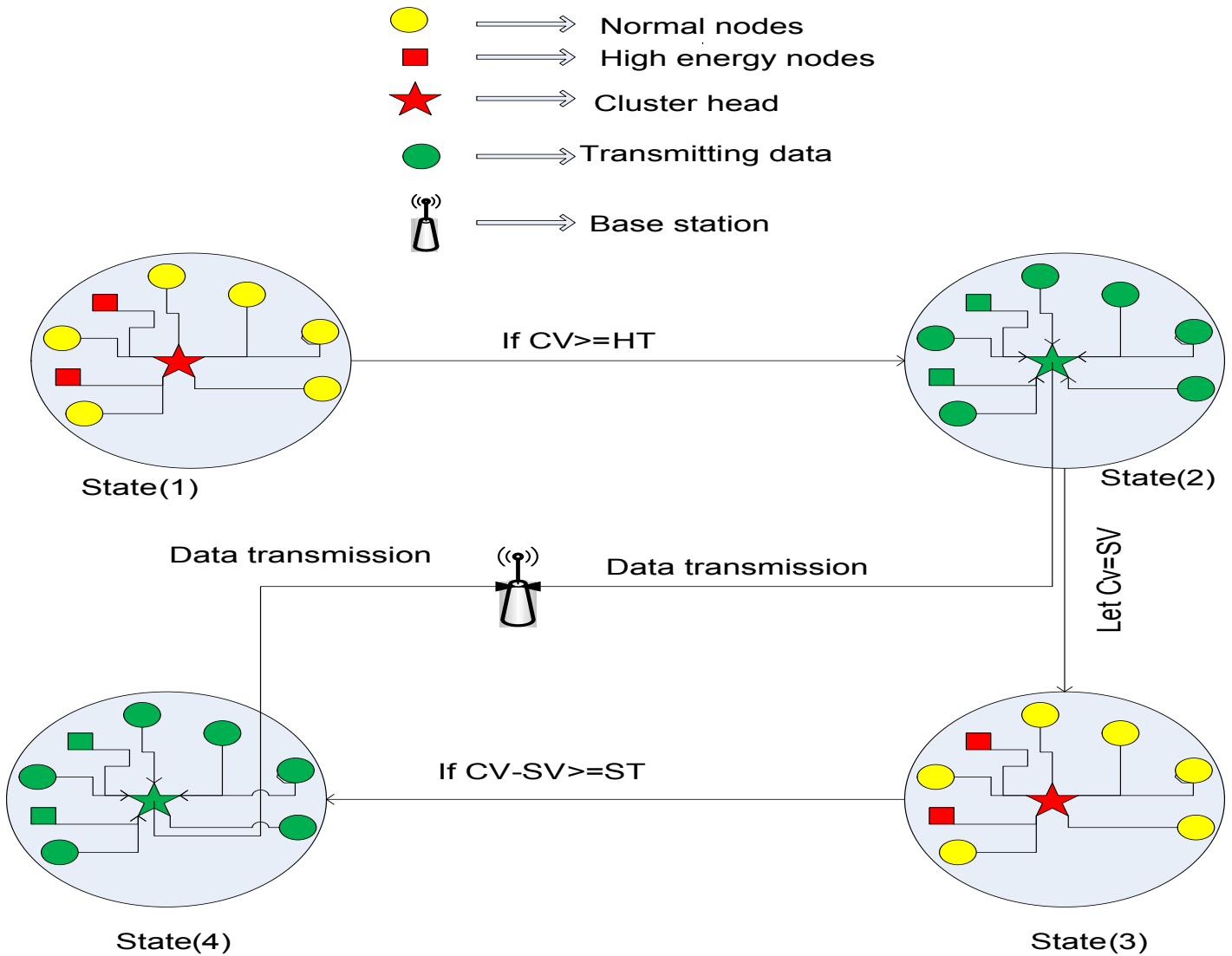
- Most routing protocols are for proactive networks
- DEEC is for proactive networks and TEEN is for reactive networks.
- HEER is for reactive networks
- HEER outperforms both DEEC and TEEN in homogeneous and in heterogeneous environment.


Normal nodes
High energy nodes
Cluster head
Transmitting data
Base station
If CV>=HT
State(1)
State(2)
Data transmission
Data transmission
Let Cv=SV
If CV-SV>=ST
State(4)
State(3)

- Nodes become CHs due to residual energy
- We introduced thresholds(hard and soft)

$$P_i = P_{opt} E_i(r)/(1 + am)\bar{E}r \tag{1}$$

$$CV - SV \geq ST \tag{2}$$

Parameters	Values
Initial energy, E_0	0.5 J
Transmitting and Receiving energy, E_{elect}	5nJ/bit
Amplification energy for short distance, E_{fs}	10pJ/bit/m2
Amplification energy for long distance, E_{mp}	0.013 pJ/bit/m2
Energy for data aggregation, E_{DA}	5nj/bit/signal
Percentage of advanced nodes, m	0.1
Energy of advance nodes	$E_0(1+a)$

Table : Parameters used in our simulations

Protocol	Stability period	Life time	Environment	Classification
Teen	1221	1947	Homogeneous	Reactive
DEEC	1395	2461	Homogeneous	Proactive
hard HEER	2005	3595	Homogeneous	Reactive
soft HEER	2493	3959	Homogeneous	Reactive

Table : Comparison table: when HT=100 and ST=2

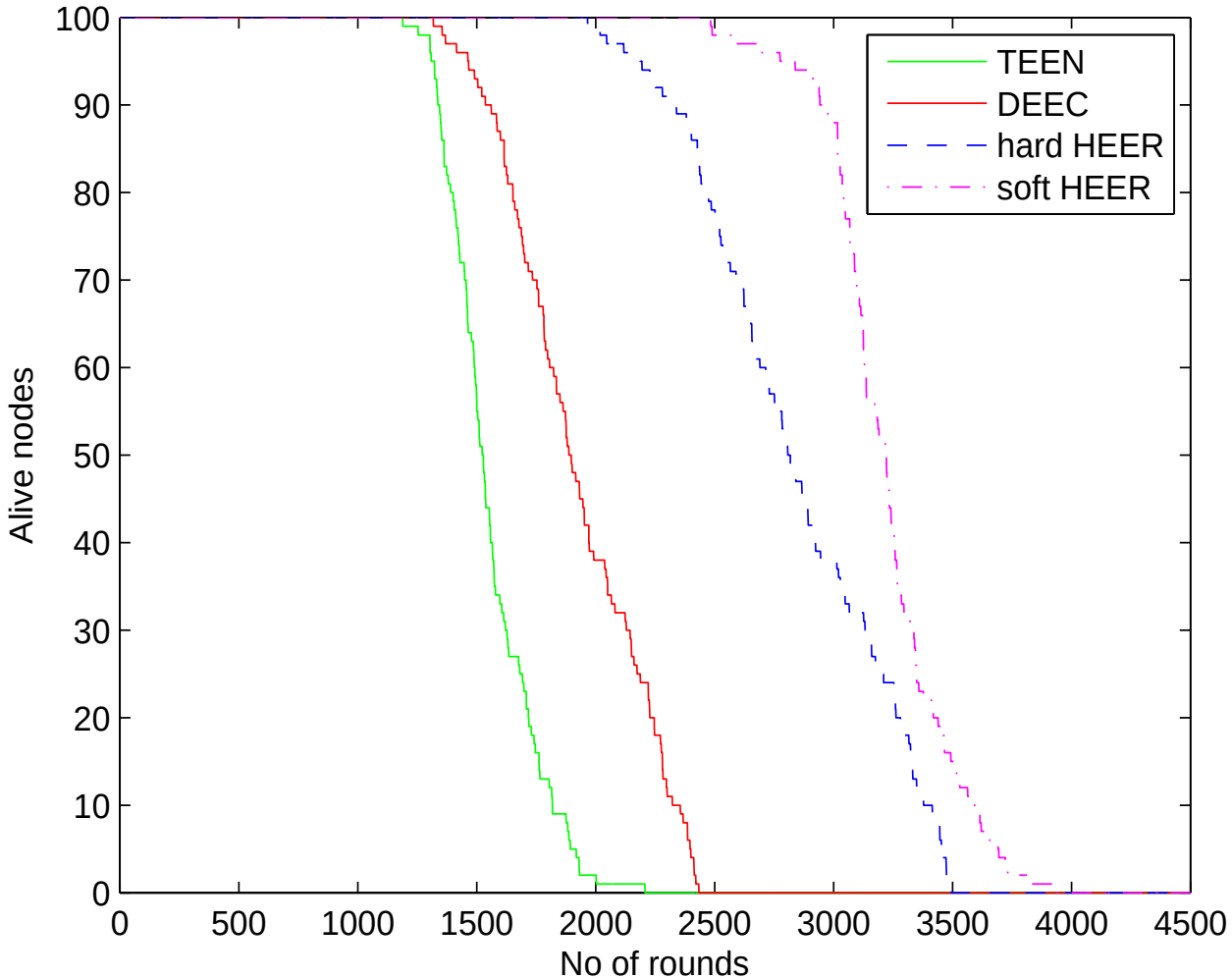


Figure : Homogeneous environment HT=100,ST=2

- Stability period of HEER is much longer than that of DEEC and TEEN
- CH selection in HEER is due to residual energy and moreover, hard and soft threshold are also introduced which increases the stability period and network lifetime
- We observe that in TEEN after the death of first node, all the remaining nodes die within a small number of rounds. This is due to the reason that all the nodes have same probability to become a CH
- CH selection in DEEC is due to residual energy only

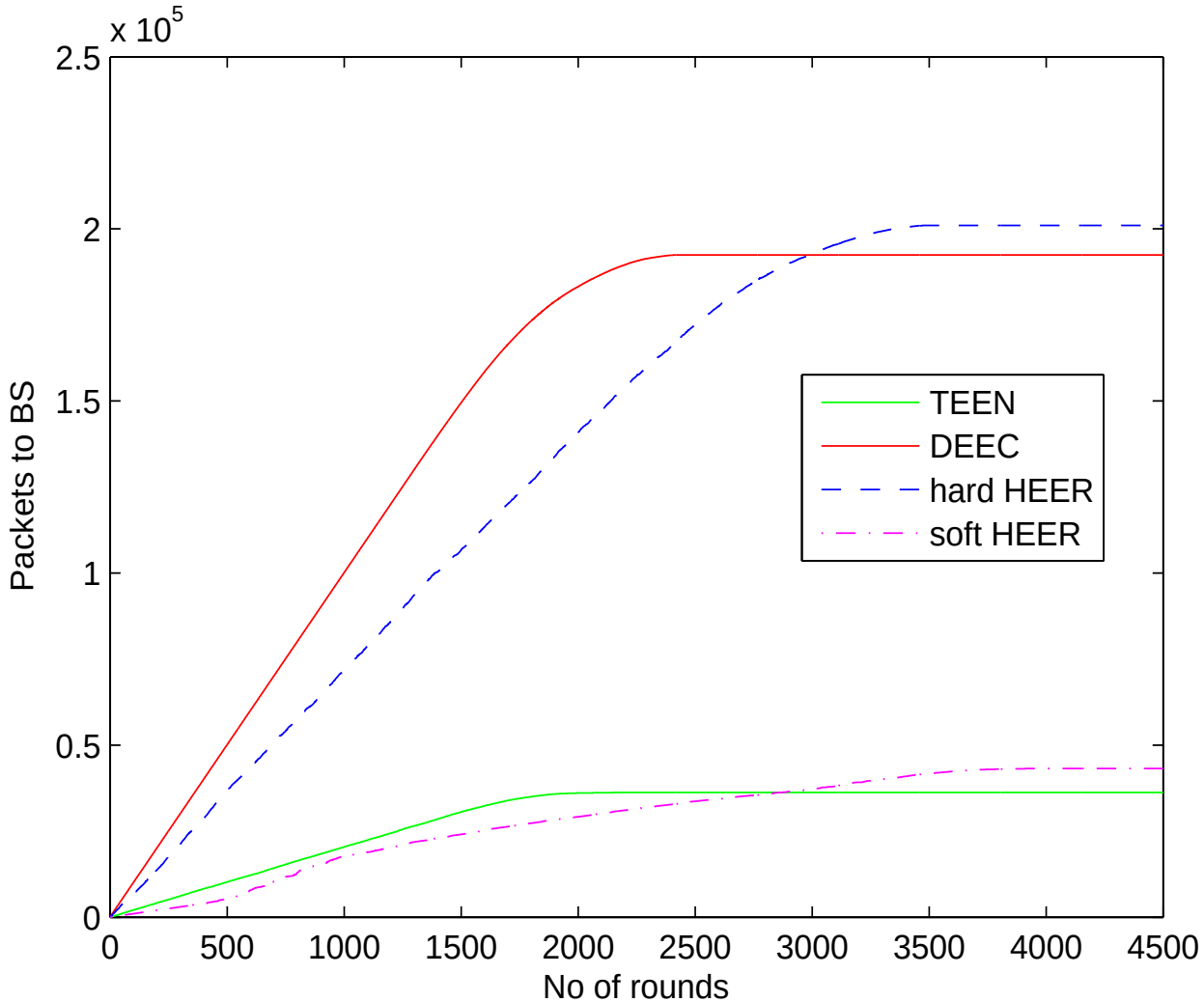


Figure : Homogeneous environment HT=100,ST=2

- Number of transmissions to BS are limited by hard threshold
- Number of transmissions to BS are further scrutinized by soft threshold which reduces energy consumption
- From previous slide we can observe that by increasing difference between threshold we are increasing packets to BS

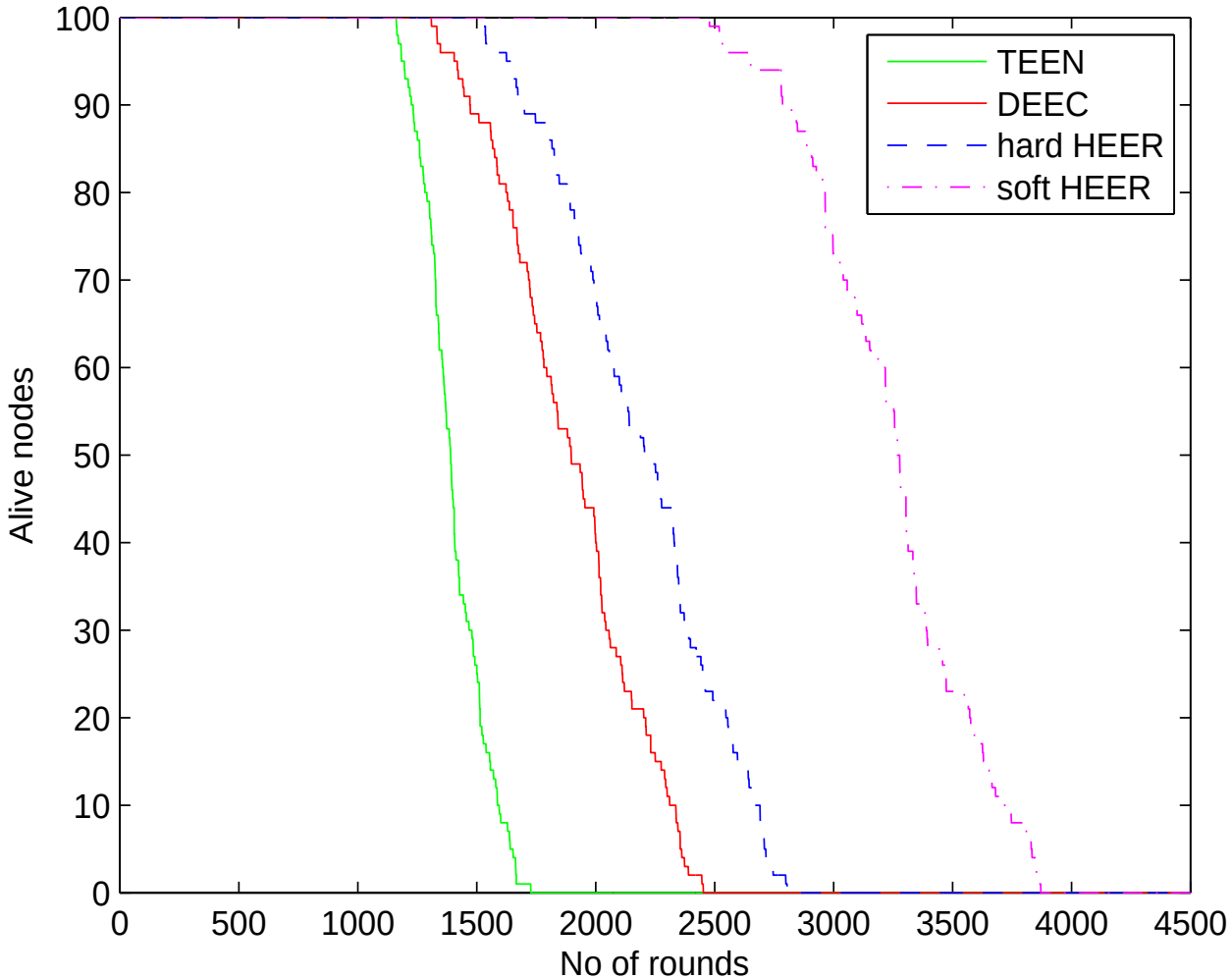


Figure : Homogeneous environment HT=70,ST=10

- By reducing the difference between thresholds we can vary our stability period and network lifetime as per our application
- By increasing the difference between the thresholds we can increase our stability period and network lifetime
- In the previous slide we observe, that my reducing the difference between thresholds we are actually reducing our stability period and network lifetime

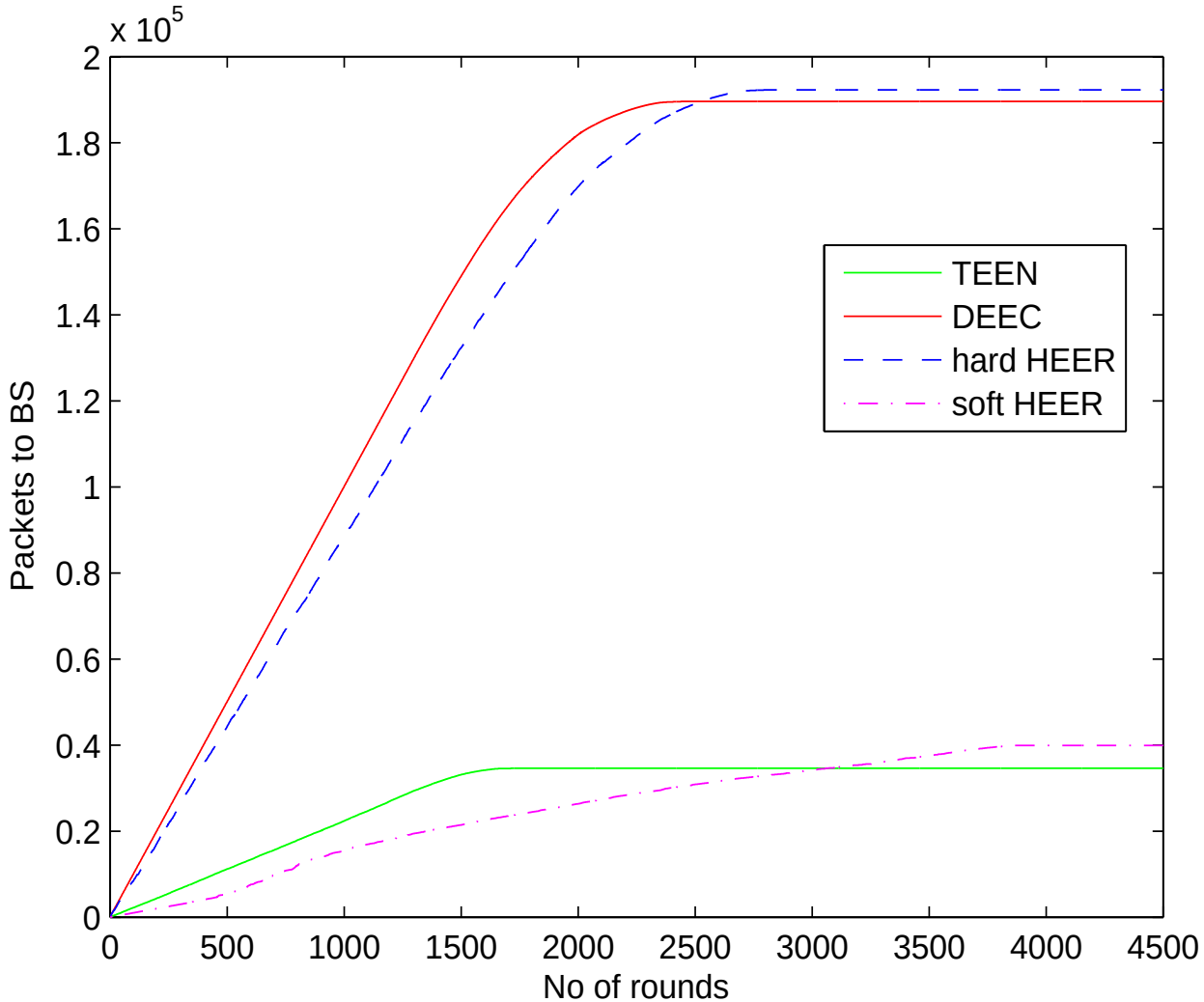


Figure : Homogeneous environment HT=70,ST=10

- By reducing the difference between thresholds we can vary packets sent to BS which is set accordingly as per our application
- By reducing difference between thresholds we reduce our packets to BS
- By lowering difference in thresholds we reduce energy consumption

- HEER minimizes energy consumption by distributing load to all high energy nodes and then on to low energy nodes
- HEER is well suited for well suited for time critical applications
- HEER outperforms DEEC and TEEN in homogeneous environment
- HEER outperforms DEEC in terms of stability period and network lifetime by a factor of 1.78 and 1.60 respectively
- Relative to TEEN, HEER outperforms it in terms of stability period and network lifetime by a factor of 2.0

Questions

Thank you!