

Performance Analysis of Ad-hoc Network Considering Energy and Packet Delivery Ratio with Speed - A Fuzzy Approach

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ABSTRACT

In ad-hoc network, mobility is one of major factor. Due to mobility, node performance as well as overall network performance gets affected which creates vulnerabilities in the network. There are several factors affecting for safe and secure working of mobile nodes in ad-hoc network. Regarding this, this paper focused on energy and packet delivery ratio in correspondence with speed of node. For analyzing the same, fuzzy approach is applied for obtained simulated data using ns-2 simulator for getting absolute result.

Keywords

ad-hoc, fuzzy, mobility, ns-2, packet delivery ratio.

1. INTRODUCTION

As Mobile ad-hoc network works on the basis of demand of mobile nodes. Mobility, dynamicity are some features of mobile ad-hoc network. As per need or requirement or demand, as any node can join or leave the network at any instance of time. It indicates its dynamicity or they may static inside the network. It badly affects normal routine of network causing vulnerability performing malicious activity like packet dropping, energy saving, delay etc. Such problem creates threats for security of network. Regarding the same, this paper analyzed how speed matters on energy and packet delivery ratio. Used data for it is obtained data from ns-2 simulator.

2. IMPACT OF SPEED VARIATION ON ENERGY AND PACKET DELIVERY RATIO

Energy is one of important parameter for safe working of node in ad-hoc network. A node with more energy saver can be considered as malicious node. In opposite to this a more energy spender is considered as safe node in the network. Such activity of it may affect on several parameters like packet delivery ratio, end to end delay etc. To analyze here speed of node is more important. General observation is that if speed increases or decreases, there is variation in energy remained at node, which automatically affects on packet delivery ratio, end to end delay etc. To get more absolute results fuzzy approach is applied for data obtained using ns-2 simulator.

3. FUZZY LOGIC

Fuzzy means not much clear data which can be guessed easily for correct interpretation. Inventor of Fuzzy Logic is Lotfi Zadeh. It is a mathematical tool for dealing with uncertainty.

Fuzzy inference system consists of four modules -

- i. Fuzzification module transforms the inputs (crisp) into fuzzy sets using membership functions.
- ii. Knowledge base contains IF-THEN rules provided by experts.
- iii. Inference engine simulates results by making fuzzy inference on the inputs and IF-THEN rules.
- iv. Defuzzification module transforms the fuzzy set generated by the inference engine into a crisp value.

4. FUZZY BASED EXPERIMENTAL APPROACH

While applying fuzzy approach, we have to form rule base using FIS which will be helpful to get result. For this analysis is done on obtained data from simulation using ns-2 simulator.

Used parameters for fuzzification is energy, packet delivery Ratio (PDR) and speed. Among those energy and packet delivery Ratio (PDR) are input parameters and speed is output parameter. Obtained fuzzified result is again applied in ns-2 and is used to compare secure working of network using with and without fuzzy approach. And compared result shows improvement in the result.

Rule-base is in a form called functional fuzzy system where each rule i is written as follows.

Rule i : IF Energy is low and PDR is Average THEN Speed = low

To verify its working from the designed rule base, result verified using FIS. Fuzzy controlled energy and PDR based scheme consists of fuzzification, inference, and defuzzification steps.

4.1 Working of FIS

Following Fig.1 shows designed FIS using fuzzy based Approach to determine the speed based on energy remained and Packet Delivery Ratio (PDR). Here Energy and PDR are input parameters and Speed is output parameter.

Energy and PDR have values like VeryLow (VL), Low (L), Medium (M), High (H), VeryHigh (VH) And Speed has values like Low (L), Average (A), Medium (M), High (H), VeryHigh (VH). We have created FIS for varying number of mediators.

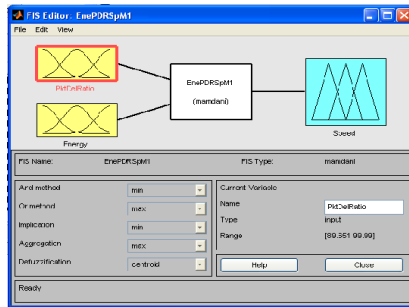


Fig.1 Working FIS

Data used for FIS is obtained data from simulation using ns-2 simulator.

We have considered various cases with varying number of mediators for determining speed from Energy and Packet Delivery Ratio.

Obtained speed from FIS is again applied to ns-2 to check performance.

Following table shows us result obtained in ns-2 with and without fuzzy for various cases (with varying number of mediators).

Case I- Two mediator (Total Number of Nodes : 6 Sources : 2 Mediators : 2 Destination : 2)

Table 1 shows comparative result of with and without fuzzy result of ns-2 simulator for two mediators.

Src 2 Med 2 Dest 2 Total Nodes: 6

Table 1 : Simulated Data for Two Mediators

| Speed | Avg Enr at specific speed | Average (PDR) | Fuzzy Speed | Avg Fuzzy Enr at specific speed | Average Fuzzy (PDR) |
|-------|---------------------------|---------------|-------------|---------------------------------|---------------------|
| 10 | 0.289 | 89.651 | 32.800 | 0.339 | 99.79374 |
| 20 | 0.311 | 99.729 | 87.900 | 0.337 | 99.97317 |
| 30 | 0.345 | 99.692 | 55.000 | 0.342 | 99.92573 |
| 40 | 0.341 | 99.851 | 90.000 | 0.337 | 99.89969 |
| 50 | 0.342 | 99.932 | 90.700 | 0.315 | 99.89986 |
| 60 | 0.343 | 99.774 | 91.000 | 0.338 | 99.89986 |
| 70 | 0.344 | 99.797 | 91.000 | 0.338 | 99.89986 |
| 80 | 0.337 | 99.979 | 90.600 | 0.337 | 99.89986 |
| 90 | 0.337 | 99.900 | 90.800 | 0.336 | 99.89986 |
| 100 | 0.338 | 99.990 | 55.000 | 0.342 | 99.92573 |

Following Fig.2 shows graphical representation of Energy Vs Speed for above data.

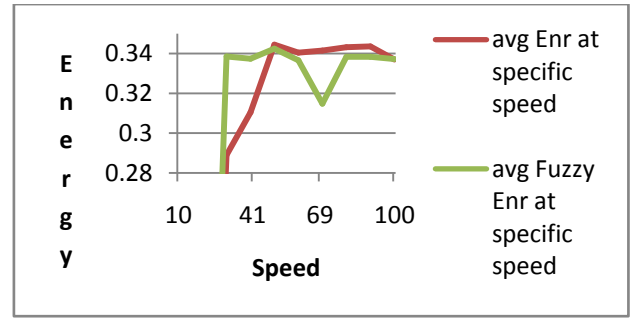


Fig.2 Energy Vs Speed

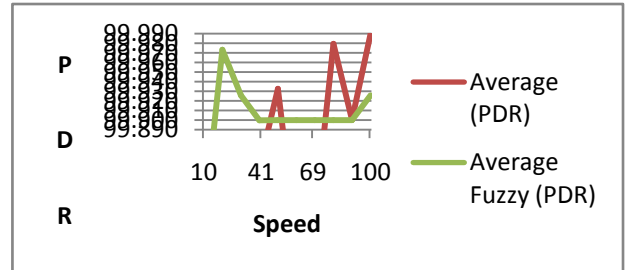


Fig.3 PDR Vs Speed

Case II - Three mediator (Total Number of Nodes : 11 Sources : 4 Mediators : 3 Destination : 4)

Table 2 shows comparative result of with and without fuzzy result of ns-2 simulator for three mediators.

Src 4 Med 3 Dest 4 Total : 11

Table 2 : Simulated Data for Three Mediators

| Speed | Avg at specific speed | Average PDR | Fuzzy Speed | Fuzzy Avg at specific speed | Fuzzy Average PDR |
|-------|-----------------------|-------------|-------------|-----------------------------|-------------------|
| 10 | 0.760 | 98.698 | 21.300 | 0.720 | 98.58947 |
| 20 | 0.795 | 98.703 | 55.000 | 0.878 | 98.336 |
| 30 | 0.800 | 98.515 | 60.400 | 0.810 | 98.216 |
| 40 | 0.791 | 98.596 | 45.400 | 0.695 | 98.610 |
| 50 | 0.759 | 98.495 | 55.000 | 0.878 | 98.336 |
| 60 | 0.784 | 97.841 | 55.000 | 0.878 | 98.336 |
| 70 | 0.791 | 98.074 | 55.000 | 0.878 | 98.336 |
| 80 | 0.799 | 98.260 | 62.900 | 0.821 | 98.253 |
| 90 | 0.805 | 98.184 | 55.000 | 0.878 | 98.336 |
| 100 | 0.829 | 98.468 | 90.800 | 0.786 | 98.094 |

Following Fig.3 shows graphical representation of Energy Vs Speed for above data.

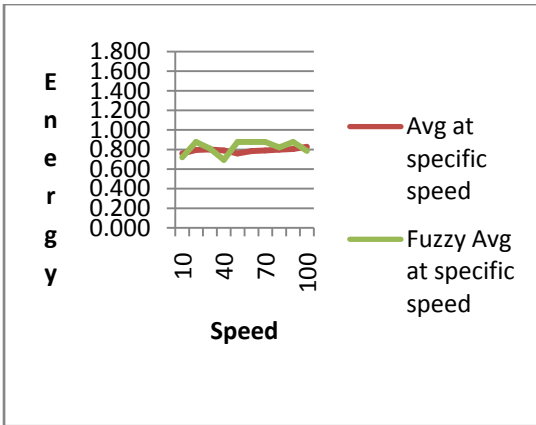


Fig.4 Energy Vs Speed

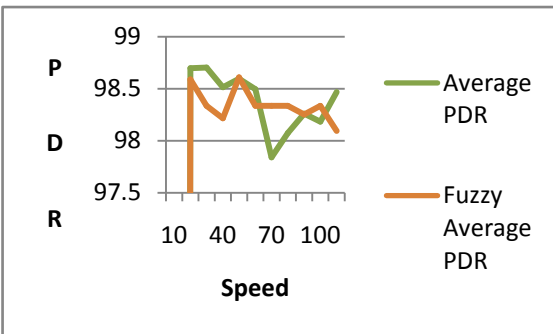


Fig.5 PDR Vs Speed

Case III - Four mediator (Total Number of Nodes : 14 Sources : 5 Mediators : 4 Destination : 5)

Table 3 shows comparative result of with and without fuzzy result of ns-2 simulator for four mediators.

Src 5 Med 4 Dest 5 Total Nodes : 14

Table 3 : Simulated Data for Four Mediators

| Speed | Avg at specific speed | Average PDR | Fuzzy Speed | Fuzzy Avg at specific speed | Fuzzy Average PDR |
|-------|-----------------------|-------------|-------------|-----------------------------|-------------------|
| 10 | 1.117 | 99.328 | 20.3 | 1.132 | 99.23384 |
| 20 | 1.123 | 99.197 | 55 | 1.119 | 99.164 |
| 30 | 1.133 | 99.175 | 55 | 1.119 | 99.164 |
| 40 | 1.118 | 99.086 | 32.8 | 1.129 | 99.360 |
| 50 | 1.124 | 99.081 | 55 | 1.119 | 99.164 |
| 60 | 1.125 | 99.125 | 55 | 1.119 | 99.164 |
| 70 | 1.137 | 99.323 | 93.2 | 1.119 | 99.192 |
| 80 | 1.126 | 99.115 | 55 | 1.119 | 99.164 |
| 90 | 1.116 | 99.182 | 55 | 1.119 | 99.164 |
| 100 | 1.120 | 99.353 | 55 | 1.119 | 99.164 |

Following Fig.4 shows graphical representation of Energy Vs Speed for above data.

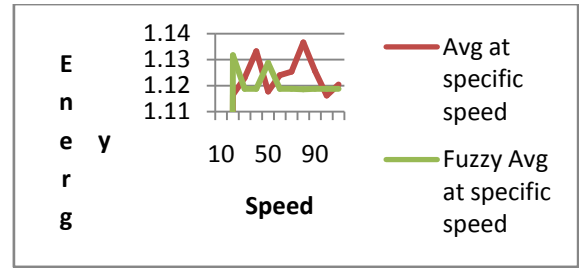


Fig.6 Energy Vs Speed

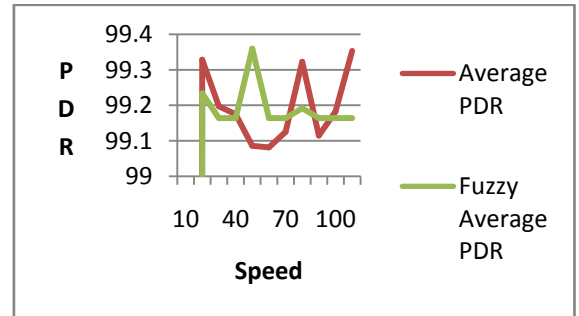


Fig.7 PDR Vs Speed

Case IV - Five mediator (Total Number of Nodes : 25 Sources : 10 Mediators : 5 Destination : 10)

Table IV shows comparative result of with and without fuzzy result of ns-2 simulator for four mediators.

(Src 10 Med 5 Dest 10 Total : 25

Table 4 : Simulated Data for Five Mediators

| Speed | Avg at specific speed | Average PDR | Fuzzy Speed | Fuzzy Avg at specific speed | Fuzzy Average PDR |
|-------|-----------------------|-------------|-------------|-----------------------------|-------------------|
| 10 | 1.432 | 98.436 | 55.000 | 1.482 | 98.414 |
| 20 | 1.533 | 98.336 | 55.000 | 1.482 | 98.414 |
| 30 | 1.536 | 98.367 | 66.700 | 1.535 | 98.393 |
| 40 | 1.506 | 98.334 | 55.000 | 1.482 | 98.414 |
| 50 | 1.521 | 98.194 | 55.000 | 1.482 | 98.414 |
| 60 | 1.583 | 98.414 | 55.000 | 1.482 | 98.414 |
| 70 | 1.509 | 98.410 | 49.100 | 1.497 | 98.315 |
| 80 | 1.479 | 98.545 | 31.700 | 1.489 | 98.237 |
| 90 | 1.518 | 98.607 | 55.000 | 1.482 | 98.414 |
| 100 | 1.492 | 98.143 | 55.000 | 1.482 | 98.414 |

Following Fig.5 shows graphical representation of Energy Vs Speed for above data.

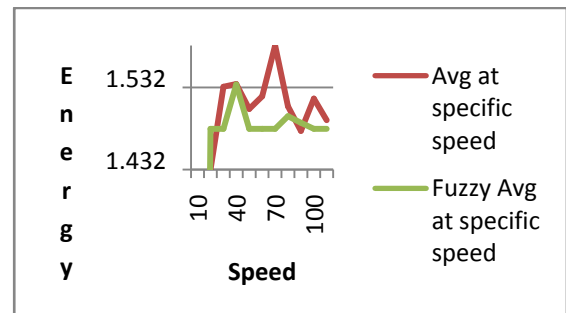


Fig.8 Energy Vs Speed

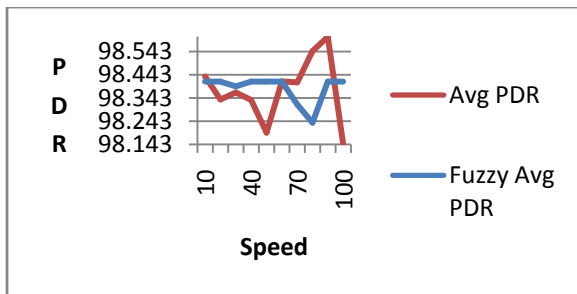


Fig.9 PDR Vs Speed

5. RESULTS AND DISCUSSION

Above obtained table data and graphs shows improved results. Obtained fuzzy speed for ns-2 data shows improvement in average energy as well as Packet Delivery Ratio. It helps user to find safe mediator in terms of energy spender.

6. CONCLUSION

Designed above system will be helpful for the user to choose safe mediator from average energy data of ns-2 simulator. The data is useful to identify packet delivery ratio as well as end to end delay for designing a secure network with varying number of mediators. User can use this existing system as one of the Decision Support System for his/her own network.

7. REFERENCES

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