**Motivation: -**

**Contribution: - Neutrosophic set implications**

**Objective: - To give the enhanced results of energy consumption when a packet is sent to a destination within a given number of nodes.**

**Abstract:**

**C**ongestion in the system causes major loss of packets  for the compromise of propagation time wasted and processing time at sending node which consumes a lot of energy. The previous related works have in common that they have tried to avoid congestion or detect them as in CSMA/CD or CSMA/CA and other protocols. This paper proposes a new Neutrosophic approach to reduce energy loss by Neutrosophic means. In the proposed method, confidence function is used as the truth membership function, which is associated with all the nodes in the cluster with the reference that any information or packet coming into the cluster are always true and that it will be delivered to the destination hop. Then, we define a Dependency function which consists of uncommon or transfer hubs/portals where the chances or possibility of congestion will be minimized. Finally, a Falsehood function, which indicates that the negative acknowledgements so obtained are not supposedly false and hence it is true that congestion has really occurred.Our objective is to minimize the falsehood function using several neutrosophic systems so that  .

Let the Neutrosophic set (A) be defined using three components as A⇒{T, R, F} where T -> confidence, R -> dependency, F -> falsehood. All the three components are intended to be degrees of neutralities with values in the set [0, 1]. This can be better understood by the following analogy: “A is the opposite of Anti A”. Here, the term Anti A refers to A or its complement, not negation. However, if we use a term “Non A” instead of Anti A, it has a different meaning but still it is not the negation of A. Thus, we denote “Non A” as “Neut A” to define neutrality throughout this paper. This concept is the basis of Neutrosophic philosophy wherein nothing is defined as false or negation of any system. **We define neutralities (Neut A) as consistent logic** to characterize many logical statements defined as Confidence (T), Dependency (R) and Falsehood(F). C depends on whether “Neut A” is neutral or not, D indicates if “Neut A” is “Non A” and whether it is dependent on A or “Anti A”, F depends on if “Neut A” is very false or not. In practical situations, it is not possible for “Neut A” to be false, as it represents a null system. Therefore, we do not define any Falsehood function for our model.

We have considered that the family of clusters is the universe of discourse **X**. Here, **we define the time domain as the truth membership function or confidence function** t(x) **T**. As the nodes in the cluster do not change during the packet transmission of signal, we use the Confidence to denote the truth membership function. The reason is that, any packet in transmision, the nodes in cluster remain consistent throughout communication for which we have used Confidence as a membership function (which as per the Neutrosophic theory is “Truth membership function”) denoted by (T). In addition, we define transferable hubs and other devices where congestion chances are less which are there in the cluster following a particular path as the indeterminacy function or dependency function (R) as it is also affecting the choice of paths for optimization.

Finally, as the cluster heads that generates negative acknowledgements denoting congestion at those nodes and hence the falsehood function is Anti of the truth membership function (F). We use Confidence, Dependency and Falsehood instead of standard definitions as they are relatable and easy to understand. From energy conservation and efficient management point of view,our overall **objective is to minimize the amplitude and frequency loss** over the entire time span of signal transmission. In this paper, we focus on Signal Systems on the classical domain interval of [0, 1]. Let X be the universe of discourse, or the domain of the signal being transmitted. Then, Neutrosophic set N is as follows:

|  |  |
| --- | --- |
| N = {<tx, rx, fx>} | t∈T; r∈R;f∈F | ∀x∈X } | (1) |

where t(x) is degree of confidence for x, r(x) is degree of dependencies between two components, f(x) is degree of falsehood over component x. X is the universe of discourse, and N is the Neutrosophic set.

. We use it to define the Dependency set for further investigations. We **define the Correlation coefficients** for Neutrosophic sets as follows:

       CorrNSA,B=1n\*i=1nmaxtAx, tBx+ maxrAx, rBx+ minfAx, fBxtAxtBx + rAx, rBx + fAx, fBx       (2)

  where the symbol “min” is the minimum operation,”max” is the maximum operation. Using above definition, we conclude the following properties about the correlation coefficients.

|  |  |
| --- | --- |
| 0 ≤CorrNSA,B≤1 | (3) |
| CorrNSA,B = CorrNSB,A | (4) |
| CorrNSA,B = 1 if and only if A = B | (5) |

Here, an optimal path has to be chosen from t(x) since all the nodes are in that cluster and by choosing maximum number of nodes we will be able  more than one optimal path. Dependency function r(x,y) is chosen as maximum as nodes which are not frequently used are used here so lesser chances of congestion. In f(x) ,the  chosen cluster heads sends negative acknowledgements which means a complimentary path needs to be chosen.

E (for transmission of same packet) directly proportional  RTT for the same packet.

// Should I include Energy derivations as well as listed below?

// Then again I will have to work on different < t,r,f > s

// <t,r,f> for the part above will be different from the part below

????

I include Energy derivations as well as listed below?this would be correct

We **define a metric for computing the average amplitude over a time span** denoted as KxKlower, Kupper. Here, Klower and Kupper denotes the average amplitude of the lower band and upper band of signal over time T, where T is the time period. To be free from congestion, we need to compute Kxand Ky, which denote the average frequency and amplitude over the entire time span of transmission.

By computing, we get to know the average loss in frequency and amplitude and we can compare it with the original message and the received message. We compute these values after applying the confidence and dependency components with that of the carrier and then justifying the degree of falsehood.

Assume BxiAlower, Aupper do not have an absolute value between [0,1]. We take the upper bound Aupper as 1 and the lower bound Alower as 0. We now **define the new Neutrosophic approach for signal** as:

|  |  |
| --- | --- |
| Lossxi =x2d2 | (6) |
| d = (Aupper-Alower)/2 | (7) |

where ‘Loss’ is the loss of the transmitted signal and is the variance in error of the Confidence vector after transmitting the signal samples. As the error can occur in any time, we take a cumulative sum of all the time domains to define the total loss. Here, d denotes the time span during which the error occurs. According to the Shannon theorem and applying the estimated Neutrosophic for signal loss, we **define the signal loss** as,

|  |  |
| --- | --- |
| Lossxs =x2d2+Kx2d2 | (8) |
|  |  |

where x2 and  Kx are the standard deviation and mean of frequency and amplitude after noise respectively. In eq. (8), as the exact loss cannot be calculated over the entire time span, we calculate the mean and deviation of the cumulative errors occurred and hence we get an approximate model for the loss. According to the Neutrosophic loss theory , the loss on signal is defined:

|  |  |
| --- | --- |
| Lossxi=SNRx2d2, x∈0,1                                           SNR = Bx1Lossxs | (9)                                            (10) |

The above approach reduces any impairment that may have been added to the original carrier frequency. Here, Neutrosophic Loss defines the true loss according to our proposed algorithm and is calculated by taking the Signal to Noise ratio (SNR) between the original quantized signal values and Shannon’s signal loss (Noise) values. The quantized values are calculated using Neutrosophic approach by computing the Confidence, Dependency and Falsehood sets, incorporating neutrosophication in the loss. Neutrosophic sampling plan can be reduced by limiting quality level. For this, we propose the following steps to minimize the noise and maintain the results using confidence, dependency and falsehood components.

Minimization by unpacking the Neutrosophic set:

Bx∈ Alower, Aupper∈ 0,1 Provided Bx∈ Aapproxlow , Aapproxhigh

Tabulating the results and analyzing the carrier signal and the receiving signal.

The proposed algorithm is given as follows:

|  |
| --- |
| **Input**: TTL, TTA, QT, TACK |
| **Output**: Energy level, Lossxi |
| Select a cluster.  Calculate the total possible loss between various nodes of a cluster between source and destination.   |  |  | | --- | --- | | Lossxi =x2d2 |  | | d = (Aupper-Alower)/2 |  |   Obtain two parameters below:  Bxi∈ Alower, Aupper  Axi∈ Aapproxlow , Aapproxhigh  Apply Neutrosophic operations:  Nxi = ρ AlowerAupper; Bxi∈ AlowerAupper  Qxi∈ Alower, Aupper;  Pxi∈ Aapproxlow , Aapproxhigh  Calculate {t,r,f} from the results obtained in step 4:  t =max(Aapproxlow(t), Aapproxhigh(t))  r=max(Time(Alower(t),Aupper(t)))  f = max(freq(Alower(t), Aupper))  Calculate Neutrosophic Loss using {t,r} calculated in Step 5 and existing definition of loss in Step 2:                                 Lossxi=SNRx2d2, x∈0,1        7. Generate the energy level. |

1st Column: TTL(ms)

2nd Column: TTA(ms)[Source is waiting for the Acknowledgement ]

3rd Column: Quantum Time(ms)[the extra time taken]

4th Column: Acknowledgement Time(ms)[time taken for detection]

Please change the notations that are highlighted. (I think I have listed all these issues to Swayam yesterday)

Secondly modify the algorithm (using neutrosophic), you may refer the algorithm of my paper of energy efficient

Thirdly, apply the algorithm using the datasets from **<<http://di.ulb.ac.be/labo/datasets.html>>  ---> 404 not found**

Yes sir

Hi Swayam, did you check the list that I had texted your yesterday, SMS one.

Since time is running out, let us go with the datasets given in the above link

Calculate the energy using <<https://www.utdallas.edu/~venky/pubs/sensor-mob-bs-globecom03.pdf>>

Convert all the equations from 1 to 6 into Neutrosophic, it will also help you to give Neutrosophic  approach of those equations.

Any questions???

1st Column: TTL(ms)

2nd Column: TTA(ms)[Source is waiting for the Acknowledgement ]

3rd Column: Quantum Time(ms)[the extra time taken]

4th Column: Acknowledgement Time(ms)[time taken for detection]