Node Selection for Routing Data Using MCDM Algorithm

Jayesh Bakhshi , Mr. Jitendra singh Yadav

1. M Tech scholar, Deptt. of CSE,. Bhabha Engineering Research Institute , Bhopal

2. Asstt. Professor Deptt. of CSE,. Bhabha Engineering Research Institute , Bhopal

ABSTRACT

In this paper, an algorithm for node selection is proposed. This algorithm is based on fuzzy set theory concept and classical AODV routing . Previous node selection methodology were based on different routing tables . subset theory has been constituted and presented with a two level structural analyses in order to enhance the performance of network by selecting most trusted node

This paper proposes a multi objective node selection algorithm, based on fuzzy set has two levels. The first level is to evaluate fuzzy weightage with respect to various criteria. Second level is to assign rating to all alternative node against each selection criteria. Thus, this algorithm enable to account for decision makers fuzzy assessments with various rating attitude and trade offs between various evaluation criteria. The weightage of each criteria can be evaluated by direct assignments or pair wise comparison, linguistic variables are used to assess preference. A scale is employed by decision maker to evaluate relative importance of different attributes using overlapping grade functions of triangular linguistic variables, each decision maker has to weigh each attribute on the designed scale.

Fuzzy suitability indices have been evaluated by aggregating decision maker's fuzzy assessments about criteria weightings and merit ratings of alternatives with respect to selection criteria. The merit ratings of alternatives are further ranked to select the node.

Keyword: *Fuzzy, MCDM, UDRP, Node selection , AODV Routing*

INTRODUCTION:

Spurred by technological success and growing multi facet demand, there has been a large increase in the range of available routing protocols. a network may have no Nodes with varying distance and capacity to receive packets.

The proper selection of a node to suit network security among the wide range of node available become a difficult task. Previous methods are based on crisp value set . All the old model models are based on concepts of accurate measurement and crisp evaluation values in routing tables .

Attributes considered for calculation and evaluation of trust worthiness are Some of the subjective attribute i.e.

Battery exhaustion	Destination unavailable	Link broken	Buffer overflow	% Packet dropped

can not be precisely defined and algorithm to deal for such imperfect, imprecise and uncertainties is a dire need of present day situation. Node suitability under different criteria and their weightage are normally expressed in fuzzy terms or linguistic variables. Hence fuzzy assessments and fuzzy weightage are to be pooled to evaluate suitability rating and to select a node and evaluate trust value of particular node.

objective attribute

% Packet Dropped	No. of replay packets generated	No. of false routing message	% packet forwarded to wrong destination	Trust level of a node

Nodes selection criteria in to (i) critical factor (ii) objective factors (iii) subjective factors[1].

A Mathematical Concept: *Fuzzy Subset*

Most of the real systems involve vagueness and imprecision because of nature of measurements. Such situations can be dealt by mathematical modeling using fuzzy subset theory as presented by Zadeh [13] and imprecision dealt by Jain R [14].

Triangular Fuzzy Number :

In a universe of disclosure X, a fuzzy subset A of x is defined by grade of membership $f_A(x)$ which associates with each x in X a real number in the interval of (0,1). $f_A(x)$ represents degree of membership of x in A.

A fuzzy number A in $\mathcal{R}$ (real line) is a triangular fuzzy number if its membership

$f_A : \mathcal{R} \rightarrow (0, 1)$ is as under:

$$f_A(X) = (x - a) / (b-a) \qquad a \le x \le b,$$

$$= (x-c) / (b-c), \qquad b \le x \le c,$$

$$= 0 \qquad \text{otherwise}$$

Where $a < b < c$

a and c are upper and lower bounds for available area for evaluation data and b most probable value on evaluation data.

ALGORITHM:

I. Identifies the importance of data/information sort out pertinent attributes and prepares a list of prospective alternative routing nodes.

II. Node selection attributes are categorized into the objective and subjective categories.

III. Preference rating scale sets are set-up, for relative weightage of the criteria and suitability of alternative with respect to criteria.

IV. Weightage W_{tj} given by decision maker B_j, to the criteria C_t, are pooled to get aggregated weightage N_t.

V. Lists out suitability index A_{itj} assigned to alternative node N_i for subjective criteria C_t by decision maker B_j, than pools them with respect to all decision makers, evaluate aggregate fuzzy index M_{it} of alternative N_i under subjective criterion C_t.

VI. Lists out objective attribute values O_{it} given to alternative node N_i for objective criteria C_t and pools them to obtain the aggregate fuzzy index M_{it} of alternative node N_i under objective criterion C_t.

VII. Aggregating M_{it} and N_t with respect to each criterion, fuzzy suitability indices of all alternatives are evaluated.

VIII. Ranking value (Ui (K_i)) associated with each alternative fuzzy suitability rating K_i is evaluated.

IX. The node having maximum ranking value is selected.

Numeric attributes are looked up critically, while evaluating the suitability of a node for a particular application. committee sorts out pertinent attribute for the application of the routing node. The attribute can be categorized as objective and subjective. Objective attribute are evaluated in numeric terms. Subjective attributes are evaluated in axiom or linguistic values.

Let O_{it}, i = 1, 2, 3, 4, ... m; t = h + 1, h + 2, ... l ;

denote the objective attribute value, assigned to alternative node R_i by committee for objective criterion C_t.

Average fuzzy suitability index M_{it}, for alternative node R_j; under criterion C_t; n

For direct relationship:

$$M_{it} = O_{it} \oslash [O_{1t} \oplus O_{2t} \oplus O_{3t} \oplus \dots\dots \oplus O_{mt}]$$

For inverse relationship:

$$M_{it} = O_{it}^{-1} \oslash [O_{1t}^{-1} \oplus O_{2t}^{-1} \oplus O_{3t}^{-1} \oplus \dots\dots \oplus O_{mt}^{-1}]$$

Aggregating Decision Makers Fuzzy Assessment

In this paper, mean operator is used to pool the decision maker opinion.

Let $A_{itj} = (q_{itj}, s_{itj}, p_{itj})$,

$i = 1, 2, 3, 4, \ldots\ldots\ldots\ldots m; t = 1, 2, 3, \ldots\ldots\ldots h; j = 1, 2, 3, 4, \ldots\ldots\ldots\ldots n,$

be the linguistic rating accorded to node alternative R_i by decision maker B_j, for subjective criterion C_t.

Let $X_{tj} = (Z_{tj}, X_{tj}, Y_{tj})$, $t = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots l; j = 1, 2, 3, \ldots\ldots\ldots n,$

by linguistic weightage assigned to criteria C_t by decision maker B_j,

$M_{it} = : (1/n) \otimes 1 (A_{it1} \oplus A_{it2} \oplus \ldots\ldots\ldots\ldots \oplus A_{itn})$

$: (q_{it}, s_{it}, p_{it})$

$i = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots m; t = 1, 2, \ldots\ldots\ldots\ldots\ldots h;$

$i = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots m; t = h + 1, h + 2, \ldots\ldots\ldots\ldots\ldots l;$

And

$N_t = (1/n) \otimes [X_{1t} \oplus X_{2t} \oplus \ldots\ldots\ldots\ldots \oplus X_{nt}]$ $t = 1, 2, 3, \ldots\ldots\ldots l;$

Where M_{it} and N_t are average fuzzy suitability index of alternate node R_i, under criteria C_t, Using extension principle M_{it}, N_t are also triangular fuzzy number i.e.

$q_{it} = \sum^{n}_{j=1} q_{itj}/n;$ $s_{it} = \sum^{n}_{j=1} s_{itj}/n;$ $P_{it} = \sum^{n}_{j=1} p_{itj}/n;$

where $i = 1, 2, 3, \ldots\ldots\ldots\ldots m; t = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots\ldots\ldots h.$

$Z_t = \sum^{n}_{j=1} Z_{tj}/n;$ $X_t = \sum^{n}_{j=1} x_{tj}/n;$ $Y_t \sum^{n}_{j=1} Y_{tj}/n;$

Where $t = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots l;$

$M_{it} = (q_{it}, s_{it}, p_{it})$, $j = 1, 2, 3, \ldots\ldots\ldots\ldots m; t = 1, 2, 3, \ldots\ldots\ldots h.$

$N_t = (Z_t, X_t, Y_t)$, $t = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots l$. Further M_{it} and N_t can be aggregated by averaging products between the criteria index and corresponding weightage. The fuzzy suitability index of K_i of ith node can be evaluated as under:

$K_i = (1/l) \otimes [(M_{i1} \otimes N_1) \oplus (M_{i2} \otimes N_2) \oplus \ldots\ldots \ldots\ldots(M_{il} \otimes N_l)].$

By principle of extension, K_i is fuzzy number with grade of membership :

$$f_{ki}(a) = \begin{cases} - H_{i1} + [H^2_{i1} + (a-D_i) / O_{i1}]^{1/2}, & D_i \leq a \leq Q_i, \\ H_{i2} - [H^2_{i2} + (a-F_i) / U_{il}], & Q_i \leq a \leq F_i \\ 0. & \text{otherwise.} \end{cases}$$

----------equation A.

for i = 1, 2, 3, 4, ... m.

Where

$O_{i1} = \sum_{t=1}^{l} [(s_{it} - q_{it})(X_t - Z_t)] / l,$

$O_{i2} = \sum_{t=1}^{l} [(q_{it} (X_t - Z_t) + Z_t (s_{it} - q_{it})],$

$U_{i1} = \sum_{t=1}^{l} [(p_{it} - s_{it}) (Y_t - X_t)] / l,$

$U_{i2} = \sum_{t=1}^{l} [(Y_t(s_{it} - p_{it}) + p_{it}(X_t - Y_t)];$

$H_{i1} = O_{i2} / (2 . O_{il}).$

$H_{i2} = -U_{i2} / (2 . U_{i1}).$

$D_i = \sum_{t=1}^{l} [q_{it} . Z_t) / l,$

$Q_i = \sum_{t=1}^{l} [s_{it} . X_t) / l,$

$F_i = \sum_{t=1}^{l} [p_{it} . Y_t)/l;$

Ki is not triangular fuzzy number and fuzzy numbers are:

$Ki = (D_i, Q_i, F_i; H_{il}, O_{il}; H_{i2} ; U_{i2})$

Where i = 1, 2, 3, 4 .... m.

RANK THE FINAL RATING:

The Maximizing Set And Minimizing Set:

Let Ki (i = 1, 2, 3, 4 ....m) be fuzzy suitability indices of the m routing protocols: the membership function is as per equation A.

Max → □M = $\{x, f_M (x) / x \in \mathcal{R} \}$ with

$f_M (x) = : (x - x_1) / (x_2 - x_1);$ $x_1 \leq x \leq x_2.$

: 0 otherwise.

Min → □G = $\{x, f_G (x) / x \in \mathcal{R} \}$ with

$f_G (x) = : (x - x_2) / (x_1 - x_2),$ $x_1 \leq x \leq x_2.$

: 0 otherwise.

Where

X_1 = inf E. X_2 = Sup. E_i

$E = \cup \ E_i$

$E_i = \{x / f_{ki}, (x) > 0\}$ i = 1, 2, 3, ... m.

RANK FUZZY SUITABILITY INDICES

A method of determining ranking of fuzzy alternative suitability indices with max -set and min-set is used.

Let optimistic utility $U_M (K_i)$ and pessimistic utility $U_v (K_i)$ of fuzzy suitability indices K_i as

$$U_M (K_i) = \text{Sup}_x * \{ f_{ki} (x) \wedge f_M (x)\}$$

$$U_v (K_i) = 1 - \text{Sup}_x * \{ f_{ki} (x) \wedge fv (x)\}$$

for i = 1, 2, 3, ... m. Ranking value of $U_T (K_i)$ of fuzzy suitability indices :

$$K_i = (D_i, Q_i, F_i; H_{i1}, O_{i1} ; H_{i2} ; U_{i1})$$

so membership function given by equation A.

$$U_T (K_i) = K\, U_M (K_i) + (1 - K)\, U_v (K_i)$$

for i = 1, 2, 3, ... m. $o \leq k \leq 1$.

The value k an index of rating attitude shows the decision makers risk taking attitude. If K>0.5, it implies decision maker is too risky or conversely conservative.

$$U_T (K_i) = [H_{i2} - \{H^2{}_{i2} + (X_R - F_i) / U_{i1} \}^{1/2} + 1 + H_{i1} - \{H^2{}_{i1} + (X_L - D_i) O_{i1}\}^{1/2}] / 2$$

for i = 1, 2, 3, ... m.

Where

$$x_R = \{2x_1 + 2H_{i2} (x_2 - x_1) + (x_2 - x_1)^2 / U_{i1} - (x_2 - x_1)$$

$$[(2H_{i2} + (x_2 - x_1) / U_{i1})^2 + 4(x_1 - F_i) U_{i1}]^{1/2} \} / 2$$

$$x_L = \{2x_2 + 2H_{i1} (x_2 - x_1) + (x_2 - x_1)2 / O_{i1} - (x_2 - x_1)$$

$$[2H_{i1} + (x_2 - x_1) / O_{i1})2 + 4(x_2 - D_i)/ O_{i1}]^{1/2} \} / 2$$

Now ranking value of fuzzy suitability indices of the m alternative node calculated and decide sthe most suitable node .

DISCUSSION:

I. In fuzzy environment, assessment of node alternatives with respect to criterion and their weightage are given in linguistic terms to express the imprecision and vagueness of environment information to decision maker. The conventional methods either deterministic or random fails to take proper account for the situation. The proposed algorithm designed to take into account the view point of decision making manager fully, without constraints by using fuzzy numbers and linguistic variables.

II. The proposed algorithm is independent of type of grade function is used. Thus more complex, intricate function may be used instead of triangular numbers.

III. The algorithm is equally capable to use crisp data (i.e. precision based non fuzzy) as fuzzy linguistic assessment.

IV. A software may be developed using the algorithm for selection node to route data .

REFERENCES:

1. Performance Comparison of Mobile Ad-hoc Network Routing Protocol., International Journal of Computer Science and Network Security (IJCSNS), VOL.7 No.11, pp. 77-84 November 2007.

2. The dynamic source routing protocol for mobile ad hoc networks, Internet Draft, draft-ietf-manet-dsr-07.txt, work in progress, 2002.

3. C. Perkins, E. Belding-Royer and S. Das "Ad hoc On-Demand Distance Vector (AODV) Routing." RFC 3561, IETF Network Working Group, July 2003.4. .

4. X. Yang and N. Vaidya, "Priority Scheduling in Wireless Ad-hoc Networks," Wireless Networks, 2006, vol. 12, pp. 273-286.

5. L. Fanzhi, S. Xiyu, J. Sabah, and A. Christopher, "The effects of malicious nodes on performance of mobile Ad-hoc networks," In Proc. of the Mobile Multimedia Processing for Military and Security Applications, 2006, pp. 1-6.

6. V. Balakrishnan, V. Varadharajan, U. K. Tupakula, and P. Lucs, "Trust and Recommendations in Mobile Ad-hoc Networks," In Proc. of the 3rd Int. Conf. on Networking and Services (ICNS 07), Athens, Greece, 2007, pp. 64-69.

7. Srinivasan, J. Teitelbaum, H. Liang, J. Wu, and M. Cardei, "Reputation and Trust-Based Systems for Ad-hoc and Sensor Networks," Algorithms and Protocols for Wireless Ad-hoc and Sensor Networks, A. Boukerche (ed.), Wiley & Sons, 2007.

8. Lidong Zhou, Zygmunt J. Haas: Securing Ad Hoc Networks, IEEE Network Magazine, vol. 13, no.6, November/December 1999.