COMPARISON BETWEEN MADM ALGORITHMS FOR VERTICAL HANDOFF DECISION

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Abstract
Composite communication platform is the basic requirement of today's Mobile Terminals. The need for this communication platform is to provide seamless roaming to the user without much distortion in their services. So far many different approaches have been adopted, for raking these switching decisions and among all of these approaches, MADM (Multiple Attribute Decision Making) is considered as one of the approach for solving such types of vertical handover problems. The types of few MADM algorithms are AHP, TOPSIS, MEW and SAW. In this paper comparisons between these MADM algorithms have been done. Results of each algorithm and their response against the decision ranking have been analyzed. It is observed that TOPSIS is suffering from non stability behaviour; MEW shows penalizing behaviour towards poor attributes, where as AHP and SAW shows less risk in its decision ranking with minimum standard error mean and statistical variance.

Keywords
Vertical Hand off, Composite Communication Platform, Ranking, Sensor devices, MADM

1 Introduction
Now a day, researchers are focusing to develop a composite communication platform [1] for the mobility management. The aim behind this composition is to reduce the communication gap between various heterogeneous wireless network environments. From architectural point of a view, a vast set of these wireless technologies such as Code Division Multiple Access (CDMA2000), Satellite Network, Sensor Networks, and Global System for Mobile Communications (GSM), Wireless Local Area Network (WLAN), Universal Mobile Telecommunication System (UMTS), Mobile Ad Hoc Network (MANET), and Home RF network and Blue tooth basically requires a platform which seems to provide seamless roaming to the user without any distortion. The demand for this seamless roaming or handoff becomes more important, when this roaming is vertical not horizontal. Vertical handoff is quite different from horizontal handoff. As in horizontal handoff the mobile user roams from one base station to another within the same network. Where as in vertical handoff the mobile user roams between two different network technologies. Many issues are involved in this vertical handoff, which indirectly affects the decision factors of mobile user. According to the requirement of the user preferences as well as the available network services, parameters such as bandwidth, cost, application type support, bit error rate, coverage area and other QoS attributes, forcefully compel the wireless devices, to take a dynamic decision of network selection. Various vertical handover decision algorithms have been proposed and discussed in literature [4], [5], [6],[7] which are using either fuzzy logic or based on policies [9],[10],[11],[12].
In our previous paper [23], we have proposed an idea of Intelligent Intermediate Robust Gateway (IIRG) for handling handover decisions of remote sink sensor applications problems. The Gateway module discussed in that paper is based on fuzzy logic and Analytical Hierarchal Process (AHP), which use fuzzy comparison ratio based criteria for the handling weights of different criteria's by using pair wise judgment. The framework of IIRG is based on three basic modules called Network Monitor, Data Mine, Sensor Application Based Module and FANS [23] as shown in Fig 1. For making analysis of this framework, we extend our work by conducting a comparative study of different MADM based vertical handoff algorithms. Although there is much work done in this vertical handoff but there is lack of comparison between their performance works. The main contribution of our work in this paper is to make comparison among different decision making techniques and check their pros and cons. The algorithms which are used in our comparison work are Technique for Order Preference by Similarity to ideal Solution (TOPSIS) [13], Multiplicative Exponent

Weighting (MEW) [13], Analytical Hierarchy Process (AHP) [3], and Simple Additive Weighting (SAW) [13]. A different type of performance attributes such ranking, non stability behavior, Standard Error of Mean (SEM), Minimum Variance Unbiased Estimator (MVUE) and their resultant is discussed in this paper. We have used Matlab for the simulation of our work. Results show that more that 80-85% of times the decision made by SAW, MEW, TOPSIS and AHP are same, whereas 20% of time they made different ranking decisions. The reason for selecting different ranking criteria by different algorithms depends on the abnormality behavior of TOPSIS, penalizing behavior of MEW, minimum response value of SEM and MVUE for AHP as well as SAW. For checking the performance of each algorithm, study is made on the bases of quantitative as well as qualitative data. The resultant of this approach shows that TOPSIS is a non stable algorithm in its decision ranking, MEW is suffering from penalizing behavior in case of poor attributes, whereas AHP and SAW show much stable and better decision as compared to other two.
In section II a brief overview of different types of MADM techniques are discussed. Whereas in Section III shows a comparative study of these techniques. Finally in section IV conclusion is drawn from their comparative results for the future perspective.

2 **DECISION MAKING TECHNIQUES**

As discussed in section I, that Vertical Handoff consists of three major phases described as system discovery, handoff decision, and handoff execution [2]. At system discovery phase the availability of different networks and their provided set of parameters are studied. At handoff decision phase the final selection of network take place from among the list of candidate networks. The final decision is made after considering both user preferences as well as available network parameters. User preferences give weightage to the QoS parameters, which provide much help in the selection of network from the list. Where as in the last phase of handoff execution, the step is taken to change the current network/cell/technology into the newly selected network/cell/technology. Before going in the details of our work, a brief over view of four different MADM techniques are discussed.

• **Analytical Hierarchal Process (AHP)**

It was developed by Prof T.Saaty (1980) at Wharton School of Business [3]. This process decomposes a complex decision problem into a hierarchical structure.AHP hierarchal structure has at least three major steps.

1. At the top of the hierarchy, problem Statement and objectives are placed.

2 In the middle of the hierarchy a list of criteria's are mentioned that are required to the alternatives.

3 Where as at the lowest levels the sets of alternatives is defined as shown in Fig 1.

4 A pair wise comparison matrix is established which shows the relation ship between upper level elements with respect to the level immediately below it.

5 Two questions are answered during this comparison procedure i.e.

1. Which criteria are more important?
2. How much extend it is important as compared to other criteria.

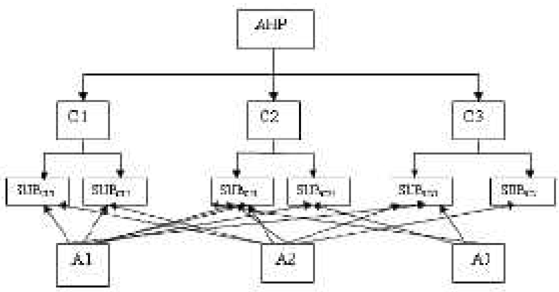

Fig. 2. Hierarchy Decision Making Process

INTENSITY OF IMPORTANCE	DEFINATION
1	Equal Importance
2	Equal to Moderately Importance
3	Moderate Importance
4	Moderate to strong Importance
5	Strong Importance
6	Strong to very strong Importance
7	Very strong Importance
8	Very to Extremely Strong Importance
9	Extreme Importance

TABLE I: SCALE FOR PAIR WISE
COMPARISON SAATY, 1980) [3]

Buckley's in 1985 [15], [16] suggested fuzzy AHP by allowing fuzzy numbers for pair wise comparison and calculate fuzzy weights and fuzzy performance/results. Linguistic variables are used to express fuzzy numbers. These linguistic variables use linguistic terms like Low, Medium, and High to classify different perception of the related subject. For example the bandwidth can be low medium or high and similarly the distance covered by the network can be Low, Medium or High. Saaty uses scale table as shown in Table I for the judgment and comparison of criteria's.

– 6 At the final step of Saaty AHP method, eign vector of comparison matrix is calculated, which is used to find the relative weights among the criteria's (sub criteria's and one level above of the hierarchal system). Saaty [3] gives different methods for the calculation of the eign vectors. These methods are summarized below:-

_ Normalization of Row Average

$$w_i = \sum_{j=1}^{n}(b_{ij}) / \sum_{i,j=1}^{n}(b_{ij}) \quad (1) \qquad w_i \quad \prod_{i=1}^{n}(a_{ij})^{1/n} / \sum_{k=1}^{n}\prod_{j=1}^{n}(a_{kj})^{1/n} \quad (2)$$

where in eq 1 nominator part is showing sum of each row and denominator is showing sum of over all rows. Hence there division gives a normalized output.

_ Geometric mean of Rows

It takes nth root of multiplication of all elements in each row and divides them with the sum of product of all elements in each and every row.

_ Average of Normalized Column

Converts fraction pair wise comparisons to decimal equivalent and calculate normalized value
by dividing each element by its column total. Row wise total is then taken for this normalized matrix. Average normalized column is obtained by dividing row sum by the number of elements in the row.

$$w_i = 1/n(\sum_{j=1}^{n}(a_{ij}) / \sum_{k=1}^{n} a_{kj}) \quad (3) \qquad CI = (\lambda_m axn)/n-1 \quad (4)$$

_ Consistency of Matrix

Consistency checking is considered as one of the major key point for AHP decision analysis. It is used to verify the reliability of our judgment. The judgment is considered to be consistent if the maximum eign value _max of the reciprocal matrix is equal to the order of the matrix. Whereas it is considered as in consistent if the value of maximum eign value is greater than the order of the matrix. For measuring the consistency of the matrix we use the Consistency Index (CI) as shown in the Eq 3. CR =CI/RI (5)

For consistent pair wise matrix CI would be zero. Consistency of judgment can be further calculated by using the Consistency Ratio i.e.Random Index (RI) for different order of matrix are calculated by Saaty [3] and shown in Table II. If the calculated CR is less than 0.10, it means less inconsistency exists in our assumed matrix, where as if CR¿0.10 than calculated matrix is not consistent and whole matrix should be revised or re-examined.

MATRIX SIZE	RANDOM INDEX	MATRIX SIZE	RANDON INDEX
1	0	9	1.45
2	0	10	1.49
3	0.58	11	1.51
4	0.9	12	1.48
5	1.12	13	1.56
6	1.24	14	1.57
7	1.32	15	1.59
8	1.41		

TABLE II
RANDOM INDEX TABLE (SAATY, 1980) [3]

_ Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

In this method two artificial alternatives are hypothesized: i.e.
1) Ideal alternative (Positive alternative)
2) Negative alternative
The basic rule behind these hypotheses is that the chosen alternative should have shortest distance form positive ideal solution and longest distance from negative ideal solution [17].
Best/Ideal alternative: considered to be one which shows the best value for all attributes. **Negative ideal alternative**: the one which has the worst attribute value. TOPSIS makes the decision of alternative that is very near to the best result and very far from Pessimistic option alternative. In this method the problem is classified on the bases of m alternatives (options) and n attributes/criteria. Each option or alternative is assigned a score against each criterion. For the explanation of the mathematical process if x_{ij} is the score of option i with respect to criterion j and matrix X = x_{ij} is a m x n matrix then it is consider that J be the set of benefit attributes or criteria (more is better and J' be the set of negative attributes or criteria (less is better). The following steps are followed for the calculation of this method.
Step 1: Make a decision matrix using normalized values. Through this step, different measuring units of attributes are transformed into uniform unit attributes, which allows comparisons across criteria. The normalize scores or data are as given in Eq 6:

$$r_{ij} = x_{ij}/\sqrt{\sum (x_{ij})^2} \quad (6)$$

$$v_{ij} = w_j * r_{ij} \quad (7)$$

Step 2: Make a decision matrix having weighted normalized values. Assume we have a set of weights for each criteria wj for j = 1…n. Multiplications have to be done between columns of the normalized decision matrix and its corresponding weights. An element of the new matrix is given as in Eq 7: for i = 1, ..., m; j = 1,..., n
Step 3: Determine the ideal and negative ideal solutions. The positive or ideal solution can be obtained as in Eq 8

$$A* = v_1*, ..., v_n* \quad (8)$$
where $v_j* = max v_{ij} if j \in J$; min v_{ij} if $j \in J'$

$$A' = v'_1, ..., v'_n \quad (9)$$
where $v' = \min v_{ij} if j \in J$; $\max v_{ij} if j \in J'$

Whereas the negative ideal solution is given as in Eq 9
Step 4: Calculate the separation measures for each alternative. The separation from the
ideal alternative is given in Eq 10

$$S_i^* = [\sum (v_j^* - v_{ij})^2]^{1/2} \quad (10)$$

$$S_i' = [\sum (v_j' - v_{ij})^2]^{1/2} \quad (11)$$

where i = 1....., m And similarly, the separation from the negative ideal alternative is as given in Eq 11: where i = 1,...., m
Step 5: Calculate the relative closeness to the ideal solution Ci*. Select the Alternative with Ci*closest to 1.

$$C_i^* = S_i'/(S_i^* + S_i') \quad (12)$$

$$S_i - \sum_{j=1}^{M} (w_j * r_{ij}) \quad (13)$$

where $0<C_i < 1$

Simple Additive Weighting (SAW) here the normalized value of the criteria for each alternative is multiplied with the importance of the criteria i.e. weights assigned to the attributes/criteria. After that the total score against each alternative is calculated by summing these products over all these attributes. At the end the alternative having highest score is selected finally. Equation 13 gives the mathematical way for calculating the sum these products over all of these attributes. Where i = 1... n, j=1,.....,m, Si represents the Overall score of the ith alternatine,r_{ij} is the normalized rating of the ith alternative of the jth criterion,xij is the value of the jth criterion of ith alternation, wj is the weight of the jth Criterion, M is the number of criteria and N is the number alternative.

Multiplicative Exponent Weighting (MEW) MEW is another way of solving multi attributes Problem. Here the attribute problem consists of a matrix having N number of alternative and M number of criteria's against them. The score for each network i can be calculated as

$$S_i = \prod_{j=1}^{m} (x_{ij})^{w_{ij}} \qquad (14)$$

Here x_{ij} is the element or value of jth attribute and wj is the weight assigned to each attribute. The value of wj will be considered as positive for benefit matrix x_i^{wij} j and its value will be negative for cost factor i.e. xi^{-wij} .The selected network is the best value of each matrix. The highest value in benefit matrix is considered as preferred one; where as the lower value in the cost matrix is selected as final option.

3 **COMPARISON OF TECHNIQUES**

For making a comparison between these four handover methods i.e. AHP[3], TOPSIS[13], MEW[13]and SAW[13] we have consider an example of traffic, coming from some remotely placed sensor devices. According to the authors in [18] sensor devices provide support for many different types of applications such as Event, Continues, Hybrid and Query. The classification of these data types are done on the bases of data driven module. Each application type has a requirement of diverse QoS parameters. Event type applications of sensor devices always activate in the presence of some triggers, Query type applications responded when some question is generated from the sink, continues type response continually by sending data at some fixed rate, whereas hybrid applications are combination of all these three above applications. In the calculation of network selection for this application, different types of QoS parameters are required both from user as well as from network. The parameters which we used for the evaluation of methods are bandwidth, delay tolerance, security, application type, coverage area, cost and priority. Here the values of these parameters, either received from user or from network, are first converted into fuzzy variables by making use of Gaussian membership function [19]. The advantage of using these fuzzy variables is that one can easily express both quantitative and qualitative data. Later on these fuzzy values are normalized between [0, 1] for developing symmetry of measurement among the different parameters having different units. For the simplicity of our work, the weights for each criterion are calculated by using AHP Eigen value method based on geometric mean. Our simulation, which is carried out in MATLAB2.

QoS	App_Pri	Critical	Delay	Bandwidth	Coverage
App_Pri	1	1	4	4	7
Critical	1	1	4	4	7
Delay	1/4	1/4	1	1/5	3
Bandwidth	1/4	1/4	5	1	5
Coverage	1/7	1/7	1/3	1/5	1

TABLE III
EVENT BASED AHP MATRICE

QoS	App_Pri	Critical	Delay	Bandwith	Coverage
App_Pri	1	1	1/7	1/9	1/3
Critical	1	1	1/7	1/9	1/3
Delay	7	7	1	1/5	5
Bandwidth	9	9	5	1	7
Coverage	3	3	1/5	1/7	1

TABLE IV
CONTINUE BASED AHP MATRICE

Sensor App	App_Pri	Critical	Delay	Bandwidth	Coverage	CRatio
EVENT	0.14	0.14	0.03	0.06	0.15	0.09
CONTINUE	0.0024	0.0024	0.015	0.034	0.0055	0.079
QUERY	0.006	0.008	0.033	0.094	0.018	0.082
HYBRID	0.0071	0.011	0.052	0.109	0.041	0.09

TABLE VII
CONSISTNCY RATIO (CRATIO) AND WEIGHTS W.R.T
APPLICATION TYPE

	AHP	SAW	MEW	TOPSIS
802.11a	0.36250(3)	0.36250(3)	0.4189(4)	0.79960(3)
802.11b	0.17694(4)	0.17694(4)	0.0.49208(3)	0.24901(4)
Satellite	0.38814(2)	0.38814(2)	0.77376(2)	0.84174(2)
GSM	0.47431(1)	0.47431(1)	0.92538(1)	0.98577(1)
UMTS	0.10452(5)	0.10452(5)	0.30011(5)	0.09807(5)

TABLE IX
NETWORK RANKING

consider performance parameters of five different networks i.e. 802.11a, 802.11b, Satellite, GSM, UMTS as well as User Provided QoS parameters. The parameters provided by each network are generated randomly. Selection of the final network depends on the values of the above mentioned attributes. The AHP Matrices regarding each traffic class is shown in Table III, IV, V and VI and resulting weights calculated against each traffic class are shown in Table VII.

A. ***Ranking Approach***

For the simulation of our work, the calculations are done against Event based Application. First the parameters provided by four different networks against each QoS criteria's are converted into fuzzy set, as shown in Table VIII. These fuzzed parameters are then multiplied by the Event based calculated weights provided in Table VII. The final decision is based on highest ranking factor. The ranking distribution for four different methods i.e. AHP SAW, MEW and TOPSIS are shown Table IX. The result shows that Network 4 is the final selection due to highest ranking and the ranking order of AHP, SAW andTOPSIS are same where as in case of MEW, there is a slight variation in decision factor of Network 1 and Network 2. This variation factor in ranking is due to penalizing behavior of MEW algorithm. MEW always give lower rank to the alternative which has poor attributes as compared to other one. In this scenario, Network 1 has poor attributes as compared to Network 2, which can be verified by taking the average and variance of attributes as shown in Table VIII. Although this decision of MEW seems to be good but MEW has considered only the over all average of parameters for its decision ranking and did not considered the weights assigned to these parameters. Therefore Network1 which is providing high bandwidth and less delay has not been assigned
high rank. This means that MEW lacks behind in assigning a good ranks.

B. ***Stability Approach***

In this simulation, we concentrate on the non stability ranking problems between algorithms. Focusing on the ranking done by the algorithms in Table X, we start removing the lowest ranking decision alternative from the table. Results shows that AHP, SAW and MEW remain stable in their ranking decision; where as the ranking order of TOPSIS has been changed. This abnormal behavior of TOPSIS is due to the large variation in its assigned values of ranks. Table X and Table XI, is showing abnormal behavior of TOPSIS before and after removal of lowest Rank alternative

QoS	App_Pri	Critical	Delay	Bandwidth	Coverage
App_Pri	1	1/2	1/5	1/9	1/4
Critical	2	1	1/5	1/9	1/4
Delay	5	5	1	1/5	5
Bandwidth	9	9	5	1	7
Coverage	4	4	1/3	1/7	1

TABLE V
QUERY BASED AHP MATRICE

QoS	App_Pri	Critical	Delay	Bandwith	Coverage
App_Pri	1	1/2	1/7	1/9	1/4
Critical	2	1	1/7	1/9	1/3
Delay	7	7	1	1/5	2
Bandwidth	9	9	5	1	2
Coverage	8	3	1/2	1/2	1

TABLE VI
HYBRID BASED AHP MATRICE

	Sensor App	App_Pri	Critical	Delay	Bandwith	Coverage	Mean	Variance
802.11a	0.787	0.656	0.00004	0.1312	0.4949	0.0383	0.35122	0.1146
802.11b	0.2274	0.3279	0.8995	0.3137	0.2517	0.433	0.40887	0.05291
Satellite	0.8424	0.1845	0.5082	0.4522	0.3256	0.3801	0.44883	0.04964
GSM	0.8865	0.7613	0.8838	0.4574	0.7992	0.134	0.65372	0.03968
UMTS	0.0653	0.3751	0.3735	0.484	0.9695	0.3421	0.43492	0.03815

TABLE VIII
NETWORK PROVIDED PARAMETERS

	AHP	SAW	MEW	TOPSIS
802.11a	0.305290(5)	0.305290(5)	0.667105(5)	0.15140(3)
802.11b	0.457316(2)	0.457316(2)	0.877490(1)	0.6090(1)
Satellite	0.383(3)	0.383(3)	0.735(3)	0.4702(3)
GSM	0.4577(1)	0.4577(1)	0.8297(2)	0.608(2)
UMTS	0.3818(4)	0.3818(4)	0.6984(4)	0.378(4)

TABLE X
RANKING ANALYSIS FOR TOPSIS: CASE I

	AHP	SAW	MEW	TOPSIS
802.11a	-	-	-	-
802.11b	0.46(2)	0.46(2)	0.88(1)	0.85(2)
Satellite	0.38(3)	0.38(3)	0.73(3)	0.74(3)
GSM	0.46(1)	0.46(1)	0.83(2)	0.85(1)
UMTS	0.38(4)	0.382(4)	0.698(4)	0.73(4)

TABLE XI
RANKING ANALYSIS FOR TOPSIS: CASE II (ABNORMALITY)

N	AHP	SAW	MEW	TOPSIS
5	0.0063	0.0062	0.0024	0.0021
10	0.0068	0.0068	0.0118	0.0089
20	0.0036	0.0036	0.0060	0.0059
50	0.0021	0.0021	0.0038	0.0032
100	0.0014	0.0014	0.0027	0.0023
250	0.0009	0.0009	0.0018	0.0014
400	0.0007	0.0007	0.0014	0.0011
700	0.0006	0.0006	0.0010	0.0009
1000	0.0005	0.0005	0.0009	0.0007

TABLE XII
STANDARD ERROR OF MEAN

AHP	SAW	MEW	TOPSIS
0.03	0.03	0.10	0.16
0.01	0.01	0.02	0.07
0.02	0.02	0.02	0.11
0.01	0.01	0.03	0.10
0.01	0.01	0.01	0.09
0.02	0.02	0.05	0.09
0.02	0.02	0.07	0.11
0.01	0.01	0.02	0.10
0.01	0.01	0.01	0.07
0.01	0.01	0.04	0.11

TABLE XIII
VARIATION FOR COMPARISION OF MVUE

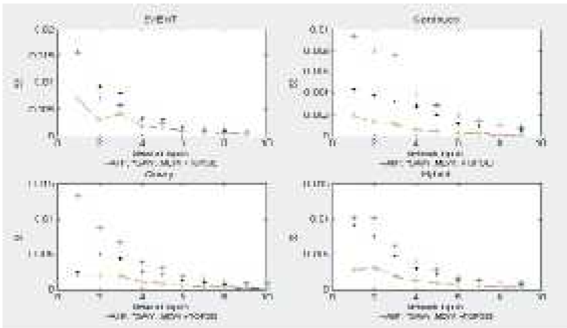

Fig. 3. Standard Error of Mean for AHP, SAW, MEW and TOPSIS

C. *Estimator Analysis*

Estimator is one of the Statistical branches where estimated value is calculated through given empirical data or measured data. The purpose of estimator is to find the desired results which are embedded as noisy signal in the available data. Although the aim is to find estimator that exhibits optimal behavior. However which is not possible [21]. Among the list of these estimators, we have used SED and MVUE for the analysis of our above algorithms.

Mean squared error: MSE of an estimator also called second moment of error [22] taking both the variance of the estimator and its bias in account. The difference between estimated and true value is actually the error, which comes due to randomness or malfunctioning of estimator. The MSE for unbiased estimator is a variance. On the other hand the under root of MSE is called the root mean squared error or RMSE and at some places also known as Standard Error (SEM). RMSD or standard error is considered as a good measure of accuracy.

For this the term standard error is often used to calculate the unknown values. The value of this standard error is very helpful in providing the indication of the amount uncertainty in the decision based on mean value. SEM is usually calculated as sample estimation of the population standard deviation divided by the square root of the sample size as shown in eq 15

$$SE = \frac{s}{\sqrt{n}} \quad (15)$$

where s is the sample standard deviation and n is the size of the sample. While considering the case of our AHP, SAW, MEW and TOPSIS method, the analysis has been drawn against SEM. The results of SEM are basically showing the efficiency of a methodology in relation to its unbiased estimator. The minimum the value of SEM estimator, the more efficient will be the methodology. It is because according to statistical rule in SEM as the value of sample size increases the resultant should move in decreasing order. The lower the SEM estimator value, the lesser will be the error or deviation of the quantity from the true value. Table XII and Fig 1 is showing the SEM resultant against different sample sizes and the behavior of this result show that AHP and SAW have the least biased value as compared to other two algorithms. So therefore we can say that AHP and SAW is showing better efficiency as compared to other two algorithms.

Minimum-Variance Unbiased Estimator A Uniformly Minimum-Variance Unbiased Estimator or Minimum-Variance Unbiased Estimator (UMVU or MVUE) is an unbiased estimator that computes low value of variance as compared with any other unbiased estimator. For finding the MVUE usually the comparison is done in terms of ratio between unbiased estimator variances. This comparison ratio is basically the efficiency of estimator. The efficiency for this estimator is normally stated in a relative terms. If we state _1 as unbiased estimator of sample 1 and _2 as unbiased estimator of sample 2, then the ratio between their variance states that VAR (_1) and VAR (_2) represents the measure of relative efficiency of _1 with respect to _1. If VAR (_1) is less than VAR (_2) then _1 is considered as more efficient than VAR _2. For checking the efficiency factor of our algorithms i.e. AHP, SAW, MEW and TOPSIS, we again calculate their variances against each ranking decision. These results are shown in XIII.For MVUE purpose six different ratio factor related variance have been calculated. These six different pairs are

1. VAR AHP vs. VAR SAW 2. VAR AHP vs. VAR MEW 3. VAR AHP vs. VAR TOPSIS
4. VAR SAW vs. VAR MEW 5. VAR SAW vs. VAR TOPSIS 6. VAR MEW vs. VAR TOPSIS

Comparison between their variances ratio again shows that AHP and SAW both have minimum variance unbiased estimator as compared to MEW and TOPSIS. Where as this estimator has ranked MEW at the second position and TOPSIS at last or third position. Thus the non stability and inconsistency in TOPSIS is due to having largest variability ratio as compared to other algorithms. That is why any small change in it rank creates major changes in it decision stability and consistency.

4 **CONCLUSIONS**

In this paper the selection of network for sensor based applications has been done by making use of AHP, SAW, MEW and TOPSIS algorithms. Parameters included for decision making are application type, bandwidth, delay, coverage area, security and priority. A number of limitations have been identified during the comparison study of these algorithms. For the simulation of this decision making process, Matlab is used. Results show that more that 80-85% of times the decision made by SAW, MEW, TOPSIS and AHP is same, whereas 20% times they made different ranking decisions. Comparison shows that TOPSIS is suffering from abnormality behavior of ranking, MEW is penalizing poor attributes and makes judgment on the mean and average value of attributes, where as AHP and SAW as compared to other two algorithms shows more stable, less risk proven and penalizing judgment behavior.

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