Routing for Computing and Constrained Mobile Ad-Hoc Network Environment

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Abstract:- Routing Mechanism in Mobile Adhoc Networks is a difficult task since it has to react proficiently in horrible and unfavorable situations and support conventional IP services. Additionally, the Quality of Service is needed to help the rapid growth of video in mobile traffic. As an outcome, enormous efforts have been committed to design of QoS routing in MANETs. The independent nature of QoS routing protocols brings results in the absence of one-for-all solution in MANETs. Then, the relative significance of QoS measurements in genuine applications isn't considered in numerous experiments. The one with most astounding weight is the optimal protocol among all the other choices. The reliability and efficiency of SAW-AHP are validated through simulations. An integrated architecture, using evaluation results of SAW-AHP is proposed which incorporates the ad hoc technology into the existing WLAN and therefore provides a solution for the last mile access problems. The protocol selection induced cost and gains are also discussed. We conclude the paper by describing a potential application.

Keywords: *Routing,MANETS, computing, adhoc environment, routing issues.*

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1. Introduction

AHP has been applied successfully in a number of practical Multi-Criteria DecisionMaking (MCDM) problems. In spite of its popularity, the validity of AHP has beendiscussed ever since its introduction. The discussion has concentrated on four areas[15], rank reversal [3]-[8], inconsistent judgement [1][10], the 1-9fundamental scale [6][7] as well as the axioms of the pair-wise comparison [3].Most of those problems have been solved at least for three-level hierarchy structure [1][4][7] and this paper will not contribute further to this discussion. Thischapter targets performance evaluation of alternative routing protocols in MANETswith SAW-AHP.

One main target of a MANET is to exchange information reliably. As a consequence,packet delivery ratio (PDR), which reflects the reliability of the whole network, isselected.Delay reveals the network's efficiency and is a critical criterion especially fortime-sensitive systems. Therefore, delay is accepted as a criterion. There are somefactors that influence the delay. The distance from the source to the destination,together with time required by every hop largely dictate the total delay. The optimumroute should have the smallest delay.

Every packet may reach the destination with different delays due to factors such ascongestion and collision, and the difference is measured by jitter. Jitter is of greatimportance for live videos and thus it is considered as a criterion.The throughput reflects the network resource utilization. It is a valuable metric for anetwork operator. An ideal routing protocol allocates traffic evenly and thus a higherthroughput is achieved.

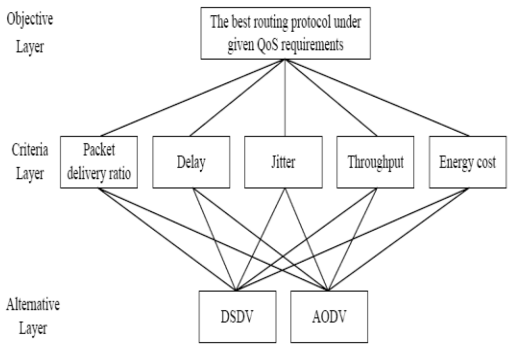

Figure1Hierarchy structure

2. Literature Survey

A. Ad-hoc routing protocols Many previous ad-hoc routing protocols require greater energy resources of the nodes and higher bandwidth than what is available in sensor networks. For example, Dynamic Source Routing (DSR) [6] floods a route request packet throughout the network. Location Aided Routing (LAR) [8] improves DSR and uses geographic location information to limit the route request flooding to a smaller region, where it is most probable the destination is located. Geographic location information has been used to develop efficient, scalable routing protocols. Geographic routing allows routers to be stateless and requires propagation of topology information for only a single hop. Most geographic ad-hoc routing protocols use greedy algorithms to forward the packet to the destination.

They differ in how they recover when greedy forwarding is impossible, e.g., at communication holes or when avoiding obstacles.

H. Lee-Kwang [2] proposes flooding search for recovering from local maxima. GPSR recovers from local maxima by deriving a planar graph out of the original network graph and then routing around the perimeter of the region containing a local maximum. A drawback of GPSR is that it tends to concentrate traffic on the perimeter when it routes around holes or obstacles, thus burning out the nodes on the perimeter sooner. Geographical and Energy Aware Routing (GEAR) [12] achieves good energy efficiency. GEAR is based on a real-time heuristic search method, Learning Real-Time A* (LRTA*) [10].

It uses energy aware and geographically informed neighbor selection to route a packet towards the target region. The strategy attempts to balance energy consumption and thereby increase network lifetime. In related work, CADR [1] uses a sophisticated information metric derived from sensor data to guide the routing process. Directed diffusion [5] is a data-centric paradigm for sensor network applications. All communication is for named data and all nodes are application aware. This enables diffusion to achieve energy savings by selecting good paths. It uses initial and periodic data flooding throughout the network. Data generated by sensor nodes is named using attribute-value pairs. An issue common to these algorithms is that expectations about both the task (e.g., find the destination) and algorithm properties (e.g., conserve energy) are built into the algorithms and cannot be changed easily. Since routing algorithms cannot be uploaded repeatedly onto thousands of already deployed nodes, a more general, programmable approach is highly desirable.

3. Pair-wise comparison matrix and weights for metrics

A decision maker is assumed to be able to compare any two elements, say *Ei* and *Ej*, atthe same level of the hierarchy structure and provide a numerical value *eij* accordingto his/her preference as shown

$$E=\begin{pmatrix} 1 & e_{12} & e_{13} & \dots & e_{1n} \\ e_{21} & 1 & e_{23} & \dots & e_{2n} \\ e_{31} & e_{3n} & 1 & \dots & e_{3n} \\ \dots & \dots & \dots & \dots & \dots \\ e_{n1} & e_{n2} & e_{n3} & \dots & 1 \end{pmatrix}$$

where n denotes the number of elements in a single layer, $e_{ij} > 0$ for any i=1,2,…,n and j=1,2,…,n. The reciprocal property

$$e_{ji}=\frac{1}{e_{ij}}$$

Construction of pair-wise comparison matrices for alternativesAfter empirical data from simulations are normalized, pair-wise comparisons areperformed. For simplicity, but without loss of generality, the detailed procedure ofcomputing weights for alternatives in the case of 2 traffic streams is provided. Thevalue of the corresponding element in the pair-wise comparison matrix for alternativesequals

$$a_{ij}=\frac{d_i^{norm}}{d_j^{norm}}$$

In addition to the two methods, TOPSIS is also a widely adopted method inMCDM problems. In this paper, GRA is adopted for benchmarking. Again, theperformance of DSDV and DSR in the 2 traffic streams network is studied. To beginwith, a decision matrix composed of performance of alternatives is constructed asfollows

$$D=\begin{bmatrix} 0.947 & 1.98 & 2.41 & 3.68 & 0.730 \\ 0.991 & 2.68 & 2.91 & 3.38 & 0.214 \end{bmatrix}$$

Comparison of evaluation resultsThis is an example of the rank reversal problem. To solve this problem andvalidate the reliability of the three evaluation methods, extensive simulations areperformed and a new metric, synthetic improvement ratio index (*SIRI*), is developed inthe following sections.

number of flows	protocol preferred		
	SAW-AHP	GRA	TOPSIS
2	DSR	DSDV	DSR
6	DSDV	DSDV	DSDV
10	DSDV	DSDV	DSDV

Table-1 Comparison of preferred protocol

4. Performance improvement ratio

Prior to defining the synthetic improvement ratio index, a metric, the performanceimprovement ratio denoted by PIR, is developed to specify the level of difference between two alternatives under certain metrics.PIR is defined as the quotient of the difference between the reference and targetprotocols for a value of the reference protocol. For metrics that are "the larger thebetter", *PIRref-tar* is computed via

$$PIR_{ref-tar} = \frac{P_{target} - P_{reference}}{P_{reference}} = \frac{P_{target}}{P_{reference}} - 1$$

PIRs may be aggregated by considering the weights for metrics in an application via

$$AIR_i = c_i \times PIR_i$$

where *AIRi* denotes the aggregated improvement ratio for the *i'th* metric and *ci* denotesthe weight for *i'th* metric. AIR reflects the impact of performanceimprovement/deterioration of a metric on the overall QoS satisfaction. AIRs aresynthesized to obtain the synthetic improvement ratio index (SIRI)

$$SIRI = \sum_{i=1}^{n} AIR_i$$

A positive SIRI is desired because it indicates system improvement when a targetprotocol is selected. On the contrary, a negative SIRI reveals performance deteriorationif the target protocol is selected.

5. Results

Table 2 itemizes fuzzy weights for packet delivery ratio, delay, jitter, throughput andenergy cost, using FGMM.

Criterion	Fuzzy weights	
	DSDV	DSR
packet delivery ratio	(0.466, 0.489, 0.524)	(0.488, 0.511, 0.548)
delay	(0.295, 0.575, 0.971)	(0.220, 0.425, 0.723)
jitter	(0.380, 0.547, 0.719)	(0.315, 0.453, 0.596)
throughput	(0.432, 0.521, 0.604)	(0.396, 0.479, 0.554)
energy cost	(0.182, 0.227, 0.628)	(0.614, 0.773, 2.122)

Table-2 Fuzzy weights for DSDV and DSR

The synthetic weight for DSR overlaps with that of DSDV's. The next step is todetermine which weight is larger. Optimist considers DSR to be a better solution since"DSR-2" could be larger than "DSDV-2" while pessimist regards DSR worse thanDSDV due to the reason that "DSR-2" could be smaller than "DSDV-2". Similarresults are also observed in [9].

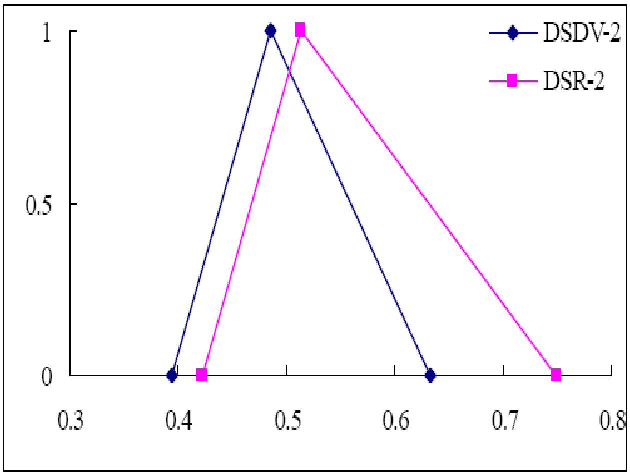

Figure-2 Fuzzy synthetic weight for 2 streams

The aggregated weights for DSR under the above three metrics are smallerthan that of DSDV, indicating that DSDV outperforms DSR in delay, jitter andthroughput.

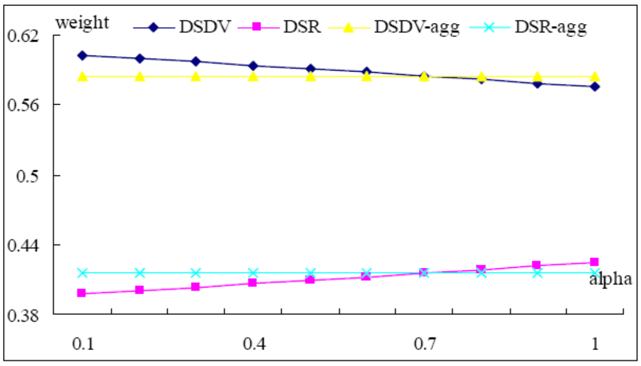

Figure-3Alternative weights under delay

6. Conclusion

SAW-AHP is extended to fuzzy SAW-AHP by considering standard deviations and thusthe latter is more accurate. Two algorithms, FGMM and FPP, are applied to deriveweights from fuzzy SAW-AHP comparison matrices. FGMM leads to fuzzy weights,which may result in different, sometimes contrary ranking orders and therefore it isabandoned. FPP is able to give crisp synthetic weights reliably based on whichalternatives are ordered.However, the distance of weights using FPP and SAW-AHP varies in different streams.It is observed that the distance depends on the ratio of standard deviation over averagevalue (RSDA). Averagely, RSDA of 6 streams are much larger than that of

2 streamsand therefore weights using FPP and SAW-AHP are closer compared to those of 6streams. Likely, weights of DSDV in 10 streams are closer compared to 6 streams, butfarther than that of 2 streams. Similar relationship also holds for DSR. It is henceconcluded that the distance between FPP and SAW-AHP depends on the ratio ofstandard deviation over average value.

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