A Survey on Least Cost Any Path Routing in Wireless Networks

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Abstract---Wireless Networks has undergone tremendous technological advancement in last few decades. Major industrial applications and research work is focus to enhance various critical aspects like packet delivery, optimum path routing and packet level security enhancement. Current technological challenges address the issue of multicast routing in wireless networks for the packet transmission from source to destination with the use of created network topologies for long distance scenarios. Various method are adopted to address the issue of packet delivery probability and the use of nearest neighbour opportunity of the node in various wireless Networks.

I. INTRODUCTION

Reviewing the Routing algorithm in the wireless network and I found the how the packet send the source to destination node. But in the single path routing the path was fixed for source to destination node. It has no opportunity for transmitting the packet from source to destination via a different path. When we apply the any path routing at that time we have one opportunity to transmit a packet via different path so we can say that the multiple path are available for transmitting the packet. Literature review I found the paper which gives the same idea for the unicast. It is the use the opportunity of the nearest neighbour node for transmitting the packet source to destination in unicast. That algorithm of routing known as the Least Cost Any Path Routing [1] In this the Cost calculated for each and every node and compare with all and take a least value of that for unicast. It is not apply for the multicast.so we will try to apply on the multicast as a general routing approach.

II. COST PROBLEM

Due to the increasing demand of wireless network the large numbers of node are established. In this huge network the packet transmission cost for send source to destination node become high [1] [2]. We also apply the shortest path routing algorithm, bellman ford distributed approach and etc. In this routing types it was not used the neighbour's node and opportunity node but in the least cost any path routing approach we consider that thing and reduce the cost of routing. Cost as parameter delivery probability of the packet or we use the packet transmission ratio of the delivering probability for source to destination.

III. SCOPE OF ROUTING

Compared to traditional cellular architectures, ad hoc networks are much more flexible for multi- hop routing. In Wireless Sensor Network the nodes are often stationary, and it offers much desirable flexibility in placing [3]. Much work has already been published on multi-hop routing for both ad-hoc and sensor networks. The Least cost any path routing the cost transfer packet source to destination which is less.

Here I have reviewed various papers on opportunistic routing and Least Cost Any Path Routing and Comparison on both, a new concept for routing with the help of neighbour's node and packet transferred source to destination. In this opportunity means the present node find the opportunity node where it is transferred and then decide which one is the best way of transmitting the data from source to destination with the help of opportunities routing.

IV. LITERATURE REVIEW

Here I have reviewed various papers on opportunistic routing and Least Cost Any Path Routing and Comparison on both, a new concept for routing with the help of neighbour's node and packet transferred source to destination.

For example, with unreliable wireless links, the probability of a packet being successfully received by at least one node in a set of neighbour's is usually greater than the probability of one specific node receiving it. This observation motivates the idea of opportunistic routing (OR) [3].

I found the how to use the opportunity and candidate relays and the minimal path of the routing. LCAR routes are more robust and stable than those based on single-path distances, due to the integrative nature of the LCAR's route cost metric.

All the paper gives the general purpose way to routing for unicast. But it is not applicable for the multicast in wireless network. We have some heuristic approach are available for finding the least cost in multicast.

V. SINGLE PATH ROUTING

In Single path routing we have a fixed path and we would go through that path. So we can say that the path established first and then the transmitting packet are transmit. Like the algorithm available is the dijkstra, link state routing, etc.

VI. VALUABLE DETOURS (ANY PATH ROUTING)

The use of a single-path metric would prevent the source from using any of its neighbour's in the upper dense area, because in single-path distance they are further from the destination than the source itself. However, sending a packet via the dense mesh takes advantage of any cast forwarding and is often cheaper than via the four-node strand at bottom, even if it goes through more hops**.**

The any path routing has multiple paths available for the transmitting packet from source to destination. But in single path metric have no this type of opportunities.

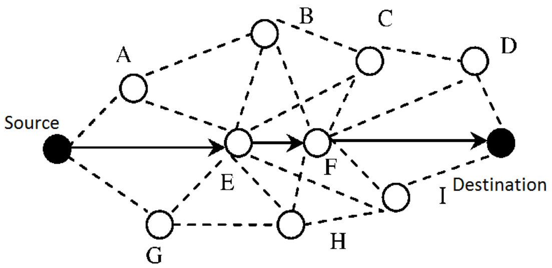

Fig.1: Valuable Detours

VII. WHY NOT USE SHORTEST SINGLE-PATH METRICS?

Consider with one example, Let us assume that all link have packet delivery probability is p=0.50 and the probability of the sending source to destination the delivery probability is p^3 = 0.125. When we use the candidate relays and the delivery probability is $(1\text{-}(1\text{-}p)^{3)4}.p=0.2930$.

In the shortest single-path metrics it ignores the opportunity and the result is the lower delivery probability.

We consider the problem of finding a single-path intra-domain routing for time-varying traffic. We characterize the traffic variations by a finite set of traffic profiles with given non-zero fractions of occurrence. Our goal is to optimize the average performance over all of these traffic profiles

Notation and Meaning	
N(i)	Neighbors of node i
P_{ij}	Packet delivery probability from i to j
J(i) (or J)	Group of Candidate relay set (CRS) at node i
d_{ij}	Any cast link cost (ALC) from i to j
R_{ij}	Remaining path cost (RPC) from J to the destination.

Table.1: Notation and Meaning

VIII. PROPERTIES OF LEAST COST SINGLE PATH ROUTES

A. *Least Cost Single Path Route And Any Path Route Can Be Disjoint.*

We have now seen how any path routes generalize single-path routes and that the least-cost any path route is equal to the least-cost single-path route when there is no gain to be had from selecting candidate relay sets of size greater than 1 [3]. It might appear natural to infer from these facts that the least-cost single-path route is always included in the least-cost any path route

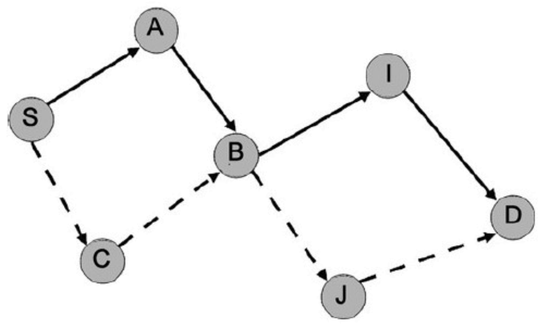

Fig.2: Least cost Single path routes

B. *Asymmetry of Least Cost Single Path Route*

A network with two end-points A and B, and three intermediate nodes all links have delivery probability 0.9, except for one link that has delivery probability 0.1. The ALC metric is expected transmission count (ETX).

C. *Sub Path Of Least Cost Single Path Routes Are Also Least Cost Single Path Route.*

In single path routing, the sub-paths of a shortest path route are themselves also shortest- paths. For example, if (n1,n2,n3,...nk−1,1) is a shortest single-path route from n1 to 1, then (n2,n3,...nk−1,1) is a shortest-single path route from n2 to 1, n3,...nk−1,1 is a shortest-single path route from n3 to 1, and so on. This fact is obvious and is usually not even stated explicitly in the context of single-path routing

IX. FIND THE LEAST COST SINGLE PATH [7]

1) Transmission-count metric (ETX): As a first example of ALC, we can generalize the expected transmission count (ETX) [1] metric for unicast transmission. With link-layer any- cast, the ETX becomes the expected number of transmissions until any node in J receives the packet. Its expression is:

$$d_{iJ}^{ETX} = \frac{1}{p_{ij}} \quad (1)$$

$$P_{ij} = 1 - \prod_{j\in J}(1 - p_{ij}) \quad (2)$$

2) Delivery probability metric (E2E): Another possible any cast link cost simply considers the probability of successful packet delivery. This any cast link cost is defined as negative logarithm of piJ, so that the costs can be added across several any cast links to obtain the end-to-end delivery probability:

$$d_{iJ}^{ETX} = -\log p_{ij} \quad (3)$$

The part is the remaining path cost which is depending on the candidate relay sets. Denoted R_{iJ}, as the expected cost to reach the destination from the CRS J to which node i has any cast a packet. The breakdown of any path route's cost into ALC and RPC is illustrated in

Figure 2.1 Denote by D_k the cost to reach the destination from a node k. If the distance is equal for all at that time, the RPC can be computed as

$$R_{iJ}^{best} = \frac{p}{1-(1-p)^n}\sum_{j=1}^{n}(1-p)^{j-1} D_j \quad (4)$$

And the general formula for finding the RPC as below

$$R_{iJ}^{best} = \frac{1}{1-\prod_{k\in J}\overline{p_{ik}}}\left(p_{i1}\, D_1 + \sum_{j=2}^{n} p_{ij}\, D_j \left(\prod_{k=1}^{j-1}\overline{p_{ik}}\right)\right)$$
(5)

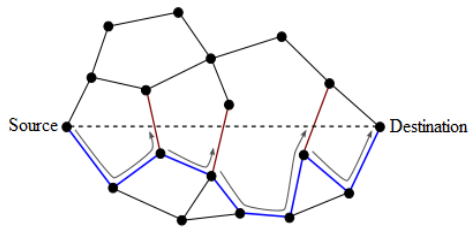

Fig.3: any path route

As illustrated in Figure 4, the expression to minimize is the sum of the ALC and RPC, which must be minimized over all possible subsets J ⊆ N

$$D_i = \min_{J\in 2^{N(i)}}\left[\, d_{iJ} + R_{iJ}\right] \quad (6)$$

This equation called as the any path Bellman equation. In the least cost the iteration are present and it is represented with h. In one iteration, each node i updates its value

$$D_1^h = 0 \quad (7)$$

And at the last estimated cost is the

$$D_i^{h+1} = min_{J\in 2^{N(i)}} [\, d_{iJ} + R_{iJ}^h \,] \quad (8)$$

The breakdown of an any path route's cost into ALC and RPC is illustrated in

Figure Denote by D_k the cost to reach the destination from a node k. If the distance is equal for all at that time, the RPC (Remaining Path cost) can be computed as

$$R_{iJ}^{best} = \frac{p}{1-(1-p)^n} \sum_{j=1}^{n} (1-p)^{j-1} D_j \quad (9)$$

And the general formula for finding the RPC as below

$$R_{iJ}^{best} = \frac{1}{1-\prod_{k\in J} \overline{p_{ik}}} \left(p_{i1} D_1 + \sum_{j=2}^{n} p_{ij} D_j \left(\prod_{k=1}^{j-1} \overline{p_{ik}}\right)\right) \quad (10)$$

As illustrated in Figure the expression to minimize is the sum of the ALC and RPC, which must be minimized over all possible subsets J ⊆ N

$$D_i = min_{J\in 2^{N(i)}} [\, d_{iJ} + R_{iJ} \,] \quad (11)$$

This equation called as the any path Bellman equation. In the least cost the iteration are present and it is represented with h. In one iteration, each node i updates its value

$$D_1^h = 0 \quad (12)$$

And at the last estimated cost is the

$$D_i^{h+1} = min_{J\in 2^{N(i)}} [\, d_{iJ} + R_{iJ}^h \,] \quad (13)$$

Comparison of single path and any path routing

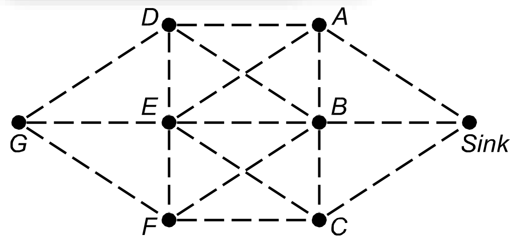

Fig.4: network topology

In this figure all link have probability is 0.4

NODE	SINGLE PATH	ANY PATH	IMPROVEMENT
A	2.50	2.50	0.0 %
B	2.50	2.50	0.0 %
C	2.50	2.50	0.0 %
D	5.00	4.01	19.8 %
E	5.00	3.78	24.5 %
F	5.00	4.01	19.8 %
G	7.50	5.17	31.1 %
TOTAL	30.00	24.46	18.5 %

Table.2: Comparisons of single path and any path

Table. 2 providing the results for the entire network, clearly shows the potential of any path routing. Note that the given network is an intentionally simple example; the advantage of any path becomes more pronounced as the number of hops increases. Note also that we focus on shortest single path routing for comparison. Other protocols would show similar results, as all of them use a single next hop and would thus face the same losses.

X. CONCLUSION

The technique is general and the associated framework can accommodate a number of different network and cost models. One such example is in low-power wireless networks, where we show how least-cost opportunistic routing cans benefit from the use of a novel low-power any cast link-layer. The algorithm is practical and has been implemented on embedded wireless nodes. The LCAR can be useful not only as an algorithmic building block for implementing any path routing protocols, but also as a protocol modelling framework to investigate design questions such as the trade-off between simplifying link-layer any cast coordination mechanisms and having higher routing costs. Least cost any path routing are useful for the minimize the delivery probability cost of the source to destination with the use of candidate relay sets and any cast link cost.

This theory reduces the delivery probability cost, low power consumption and the use of all connected channel for the unicast and multicast in wireless networks. This routing protocol is the general approach and framework.

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