MULTI-HOP NETWORKS WITH ACCUMULATIVE ROUTING

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ABSTRACT

In a wireless network, there is a single source and a single destination or number of destinations associated with the number of relays. Nodes of wireless networks communicate by sending signals transmits a message through a single source to single destination. Signals are in the encoded form when receives at the node it processes decoded/ encodes with information received from previous nodes. In the wireless network, there is a problem of routing path complex and combinatorial problem transmission from source to destination. In this system, we investigate the optimal routing problem in signal transmission from source to destination for the multi-hop network. We use the technique of rate less code which is used to accumulate the data with each packet in the transmission. This can decrease the total energy; reduce delays in transmission for transmitting data from the source to the destination. Proposed system enables significant performance through the shortest path routing using Floyd-Warshall algorithm

Keywords: Accumulative Multi-hop, Energy Accumulation, Minimum Energy, Graph Theory

I. INTRODUCTION

In the wireless network the data transmission between the source and destination maintained by the cooperation among the two nodes. In the tradition network which data transmission between source and destination achieved through the intermediate node that can receive the information from immediate nodes and transmits to next node. Sometimes this problem in the data transmission such as delays in routing requires more energy to transmit the data. In the today's era of the network the relays concept widely used is relay channeling. Compared to traditional system in this, nodes use the information of all nodes instead of nearest one. This concept first proposed by van der Meulen. In this system the relay channel considers one relay assisted to information transmitted between source and destination. This has strong control over the data transmission in the routing in good rates. In this system addressed the problem of Accumulative multi-hop network routing in the communication between two nodes.

The communication between two nodes through the single source to single destination which is accumulated with relays gained from the immediate nodes. The accumulation is done by two ways energy accumulation decoded packet after all energy received from the source node. In the data transmission multi-hop data, we mainly focus on decode and forward strategy while transferring the information from single source to destination. The mutual data accumulated until full message decoded. This can become fully aware of rate fewer codes such as fountain raptor code. This increases the reliability and decreases the energy requirement in the transmission. Studied the problem of routing in multi-hop wireless network using the accumulation of optimal mutual information with help of distress optimality

II. LITERATURE SURVEY

` Wireless Sensor Networks (WSNs) are used in many applications in military, ecological, and health-related areas. These applications often include the monitoring of sensitive information such as enemy movement on the battlefield or the location of personnel in a building. Security is therefore important in WSNs. However, WSNs suffer from many constraints, including low computation capability, small memory, limited energy resources, susceptibility to physical capture, and the use of insecure wireless communication channels. These constraints make security in WSNs a challenge. In this article we present a survey of security issues in WSNs. First we outline the constraints, security requirements, and attacks with their corresponding countermeasures in WSNs. We then present a holistic view of security issues. These issues are classified into five categories: cryptography, key management, secure routing, secure data aggregation, and intrusion detection. Along the way we highlight the advantages and disadvantages of various WSN security protocols and further compare and evaluate these protocols based on each of these five categories. We also point out the open research issues in each subarea and conclude with possible future research directions on security in WSNs.

Wireless Sensor Networks are a new class of Ad Hoc networks that will find increasing deployment in coming years, as they enable reliable monitoring and analysis of unfamiliar and untested environments. The advances in technology have made it possible to have extremely small, low powered sensor devices equipped with programmable computing, multiple parameter sensing, and wireless communication capability. But, because of their inherent limitations, the protocols designed for such sensor networks must efficiently use both limited bandwidth and battery energy. In this paper, we develop an M/G/1 model to analytically determine the delay incurred in handling various types of queries using our enhanced APTEEN (Adaptive Periodic Threshold-sensitive Energy Efficient sensor Network protocol) protocol. Our protocol uses an enhanced TDMA schedule to efficiently incorporate query handling, with a queuing mechanism for heavy loads. It also provides the additional flexibility of querying the network through any node in the network. To verify our analytical results, we have simulated a temperature sensing application with a Poisson arrival rate for queries on the network simulator ns-2. As the simulation and analytical results match perfectly well, this can be said to be the first step towards analytically determining the delay characteristics of a wireless sensor network.

In Wireless Sensor Networks (WSNs), authentication is a crucial security requirement to avoid attacks against secure communication, and to mitigate against DoS attacks exploiting the limited resources of sensor nodes. Resource constraints of sensor nodes are hurdles in applying strong public key cryptographic based mechanisms in WSNs. To address the problem of authentication in WSNs, we propose an efficient and secure framework for authenticated broadcast/multicast by sensor nodes as well as for outside user authentication, which utilizes identity based cryptography and online/offline signature (OOS) schemes. The primary goals of this framework are to enable all sensor nodes in the network, firstly, to broadcast and/or multicast an authenticated message quickly; secondly, to verify the broadcast/multicast message sender and the message contents; and finally, to verify the legitimacy of an outside user. This paper reports the implementation and experimental evaluation of the previously proposed authenticated broadcast/multicast by sensor nodes scheme using online/offline signature on Tiny OS and MICA2 sensor nodes.

III. SYSTEM DESIGN

The Accumulative Network Model

Think about a static system with N hubs. The movement is unicast, from a source hub (S) to a goal hub (D) with the assistance of transfer transmissions. Transfer hubs transmit as indicated by a given transmission arrange which is portrayed by a way vector p, where $p[0] = S$, $p[L + 1] = D$, and $L \leq N - 2$ is the quantity of transfers. Notice that we just permit one hand-off hub in every way position. Interchanges can be either point-to-multipoint as in remote channels, or point-to point as in wire line channels. In TM correspondences, see Fig. 1, given a way p, the flag transmitted by hub p[i] is just expected to hub p[i + 1]. This is along these lines, regardless of whether transmissions are over remote channels, and the transmitted signs are additionally overhead by hubs in the way other than the planned ones. These hubs disregard or regard as impedance the non planned got signals. In TM steering issues, the system is very much displayed by a coordinated chart G(V,E), as the one appeared in Fig. 2, where V is the arrangement of hubs and E is the arrangement of edges speaking to the presence of connections between sets of hubs. Let eu,v signify the edge between hubs u and v. A way p exits if ep[i],p[i+1] ∈ E for all I = {0,...,L}. Related to each edge, there can be one or a few settled measurements, e.g. the connection remove, the connection data transfer capacity, the channel greatness, the transmission delay, and so on. For straightforwardness, let us as expect that there is just a single metric for every edge, at that point β (eu,v) = βu,v means the metric related to edge eu,v.

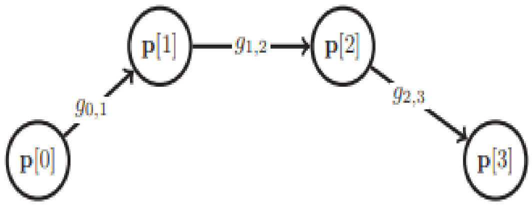


Fig. 1. TM communication model

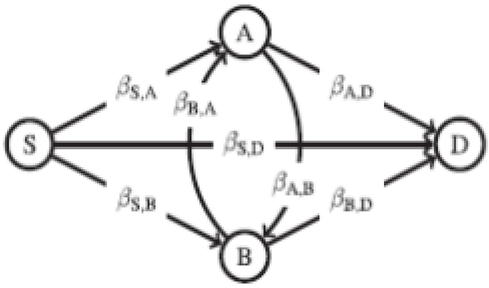


Fig. 2.TM directed graph model (N= 4) for unicast multihop routing in wireless communication channels

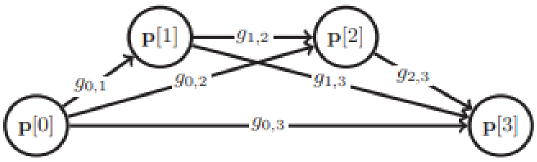


Fig. 3. AM communication model.

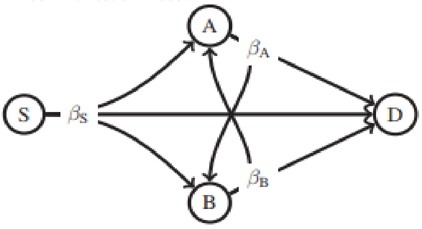


Fig. 4. AM hypergraph model ($N = 4$) for unicast accumulative multi-hop routing in wireless communication channels. If we associate one metric for each of the vertices of the hyperedge, then $\beta_S = \{\beta_{S,A}, \beta_{S,B}, \beta_{S,D}\}$, $\beta_A = \{\beta_{A,B}, \beta_{A,D}\}$, $\beta_B = \{\beta_{B,A}, \beta_{B,D}\}$.

IV. OPTIMALITY OF DIJKSTRA'S ALGORITHM IN ACCUMULATIVE NETWORKS

In previous section, we have provided the different path weight functions that we have encountered when addressing the problem of finding minimum energy paths in static accumulative multi-hop networks. We have seen that in some cases the path weight functions can be computed over graphs as for the TM, DF SAM, DF DAM and PF DAM networks, however in general, we have required hypergraphs to compute path weights function in AM networks. Here, we address the problem of finding the conditions that guarantee that a certain path search algorithm finds the lightest path in accumulative multi-hop networks. Whenever the routing problem can be represented by a graph, the conditions that guarantee the optimality of Bellman-Ford and Dijkstra's algorithms can be found in [2]. Here, we limit the discussion to the Dijkstra's path search algorithm over the directed hypergraphs H(V, E) introduced in previous section. To that end, we first review the well known optimality conditions for Dijkstra's algorithm in graphs and discuss their extensions to hypergraphs. We show that the resultant conditions are only sufficient but not necessary for optimality.

This is shown by providing a new set of sufficient conditions for optimality. In the next section, we use these new conditions to prove the optimality of Dijkstra's algorithm for the CB and DF EAM path weight functions. We begin by providing the mathematical representation of a path selection criteria which is usually called as routing metric. We represent a routing metric following the notation in [2] as an algebra on top of a quadruplet (Q, ⊕, w,), where Q is the set of all possible paths, ⊕ is a binary operation that maps pairs with a path and an ordered sequence of nodes into a path, i.e. if the path a ∈Q and the last node in a coincides with the first node of the ordered sequence of nodes b, then a ⊕ b denotes the concatenation of path a with the ordered sequence of nodes b, with a ⊕ b ∈Q, w is a function that maps a path to a weight, and is an order relation, where w(a) w(b) means the path a is lighter (better) that or equal to b. Given a routing metric (Q, ⊕, w,), a routing protocol operates with the path weights of the paths in Q to find the lightest path q ∗ ∈ Q between a source and a destination. The concatenation operation as defined above differs slightly from the one defined in [2] for graphs. In [2], ⊕ concatenates two paths in Q, and returns a path also in Q. The definition of ⊕ presented here is motivated by the fact that in a hypergraph, even if the ordered set of nodes b does not belong to Q, the path a ⊕ b might belong to Q.

A. Extension of Dijkstra's optimality conditions in graphs

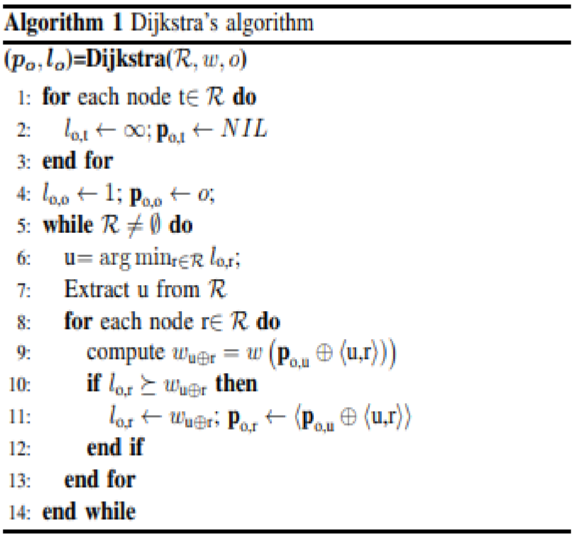
Here we review the conditions that guarantee that Dijkstra's algorithm finds the lightest path in a directed graph G(V, E), and discuss their extension to directed hypergraphs H(V, E). Given a graph, [1] and [2] developed a comprehensive framework to identify the specific conditions a routing metric needs to satisfy in order to be combined with a certain type of optimal routing protocol to obtain the optimal path. In particular, it was shown that Dijkstra's algorithm with source routing is optimal if and only if, the routing metric satisfies right-monotonicity and right-isotonicity. These properties are here stated, mostly, as they appear in [2] with the necessary modifications to account for the new definition of the binary operation ⊕.

Definition 1. The quadruplet (Q, ⊕, w,) is right-monotonic if w (a) w (a ⊕ b), for any paths a and a ⊕ b in Q.

Definition 2. Given the paths a and b between two nodes A and B, and the paths a ⊕ c and b ⊕ c from A to a third node C, sharing the nodes in c. If w (a) w (b), the quadruplet (Q, ⊕, w,) is right-isotonic if w (a ⊕ c) w (b ⊕ c) for any paths a, b, a ⊕ c, b ⊕ c in Q.

B. Alternative Dijkstra's sufficient conditions for optimality in hypergraphs

Although right-monotonicity and right-isotonicity conditions are sufficient to show the optimality of Dijkstra's algorithm, they might not be very helpful for path weight functions in AM networks. The right-isotonicity condition, for instance, can only be satisfied if there is a certain decoupling between the nodes in paths a, or b, and those in path c. However, it is precisely the connection between these nodes what we want to include by considering AM networks. In the following, we present a new set of sufficient conditions that guarantee the optimality of Dijkstra's algorithm in directed hypergraphs, with only one hyperedge per node.



Algorithm 1 Dijkstra's algorithm

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$(p_o, l_o)$=Dijkstra($\mathcal{R}, w, o$)
for each node t∈ $\mathcal{R}$ do
    $l_{o,t} \leftarrow \infty$; $\mathbf{p}_{o,t} \leftarrow NIL$
end for
$l_{o,o} \leftarrow 1$; $\mathbf{p}_{o,o} \leftarrow o$;
while $\mathcal{R} \neq \emptyset$ do
    u= $\arg\min_{r \in \mathcal{R}} l_{o,r}$;
    Extract u from $\mathcal{R}$
    for each node r∈ $\mathcal{R}$ do
        compute $w_{u \oplus r} = w\left(\mathbf{p}_{o,u} \oplus \langle u,r \rangle\right)$
        if $l_{o,r} \succeq w_{u \oplus r}$ then
            $l_{o,r} \leftarrow w_{u \oplus r}$; $\mathbf{p}_{o,r} \leftarrow \langle \mathbf{p}_{o,u} \oplus \langle u,r \rangle \rangle$
        end if
    end for
end while
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V. NUMERICAL RESULTS

The numerical results presented here aim first at showing the benefits of accumulative multi-hoping versus traditional multihoping for the simplistic communication model considered in Section III and second, at evaluating the performance of the proposed DF EAM heuristic routing protocols for the DF AM network. We provide results for the commonly used geometric propagation channel model: the channel gain between nodes i and j is gi,j = d −ν i,j where dij is the distance between these two nodes and ν is the path-loss exponent. For each simulation case, we generate M = 1000 independent scenarios with N nodes randomly and uniformly placed in a square plane of area A = N ρ , where ρ [#nodes/m2] stands for the density of nodes. For each scenario, we compute the path weights from every network node i = [1, ...N] to every node j 6= i, assuming that the rest of nodes are potential relays. Unless stated otherwise, we use N = 10, ρ = 1 and ν = 3.

Recall that the path weight functions are inversely proportional to the energy efficiency of a path. This is, lower weights means more efficient paths. Given a source destination pair let, w TH denote the TH weight of the optimal TH path and w AM denote the weight of the optimal path for any of AM strategies discussed in Section III, namely DF AM, DF SAM, DF DAM, PF DAM or DF EAM. Then, we measure the percentage increase of energy efficiency (IoE) achieved by the AM strategies with respect to the TM strategy as IoE = 100 w TM−w AM wAM . Notice that due to symmetry, for the DF DAM and DF SAM networks we always obtain the same average results and thus, we consider them together. Before showing the numerical results it is meaningful to discuss the path search algorithm complexity in each case. Finding the optimal path for the DF AM network by exhaustive search has complexity order O ((N − 1)!), see [8]. It is well known that Dijkstra's algorithm has complexity order O(N2). Thus, it follows that finding the optimal path for TH and PF DAM networks has complexity order O(N2). For the DF SAM and DF SAM networks, complexity order is O(N3) as we need to repeat the search for every possible first and last relay, respectively. Finally, the complexity order of the DF EAM is O(N4) since the extended hypergraph has O N2 nodes. In Fig. 12 we depict the average IoE for each accumulative strategy as a function of the number of network nodes. Although we consider fixed values for the density of nodes ρ = 1, the same behavior is observed in any other configuration. In general, the accumulative gain increases with the number of network nodes. Observe that DF EAM and DF AM achieve very similar performance. In Fig. 13 we depict the average IoE for each accumulative strategy as a function of the path loss exponent for a network with N = 10 node.

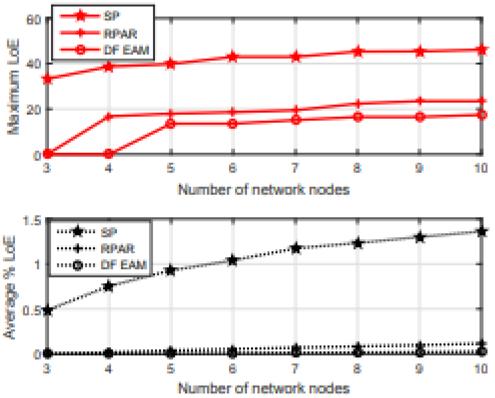

Fig5: Average (dotted) and maximum (solid) %LoE as a function of the number of network nodes (ρ = 1, ν = 3).

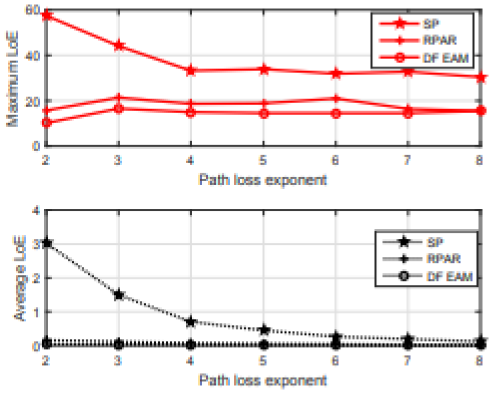

Fig6: Average (dotted) and maximum (solid) %LoE as a function of the path loss exponent (N = 10, ρ = 1)

VI. CONCLUSION

We have studied the routing in a multi-hop network that can minimize the delay and energy consumption using mutual information. The approaches such as fountain code, rate less code that is used for routing purpose and metrics to formulate the network. Energy and mutual information accumulation using relays can be used to find an optimal path using multigraph techniques and reduce communication delay

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