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Reduction of Route Broadcast Flooding for Mobile Wireless Sensor Networks using CCCF Algorithm

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Abstract— In an IEEE 802.15.4 mobile wireless sensor networks has suffered from more control packet overhead during route discovery process. It should be solved by using communication costed controlled flooding algorithm (CCCF) to rectify this overhead. After route discovery, source has shortest path to its destination and as per controlled flooding mechanism, alternative paths were also be established using scope region. When communication costed controlled flooding algorithm started, each nodes in an alternative path maintains additional state (Parameter) for its route cost (hops or distance). If in case of node movement or link disconnection, their predecessor nodes were able to determine its nearest neighbor to act as a bridge between the destination. In that situation, alternative path nodes verified whether it has lowest cost or not. Depends upon the condition, predecessor node takes alternative path because sometimes alternative path has too many nodes (cost, hop or distance) to its destination. So every node movement belongs to destination follows this entire procedure which reduces flooding to the entire network. So these effects, to avoid the overhead, delivery degradation, usage of energy, connection disruption and gives reliable communication reasonably. It gives an insight into the enhancements to improve the existing routing protocols.

Keywords— Control packet; overhead; CCCF; scope region; flooding; additional state; route cost; delivery degradation; alternative path.

I. INTRODUCTION

Wireless sensor network is a special class [13] of ad-hoc network. It has wide range of applications in many fields. It consists of large number of sensor nodes with onboard processing of sensing, computing and communication capabilities. The nature of WSNs brings several advantages over conventional wireless ad-hoc networks, self-organization, rapid deployment, flexibility and inherent [6]. However, the unique feature of WSN presents new challenges in hardware design, communication routing protocols and application design. So, many routing protocol, power management and data dissemination protocols have been designed for WSNs where energy awareness is crucial design issue.

Energy efficiency is one of the critical issues in wireless sensor network because of the devices generally operated with help of battery powered nodes and this cannot be recharged easily [1]. Especially, energy efficiency is one of the most metrics considered on wireless sensor networks [2]. Research focuses mostly on energy aware computing and distributed computing at deployed sensor network.

The limited energy source supplies of the sensor nodes in the network impose lifetime constraints on the WSN. The problem of limited resources in network can be addressed by using them efficiently [13]. Dynamic network topologies and harsh environment conditions may cause more energy consumption on sensor node and performance degradation. This requires WSN to support adaptive network operation including communication protocols to enable end-users to cope with dynamic wireless-channel conditions and varying connectivity. Energy efficient operation is required to maximize the network lifetime by implementing energy efficient protocols (e.g.) energy aware routing in network layer, energy saving mode on MAC layer, etc. [2].

A WSN technology must be address different challenges to realize the numerous envisioned applications. This requires modifying protocols or depending on the appropriateness of the environment where the sensor will be deployed. Designing new effective communication protocol mechanism to address them in WSN.

Energy consumption and throughput of large number of deployed heterogeneous sensor network will get slow performance and improper usage of network resources. Specifically, energy resources were used massively due to the process of network flooding and insufficient protocol for those dynamic networks. The most of the energy consumed at processing of routing protocol where data could be transmitted from source to destination. There are various existing protocols has its own protocol issues like routing overhead, energy efficiency, packet delivery ratio, average end-to-end delay. So this problem should be identified and solved by modifying the routing protocol such as adding new attribute or redesigning the existing protocol according to the energy dissipation.

In an ad-hoc network model, the entire routing task initiated through the network flooding which gather information about all placed sensor nodes and getting the route path information. But the working protocol has a crucial issue called overhead which consumes much energy due to this network flooding and control packet overhead.So in order to avoid and reduce these overhead problem by implementing the optimized or resigned protocol to address this issues which gradually increase the energy efficiency. In a traditional IEEE 802.15.4 mobile wireless sensor networks and most recent technique like cross-layer network model [31] have been investigated in literature. One of the major finding from both network is that these networks suffer from more control packet overhead. This will create delay and less delivery degradation. So that due to this problem, the entire network may consume more energy. In an existing routing protocol, usually It transfers the broadcast messages (Flooding) to discover nodes presented in whole network to achieve data transmission. Once route discovery established, source sends their data messages to its destination along the active path. The problem is, once this path has been disconnected or node failure, the entire network should be rebroadcasted to find another route between source to destination. Consequently, it will create overhead and delay at the resulting end. So we solve this problem by using communication costed controlled flooding algorithm (CCCF**)** to rectify this overhead.

II. RELATED WORK

Reference [31], introduced cross-layer operation mechanism that considers routing, minimizing control packet overhead with the help of location based node movement. But still this model has more control packet overhead problem during route discovery.

Reference [60], introduced avoiding network-wide broadcasting with controlled flooding that uses alternative routing mechanism to avoid the connection disruption on autonomous fashion. But the problem is decision making of shortest path between predecessor and destination node will be trouble and creates more delay.

When connection or node failure problem occurred at data transmission, decision making is one of major problem when selecting shortest path between two nodes. Because this will create more overhead and delay.The proposed Algorithm follows certain rules to solve connection or node failure problem in an autonomous fashion to avoid overhead and delay.

III. COMPARATIVE ANALYSIS

Comparisons between AODV, DSR and DSDV:

A. DSDV (Destination sequenced distance vector)

Each mobile nodes advertises routing information using broadcasting or multi-casting which is maintained in respective routing table [16]. It performs predictably, delivered virtually all data packets at low node mobility and failing to converge when node mobility increases [18].

B. DSR (Dynamic source routing)

This routing protocol entirely follows the source routing because only source is responsible for providing information of whole routing path. It will be achieved through route discovery and route maintenance. An Intermediate node not provides any information about destination.

C. AODV (Ad hoc on-demand distance vector)

Major difference between AODV and DSR protocol is that DSR uses source routing because each packet carries complete path to be traversed. But intermediate nodes lead to inconsistent routes if source sequence number is very old and due to the latest destination sequence number, stale entries will create the error on network communication [18].

Multiple route request packets in response to single route request can lead to heavy control overhead. But still requires the transmission of many routing overhead packets. If in case of higher rates of node mobility its actually more expensive than DSR

An attempt has been made to study and analyze different protocols like DSDV, DSR and AODV. Generally on-demand protocols (DSR and AODV) perform better than DSDV [18], Especially when mobility increases. Even with lower mobility, DSDV suffer from big packet loss. When it comes to power requirement proactive protocols has high power consumption than on-demand protocols [16] [21].

A. Case 1: Number of Connecting Nodes varied.

1) End-to-End Delay: All three protocols show same delay for small number of nodes, but the delay decreased with increasing nodes for DSDV network [16][18]

2) Packet Loss: It remains same for all three protocols, when numbers of nodes are less, but Comparatively DSR show maximum Packet Loss with increasing number of nodes.

3) Packet Delivery Ratio: Performance of AODV remains constant for increasing number of nodes, whereas for DSDV Packet Delivery Ratio is more than DSR.

4) Throughput: The performance of AODV, DSDV and DSR remains almost constant for increasing number of nodes but AODV and DSR provide better Throughput than DSDV [21].

B. Case 2: Pause time Varied.

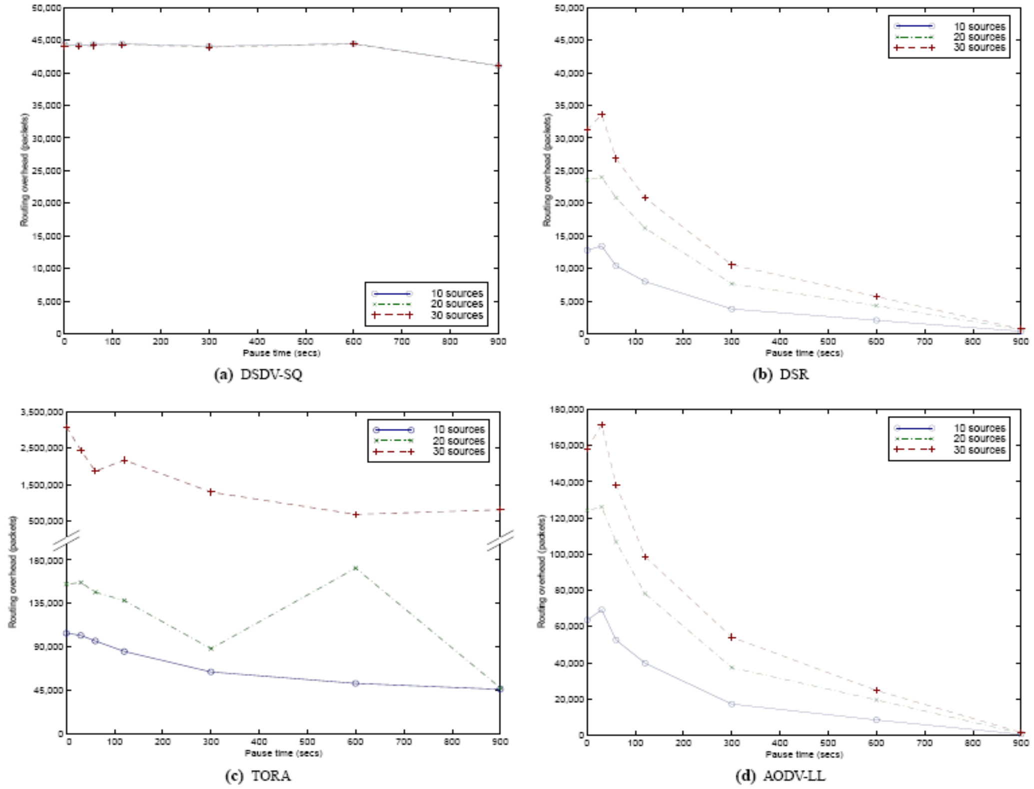
1) End-to-End Delay: AODV serves the best among all the protocols [21].

2) Packet Loss: DSDV outperforms all other protocols in all different conditions.

3) Throughput: DSDV outperforms the other two protocols but Comparatively AODV shows better performance than DSR protocol [18].

Routing overhead vs. pause time and load

On demand routing protocols DSR, and AODV-LL increase routing packets as load increases due to an increase in the number of destinations.



Speed: 20 m/s

Fig.1. Routing overhead vs. pause time and load

Overhead in bytes

If network routing overhead is measured in bytes and includes the bytes of the source route header that DSR replaces in each packet, DSR becomes more expensive than AODV-LL [16].

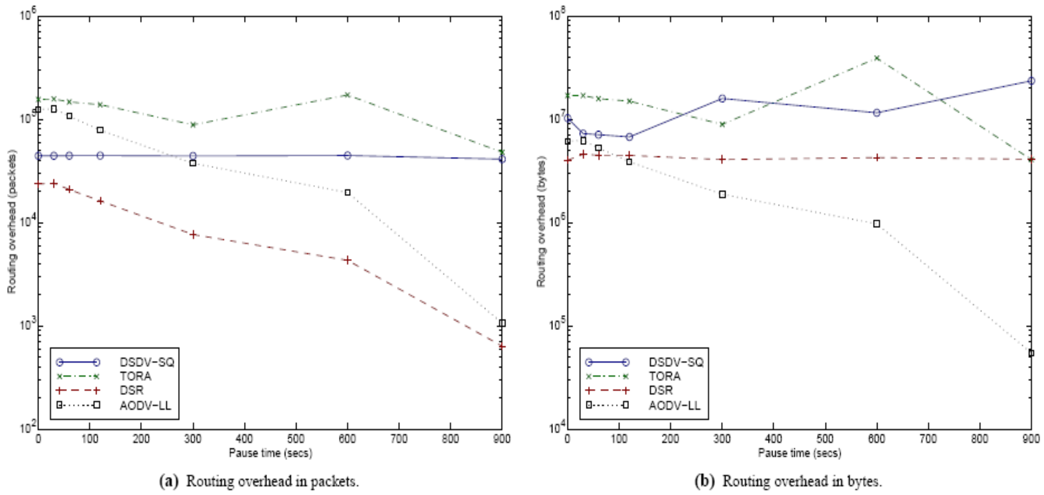


Fig.2. Overhead in bytes

Using network simulator, results were presented of a detailed packet-level simulation of four protocols.

- DSDV protocol performs predictably. Delivered virtually all the packets at low node mobility, and failing to converge as node mobility increases.
- TORA worst performer. Still this delivered 90% of the packets in scenarios with 10 or 20 sources.
- DSR was good at all mobility rates and different movement speeds.

AODV protocol performs almost as well as DSR, but still it requires the transmission of many routing overhead packets. At higher rates of node mobility it's actually high expensive than DSR. So from this different ad-hoc protocol comparison, we inferred that still the AODV protocol has issues in related to energy efficiency due to the overhead packets.

Performance parameters:

Table.1. illustrates the parameters where analyzed from existing work [16].

Table 1. Various parameters from existing protocol

Parameters	Reactive protocol	Proactive protocol
Routing Philosophy	Flat/Hierarchical	Hierarchical
Routing Scheme	On- Demand	Table-Driven
Routing Overhead	Low	High
Latency	High due to Flooding	Low due to routing tables
Storage Capacity	Low generally depends upon the number of Routes.	High, due to the routing tables.
Mobility Support	Route maintenance	Perodical updates

Drawback of the system:

- More control packet overhead during neighbor discovery(Hello packets) and path discovery(RREQ packets)
- Protocol used while route discovery is not sufficient when number of node increased and if any major problem occurred(need to be improved)
- While transmitting the data on cross layer network model if any problem occurs (high network traffic) route decision might cause problem to address the energy and throughput.

The cross-layer design [31] deviates from the traditional network model design approach in which each layer of the stack would be made to operate independently. The system represented in related work section process under the cross-layer model which entirely follows the above said protocols especially for AODV protocol.

At present, cross-layer model is advance mechanism in mobile wireless sensor networks which always used AODV protocol to make a communication with other node. So as per above discussion, all we inferred that overhead in route discovery is main issue. It must be addressed with the help of new algorithm.

Performance parameters from comparative analysis:

Table 2.Shows that, different parameters where analyzed from different protocols and cross-layer model which is considered for our proposed work. Parameter listed as follows:

Table 2. Inferred Performance parameter

Parameters	Issues
Energy efficiency	Very low
throughput	Low due to insufficient protocol
Routing overhead	High due to control packet
End to End delay	High due to flooding

Inference:

From an ad-hoc network analysis, we have to increase the maximum throughput and efficiency of wireless sensor network. This metrics technically solves overhead and usage of excessive energy resources as well as load and faulty nodes while traversing different routes.

IV. PROPOSED WORK

The abstract illustration of the reduction of route broadcast flooding using (CCCF) algorithm is detailed in Fig. 3. To show activity of each step, an algorithm CCCF was placed besides the operation model.

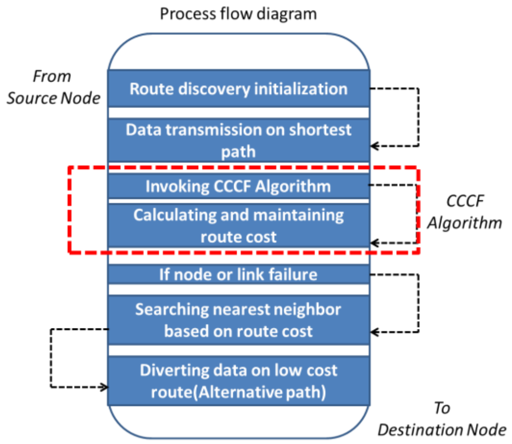


Fig.3. Operational model detailed process diagram.

After network initialization process, source has shortest path by choosing latest RREP sequence number from many response. So when source node had interest to send data along to the shortest path, CCCF algorithms were also started its process. It means algorithm simultaneously establish alternative path along with sending Precedence value. If any one of node failure or movement occurred in main path, its predecessor node were find their nearest neighbor with help of scope region (PI=2). Here neighbor might be searched and verified whether it is presented in low costed path or not by using Precedence value PR. Once all this process completed, data will be diverted into alternative path to reach its destination.

Alternative Routing Technique

It is an bypass mechanism to deviate the route from the nodes that have faced failure in active path. Messages which are traversed in alternative path come back to original path after some hops. This deviation length is given by scope size PI chosen by source at moment of CCCF algorithm started. Bypass length is defined by distance (in hops) traversed by message in alternative route. Message distance in alternative path is represented by:

a) Number of nodes or hops (distance) in shortest path between source and destination
b) Number of nodes or hops(distance) in alternative path between source, predecessor and destination
c) Communication cost calculation at source CF initialization

Communication costed controlled flooding algorithm (CCCF):

a) When controlled flooding algorithm started, precedence value PR is initially assigned as 0
b) After initialization, alternative path has been established to that particular region.
c) These alternative paths were assigned by Precedence value PR according to the lowest communication cost. Communication cost calculated by CF algorithm started by source.
d) When any of one node in main path recognize error due to node failure or node mobility, the alternative path takes an effect in an autonomous fashion without inform to source.
e) So the predecessor node, to the failure one will search nearest path in alternative one with the help of scope value with inclusion of precedence value PR.
f) Once data received by destination, this precedence value will be reset dynamically.

Table 3. illustrates general structure of AODV routing table which has inclusion of defined Precedence value PR for representing alternative path route cost.

Table 3.Structure of AODV routing table

AODV				
Node x's Routing Table				
Destination	Next-Node	Hops	Sequence No	PR
J	C	3	11	0

We suppose that the first path has already established by broadcasting the network. The first scheme figure 4 represents the first shortest path between source s and destination d. when source can start data transmission, concurrently cccf algorithm started to find its alternative path with assigning precedence value to every node presented in alternative path. The alternative path represented as dashed lines. Figure 5 shows that when node j failsfrom main path, their immediate predecessors are able to determine its nearest neighbor from alternative path. Figure 6 shows immediate diversion to alternative path in an autonomous fashion without inform to source.

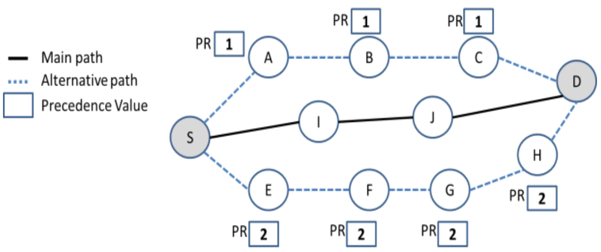


Fig.4. Process flow before CCCF algorithm

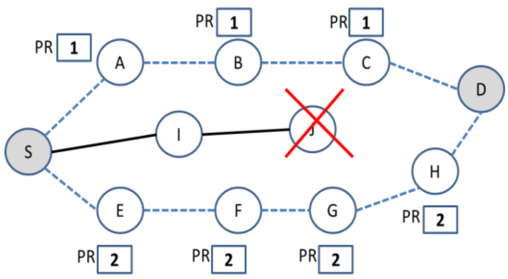


Fig.5. Process flow after CCCF algorithm

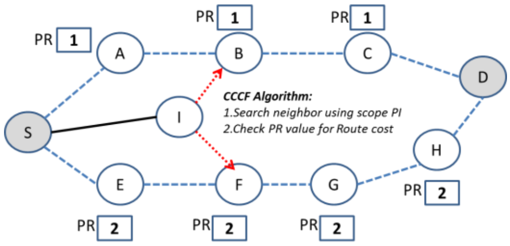


Fig.6. Process flow of CCCF alternative path

The crucial advantage over proposed system is reducing control packet overhead while path discovery. As well as, this system improves Route optimization when the data transmission on active path node fails and both of them consequently improves energy efficiency& throughput. But not effects in the less number of nodes.

V. CONCLUSION

In this work the reduction of route broadcast flooding using (CCCF) algorithm is used to reduce control packet overhead while network processing and this will improves routing optimization while data transmission on active path. This gives us more relief from overhead and increasing throughput. From the proposed work it is concluded that overhead and throughput of network model on mobile wireless sensor network will be increased on any environment.

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