Enhancement of BFF Algorithm for Energy Aware Path Selection in FISH Network

1,2S.P. Pingat, A.K. Gaikwad
1,2Dept. of Computer Engineering, Smt. Kashibai Navale College of Engineering, University of Pune

Abstract
Fundamental interconnecting structured homogenous network model has a fish shaped topology and proposes a Bypass Flow Splitting Forwarding algorithm to forward packets in network. Reset time is constant in BFF algorithm and there is no provision for optimization of energy while selecting path. Which affects the capability of BFF algorithm to make proper utilization of channel which increases packet loss ratio and controlling the transmission energy consumed for a packet to reach destination. So main objectives of proposed algorithm are:
• To achieve higher link utilization using dynamic reset time which increases throughput.
• To increase delivery rate and avoid route failures by selecting energy efficient path in Fish network.

Keywords

I. Introduction
N Fundamental Interconnecting Structured Homogenous (FISH) network bypass flow splitting forwarding (BFF) algorithm was proposed to forward packets & makes better utilization of available bandwidth. The drawback of single path routing which can limit the packet delivery rate and fixed granularity forwarding which can lead to inefficient use of network bandwidth were investigated. A enhanced BFF algorithm is presented here with energy aware path selection in FISH network. Also constant reset time affects the performance of BFF algorithm. Because it needs updation of available bandwidth for each edge to wait for finishing of hash list refreshing process. It has effect on utilization & increases packet loss ratio. If traffic rate is less in FISH network, due to constant reset time there will be less utilization of edgeline reverse case if actual bandwidth required is more, then there will be chances of packet loss. The Hash list providing available bandwidth for each edge is refreshed after reset time. So every edge has to wait for retrieving its available bandwidth till reset time is over. Also routing protocols with no means of optimizing energy generally uses same path for longer period. It results in exhaustion of energy at nodes. So we r going to implement dynamic reset time with energy efficient path selection in FISH network to increase delivery rate.

II. Fish Network Model
In this section, we first present brief view of existing FISH network model.

A. FISH Network Model
The link disjoint paths will become more than that in past with rapid increase both in bandwidth & links in recent years.
3. Bypass Forwarding Module
When packet arrives at PR2 bypass forwarding module executes. Which accepts feedback information from PR1 & sets bypass bits accordingly. It also splits data packets according to new forwarding ratio & forwards them to intended destination.

III. Energy Aware Routing Protocols
Routing protocols use same path for a longer period if there is no provision for optimization of energy. Due this energy gets exhausted at that node and decreases information delivery rate. The amount of energy that is being consumed by network also determines how long the network can work. Energy aware routing guarantees that nodes with low energy in network stay alive.

Ad hoc On-Demand Distance Vector (AODV) Routing protocol with additional energy field is used to select energy efficient path in FISH network. A probability function can be used as a means choosing sub-optimal paths in energy-aware routing.

A. AODV Protocol
AODV is a reactive routing protocol, meaning that it establishes a route to a destination only on demand. In contrast, the most common routing protocols of the Internet are proactive, meaning they find routing paths independently of the usage of the paths. In AODV, the network is silent until a connection is needed. At that point the network node that needs a connection broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. When a link fails, a routing error is passed back to a transmitting node, and the process repeats. The advantage of AODV is that it creates no extra traffic for communication along existing links. In AODV the source node and the intermediate nodes store the next-hop information corresponding to each flow for data packet transmission. In an on-demand routing protocol, the source node floods the RouteRequest packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single RouteRequest. A RouteRequest carries the source identifier (SrcID), the destination identifier (DestID), the source sequence number (SrcSeqNum), the destination sequence number (DestSeqNum), the broadcast identifier (BcastID), and the time to live (TTL) field. When an intermediate node receives a RouteRequest, it either forwards it or prepares a RouteReply if it has a valid route to the destination.

B. Energy Conserving Routing Metrics
1. Residual Energy
Energy status of a node is the most important metric to be considered while selecting a route to forward packets. Cost function used is

\[ f_{i,t} = 1/C_i^t \]  

Where \( f_i \) is the cost function and \( C_i \) is the remaining energy of node \( i \) at time \( t \).  

2. Energy Drain Rate
Energy drain rate represents the reply packet energy. Which is nothing but the energy consumed on a particular path to forward packets. An exponential weighted moving average method was used to calculate energy drain rate. For each second this method gives an approximation of the amount of energy dissipated. The fraction between Residual Battery Power (RBP) and Drain Rate (DR) represents the cost function at a node as follows:-

\[ C = \frac{RBP}{DR} \]  

IV. Proposed System
Propose system tries to enhance BFF algorithm w.r.t. bandwidth utilization and packet delivery rate. In existing system static reset time is used. It decreases the bandwidth utilization. If data rate decreases in network. Due to static reset time channel remains ideal until reset time elapses. And if network traffic increases suddenly, there are chances of packet loss. Proposed system tries to solve these problems. We are implementing dynamic reset time. So that whenever data traffic decreases, reset time will be increased avoiding unnecessary resetting of bypass bits. And if data traffic exceeds channel capacity, reset time gets decreased, bypass bits are reset. After small interval of time, avoiding packet loss. Proposed system considers energy factor also. While selecting path for data transmission, energy efficient path selection is considered. One data packet is send from source to destination having energy field added using AODV protocol. It gives acknowledgement back in terms total energy utilized for transmission. It is calculated using formula:-

\[ E = Tx + Rx + Px \]

Where \( tx \) = transmission energy
\( Rx \) = Receiving Energy
\( Px \) = processing Energy

select energy efficient path for transmission and sets bypass bits for that path. And data packets are forwarded to intended destination. Proposed system tries to improve operational time, throughput and reduces latency in FISH network.

V. Algorithm Design and Development
A. SetUp Phase
In proposed system we are implementing dynamic reset time with AODV based energy efficient path selection. The proposed algorithm will result in an unbiased energy spending among nodes which also maximizes network lifespan. The AODV protocol stores set of good paths in its routing table and one good is selected among many available paths based on a probabilistic function. The connection is initiated by source node and before the request could be sent, the energy cost field is set to zero as:

\[ \text{Cost}(i) = 0 \]  

\( n_s \) = source node
\( n_d \) = destination node

Afterwards energy of neighbor node is calculated and added to total energy cost of path:-

\[ j \in n_j, n_i = \text{Cost}(n_j) + \text{Metric}(n_j, n_i) \]

Here paths with high cost in terms of energy utilization are discarded and low costs are added to forwarding denoted as FT of \( n_j \) of \( n_i \).
Where $\alpha$ constant and $\min_{n_{j}n_{k}}$ is min energy cost in joules between node j and k.

Afterwards energy of neighbor node is calculated and added to total energy cost of path:

$$E_{T} = \{ \sum_{j,n_{j},n_{k}}(\text{Cost}(n_{j}) + \text{Metric}(n_{j},n_{k})) \}$$

(4)

**B. Path Selection Algorithm**

Get list of Path with good bandwidth $P=\{p_{1},p_{2},...,p_{n}\}$

EnergyThershold=10%

Each $p \in P$

Get hops from each path $H=\{h_{1},h_{2},...,h_{n}\}$

If(PathEnergy<EnergyThershold)

Reject $p$

End.

**VI. Performance Measures**

An awk script is executed to obtain data from trace file. This data is used to get throughput and latency. Corresponding graphs are shown in figure.

![Throughput graph](image)

Fig. 3: Throughput vs. Time

As we can observe from graph there is improvement in throughput with the use of adaptive reset time in fundamental interconnecting structured homogeneous network. It can be seen from graph that there is improvement in latency.

![Latency graph](image)

Fig. 4: Latency vs. Time

**VII. Conclusion**

We are doing enhancement for Bypass Flow Splitting Forwarding algorithm in Fish Network using optimization of reset time along with energy optimization based path selection to improve operational time, throughput and to reduce latency. The expected results from the proposed system are:-

- To achieve higher link utilization using dynamic reset time which increases throughput.
- To increase delivery rate and avoid route failures by selecting energy efficient path in Fish network.

**References**


Anuja K. Gaikwad received her B.E. degree in Computer Engineering from Smt. Kashibai Navale College of Engg., Pune, Pune University, in 2006. Currently she is teaching as Senior lecturer with Department of Computer Engineering at JSPM’s Group of Institutes, Pune since June 2007. In her post graduate course she is doing research work in finding algorithm for energy efficient path selection in FISH network.