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RESEARCH ARTICLE

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ADAPTIVE REROUTING BASED ON LOAD BALANCING AND ENERGY AWARE TECHNIQUE IN MPLS NETWORKS

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ABSTRACT

Traffic engineering (TE) is deals with the switching path from source to destination in Multiprotocol Label Switching (MPLS) into IP-networks. MPLS is one of best approach which combines the benefits of interworking and routing in Network layer (layer3) and Data Link Layer (layer2). Controlling/minimizing utilization of link is a central goal of traffic engineering as it enhances the overall network performance.

We propose the Adaptive Reroutingbased on load balancing and energy aware techniquein MPLS networks. The wireless sensor nodes have limited battery power, Dynamically rerouting the LSPs acrossing the over utilized link to under-utilizedlink and fullenergy consumed in nodes are by partial route set up around that link/nodeand Fault tolerance is the ability of the system to respond gracefully to congested link in the network by using fault indication signal (FIS), re-switching to original path when over utilized link become to under-utilized link in the network. It also improves the overall network throughput, delay performance and reduce the packet loss in the MPLS networks.

KEY WORDS: MPLS networks, Adaptive Rerouting, Load Balancing, Energy Aware, Fault indication

INTRODUCTION

Traffic engineering(TE) is to minimize the utilization of the most heavily used link in the network or the maximum of link utilization and it avoids the collision of packets in the network. As the maximum link utilization qualitatively expresses that congestion sets in when over utilization of link, it is important to minimize the utilization of link throughout the network by some of the proposed algorithms. MPLS is mainly based on the concept of label switching: a unique and independent "label" is added to each data packet and this label is used to switch and route the packet through the network,which leads to splitting traffic over multiple paths between source-destination pairs. The terminal end points(source and destination) send and receive data packets to and from the MPLS network respectively.

MPLS network consists of two parts: one is Edge LSR's(LER's) and other is Core LSR's is as shown in fig 1.

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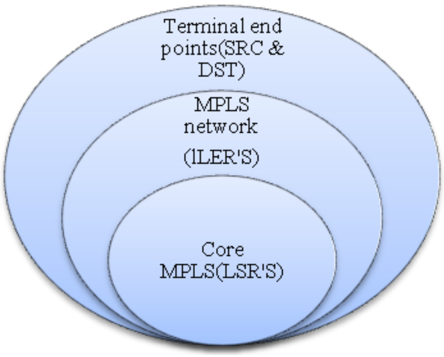

Fig 1: Implementation of different layers in MPLS Network.

The LER's are add/remove the label to/from data packets at the source/destination end points respectively. LER which initially encapsulate the label to the data packets are called as ingress LER's and the LER which finally removes the label from the data packets are called as egress LER's. Mainly switching the LSP through the Core LSR's to route the data packets, they are many methods or algorithms are implemented to switching in between LSR's in Core MPLS network. The path through which data packets are switched according to their labels in MPLS network are called label switched path(LSP), each LSR maintains their label information base(LIB) which maintains the overall functions of LSR and their constraints(bandwidth, swapping labels, delay, sending FIS, etc.), Labels are distributed between LER's and LSR's using the Label Distribution Protocol (LDP).

LABEL	EXP	S	TTL
Bits0 1920	23	24 25	31

Fig 2: Label format.

Label format consist of four fields as shown in fig 2.

LABEL- it is 20 bit long, which contains to which LSR wants to route next.

EXP- it is 3 bits, which determines the types of service, QOS and sending FIS.

S- 1 bit bottom of stack, it set to 1 when the packet contains last label.

TTL- it is 8 bits long, it is used to avoid the duplication of packets.

At each LSR the Label is swapped, the label contains the information of the next LSR to forward the data packet. At ingress LER initially add the label of the next LSR of the Core MPLS to route the packet, At each core LSR's remove the label encapsulated by last LSR then add the label of the next LSR to route until the data packet to reach the egress LER, finally egress LER removes the label then forward to the destination.

Related works

DEPR removes congestion by rerouting the LSPs crossing the congested link to a partial route set up around the congested link[1], DEPR has many advantages overother techniques such as its ability of fast reaction to congestion due to the new introduced partial rerouting technique and global rerouting(fully rerouting from source to destination). DEPR

Reduce the 30% of congestion in MPLS network. Multiple fault tolerance in MPLS [2] is dynamically noticing fault notification signal when fault occurs in routers and their outgoing links and switch to other route when faults occurs in the networks, but it takes some time(delay) to switch to other route, but it is faster than other path recovery protocols, the overall throughput of the network is efficient than other algorithms.

The paper Load balancing in IP/ MPLS network[3] which reserve the resources of bandwidth and computing power for multimedia services, The main idea for load balancing is to find the optimum path to balance the load by calculating various traffic metrics and exhibiting reliability on the IP/MPLS network. This paper proposes some difficult algorithms for increasing reliability for multimedia applications. Constrained multipath traffic engineering scheme for MPLS network [4], which splitting the traffic over the multiple path and optimize the overall network performance. traffic demand under constraints such as maximum hop count, and preferred or not preferred node/link list and some complex algorithm are used for shifting traffic over multipath by using traffic split ratio.

PROPOSED ALGORITHM

We proposes the rerouting algorithm for over utilized link and limited battery power in wireless sensor nodes in the MPLS networks, in this paper adaptively switching path from over-utilized link to under-utilized link to achieve the load balancing and energy aware technique in wireless sensor nodes.

If data packets are ready initiallyrouting this data packets from LER1 to LER14 through LSR2-

LSR3-LSR4-LSR5, if link failure between LSR4& LSR5 as shown in fig 3.

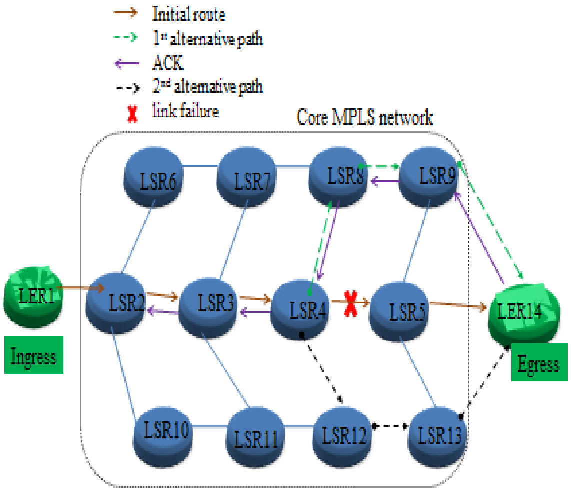

Fig 3: proposed partial rerouting for single link failure in core MPLS network

If link failure between LSR4 & LSR5 means BW of this link is not greater then threshould BW, then LSR4 adaptvely rerouting through the LSR8 & LSR9 to destination.

If working and all alternative links are over utilized as shoun in fig 4,in this case the LSR4 send the fault indication signal (FIS) to LSR3 through the backward path then LSR3 rerouting the packets through the LSR7-LSR8-LSR9 to the destination.

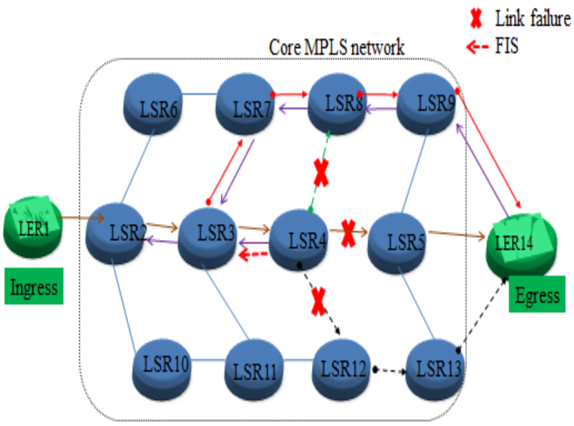

Fig 4: proposed partial rerouting after sending FIS through backward path

If the power of LSR4 is below the threshold while sending data (node failure), in this case also LSR4 do the same operation as shown in fig 4 is as shown in fig 5.

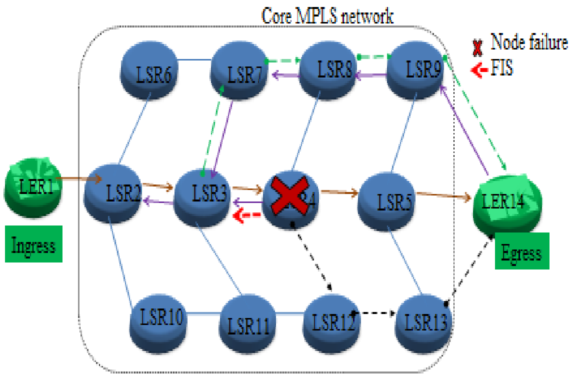

Fig 5: proposed partial rerouting if $E_{rs} < E_{th}$ of current node (node failure)

ALGORITM STEPS:

STEP 1: Pre-establish the working & alternative paths and create the LUT.

STEP 2: If data is ready to send, send broadcast signal to neighboring nodes.

STEP 3: If ACK is received for broadcast signal.

STEP 4: Check for the availability of bandwidth (BW) and residual power of link and nodes respectively.

STEP 5: If BW>RL_{th}&$E_{rs} > E_{th}$ of link and node respectively, then forward packets to working path.

STEP 6: If any link failure occurs then start rerouting.

STEP 7: Send local query to the neighboring nodes.

STEP 8: Rerouting the data packets to the link with higher BW and higher residual energy of next node.

STEP 9: If BW ofworking and all alternative paths from that current node are over-utilized and $E_{rs} < E_{th}$ of current node, then send FIS to previous node through backward path.

STEP 10: Repeats from STEP 5 until rerouting the data packets.

Load balancing can be achieved by relay load.

$$RL_{th} = \frac{BW\ of\ the\ link}{packet\ size},\ no.\ of\ packets.$$

Energy aware is achieved by using residual energy calculation.

$$E_{rs} > E_{th} > \ transmission\ energy(E_t)$$

$$E_{rs} = E_{in} - (E_t + E_{id} + E_p).$$

Where

$E_{rs} - residual\ energy\ of\ node.$

$E_{th} - threshould\ enegy.$

$E_{in} - initial\ enegy\ of\ node.$

E_t $-$ $energy\ for\ data\ transmission. E_{id} -\ ideal\ state\ energyof\ node. E_p$ $-\ processing\ energy\ of\ node$

E_{rs} Will be updated each and every data transmission.

EXPERIMENTAL RESULTS

We implemented our proposed algorithm for 35 nodes of wireless sensor nodes(WSN) in MPLS networks, omnidirectional trans-receiver antennas are used for both transmission and reception of data packets between sensor nodes and AODV protocol is used for routing at layer 3. Network Simulator (NS2) is used for simulation, in nam window shows the data flows and circles shows the broadcasting messages for forward the data packets is as shown in fig 6.

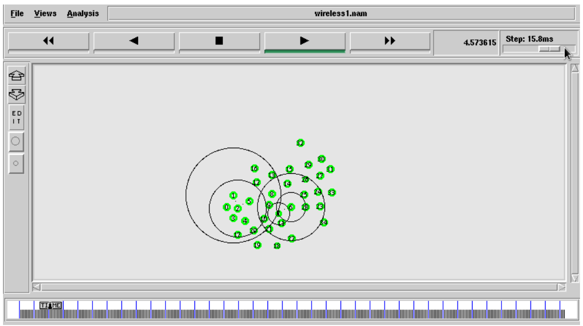

Fig 6: snap shot of Partial and Global rerouting in WSN.

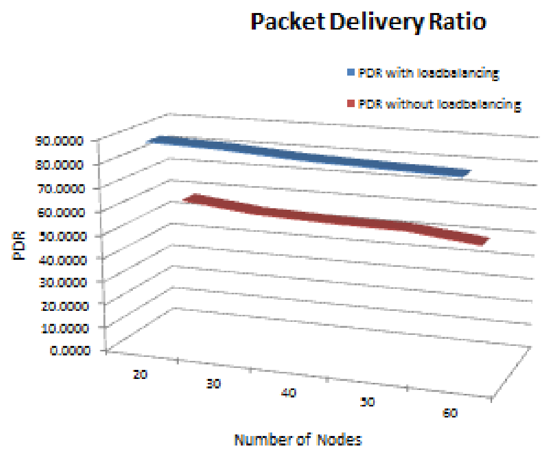

Fig 7: packet deliveryratio v/s no. of nodes.

Packet delivery ratio is defined as number of packets are received correctly over number of packets are sent, by implementation we achieved the higher packet delivery ratio the blue color shows our proposed one, packet deli is higher than without using load balancing is as shown in fig 7.

Fig 8.shows the average energy consumption verses number of nodes, if no of nodes increases then utilization of energy also increases, the utilization of energy is lower by our proposed one is shown in blue color than without energy aware technique.

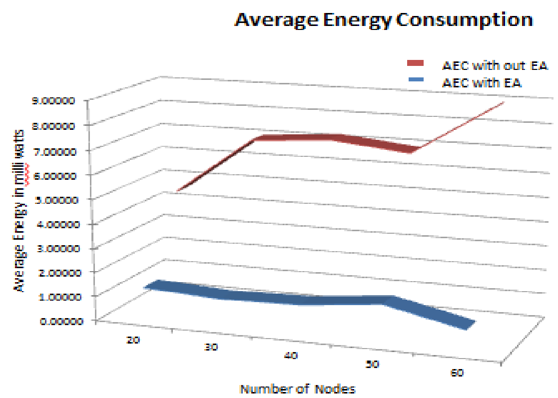

Fig 8: Avg. Energy consumption v/s no. of nodes.

CONCLUSION

By proposed this adaptive rerouting scheme for MPLS networks efficiently balancing the load by decreasing packet loss, packet delay, minimize the maximum oflink utilization (traffic congestion) and energy aware technique for reducing the energy consumption in wireless sensor nodes,by introducing load balancing and energy aware technique in the network we achieved 87.74% of packet delivery ratio (efficiency) and higher rate of energy consumption in MPLS networks.

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