Recovering the Data Delivery Efficiency Using Multihoming in Wireless Sensor Networks

R. Dhaya, P.S.Smitha, F. Abul Hasan, P. Lingasiva, and G.Mukil

Abstract**—**The treatment of network for multimedia application was enlarged lately mainly in the field of video transport. In the way of well-organized data transfer, large bandwidth is needed. The stipulate for bandwidth is gathering by cumulating the bandwidth with the assist of Multi-Streaming and Multi-Homing which are the main things of SCTP. In Networking, the Stream Control Transmission Protocol (SCTP) is a transport layer protocol, helping in the both function to the popular protocols Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). It offers a number of the similar overhaul features of both TCP & UDP: it is message-oriented like UDP and ensures reliable, in-sequence transport of messages with congestion control like TCP. The main objective is to increase the performance of CMT-QA by make the most of the use of bandwidth for data delivery by avoiding retransmission for packet loss in a heterogeneous or homogenous wireless environment and using TCP/IP spoofing technique to transmit packets even through failure nodes there by increasing the data delivery efficiency.

Keywords: SCTP, TCP, UDP , Multihoming, Multistreaming, Bandwidth

I. Introduction

THE current transport protocol workhorses, TCP and UDP, do not support multihoming; TCP allows binding to only one network address at each end of a connection. Wireless and mobile users also find that TCP reacts badly to losses and delay variations due to wireless links or handovers [3]. TCP is byte-stream-oriented, which means that applications are responsible for tracking message boundaries and using the push mechanism to ensure messages are transferred in reasonable time[5].TCP preserves order. While strict order-of-transmission data delivery is a restriction for some applications, for many other applications, un-ordered or partially ordered data delivery is sufficient[1]. For such applications, TCP's strict ordering causes unnecessary delays.TCP does not transparently support multihomed hosts.TCP is vulnerable to denial-of-service attacks, which makes it a risky protocol to use in critical applications. More over the signaling community has found that TCP service is too restrictive for their needs[2]. Also, those protocols are not practically suitable for the WSN, with a high topology update. Since a large number of nodes are densely deployed to monitor an area, the sensing area of the particular node is overlapped by other neighboring nodes, which in turn, affect the performance of the network[4]. The retransmission policy of the conventional protocol is complex when a packet loss occurs owing to the path failure and the source node has to wait for a long time to retransmit the lost packet after getting acknowledgement. TCP requires a reliable transfer of user data and the strict in order delivery[6]. If the packet in the stream gets lost, the remaining packets in those streams get stored in receiver buffer until the lost packet has to be retransmitted and arrives at receiver. During this period, applications cannot get data and do suffer from bad delay. If the receiver buffer becomes full, the sender cannot retransmit the lost data. This is called Head-of-Line Blocking. So there must be an area where the reliability is to be improved during data transmission with ease.

SCTP, being a Connection-Orientated Protocol two end-points must establish a 'connection', which is known as an Association[8]. It is formed using a 4-way handshake, which is resistant to the "Denial-of-Service" attacks. SCTP is reliable, so that any data that is transferred must be acknowledged. If the data is not acknowledged, it is retransmitted. SCTP also provides several advanced features:

1. **Multi-homing:** A host is multi-homed if it can be addressed by multiple IP addresses, as is the case when the host has multiple network interfaces. A multi-homed host is one that has more than one network interface and therefore more than one IP address for which it can be addressed. Figure 5.1 illustrates the difference between a TCP connection and a SCTP association[7,9].
2. **Multi-streaming:** All the streams within an association are independent but related to the association.[10] Each stream is given a stream number that is encoded inside SCTP packets flowing through the association. Multi-streaming is important because a blocked stream does not affect the other streams in an association

II. Problem Description

The testing measured heterogeneous wireless network for cross layer transmission. During transmission source and destination are multi-homed and the edge nodes ie., routers are single-homed introducing bursty cross traffic to simulate congestion at the routers .the aggregate cross traffic loads on

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the dissimilar path between source and destination simulate highly dynamic wireless network environment.

Times For Packet Sending And Receiving:

The sending and arrival time of several data packets using three schemes CMT, CMT-PF, CMT-QA is considered. In both CMT, CMT-PF scheme, the sender uses round robin method to transmit data chunk over all the path equally without considering the path quality difference. In contrast CMT-QA distributes the data chunks over available paths in proportion to their respective data handling rate by utilising the bandwidth efficiently. As a result the transmission sequence number (TSN) used by CMT and CMT-PF increases slower whereas the TSN used by CMT-QA increases steeply. The packets are received out-of -order due to dissimilar path characteristics and their reordering is likely to cause performance degradation[12].

Out-Of-Order Packets:

CMT and CMT-PF generate more out-of-order chunks and require increased reordering than CMT-QA. CMT-QA estimates the latest information available in terms of path quality and distributes the data according to the predicted arrival time[11]. In this way, CMT-QA reduces the out-of-order data arrival and consequently performs better than the other two schemes. When comparing the three transfer methods, it is noted that peak out-of-order data reception at the receiver is more using both CMT and CMT-PF, compared to CMT-QA. When out-of-order TSN offset reach , the receiver buffer blocking is likely to happen and the transmission performance is seriously deteriorated.

Average Retransmission:

The average retransmissions crossways all the scheme boosts with the increase in packet loss probability, directly affecting the throughput for all the mechanisms. Higher packet loss probability determines both more data chunk retransmissions, and more out-of-order data delivery. If the receiver buffer is full with out-of-order packets, waiting for the lost data retransmissions to fill the gaps, the transmission efficiency will decrease. After 4 duplications or rtx-timeout, the sender will retransmit the lost data. The average number of retransmissions of CMT increases sharply with the packet loss probability increase. The CMT-PF performs better than CMT as it detects path failures and stops transmitting data over the path with and delivery status. In contrast, CMT-QA is aware of characteristics difference between paths and adapts to each path's delivery conditions, intelligently distributing the data across the paths. In this case most of the data arrives at the receiver in the right order, reducing the number of retransmissions and hence CMT-QA performs the best among the three solutions compared.

Average Throughput

The ability of the three schemes to manage packet loss, which has significant impact on the end-to-end throughput. Network throughput decreases with the increase in the link loss probability for all mechanisms. However, the average throughput values of CMT and CMT-PF decrease more significantly than that of CMT-QA. Any increase in the PLR causes cwnd to be reduced and the transmission delay to increase. CMT's throughput decreases sharply and performs the worst when the PLR increases. Because the congestion window is halved when packet loss occurs. As the CMT- PF can identify packet loss due to short term path failures, it performs better than CMT[13]. CMT-QA can detect and differentiate random packet loss and path failure from congestion loss, sense the path condition in time and schedule the data delivery based on each path's transmission capability. Although the paths used for load sharing have different packet loss characteristics, CMT-QA achieves higher association throughput than both CMT and CMT-PF. The throughput also increases in all scheme with the increase in receiver buffer size. At first, the throughput increases rapidly because SCTP probes the available network capacity. The slow-start algorithm doubles repeatedly the cwnd size. Next, throughput experiences variations for all the mechanisms due to the packet loss, then it recovers after retransmissions and cwnd adjustments. Compared with CMT and CMT-PF, CMT-QA tolerates better packet loss and utilizes more efficiently the available aggregate bandwidth from different links[14].

III. System Analysis

System analysis is the analysis of the current and future roles of proposed computer system in an organization. The system analyst (usually software engineer or programmer) examines the flow of documents, information and material to design a system that best meets the cost, performance, and scheduling objectives.

Existing System

Quality Adaptive in Concurrent Multipath Transfer mechanism with Stream Control Transmission protocol (CMT-QA SCTP) is used for File Transfer Protocol like data transmission and real time data delivery. CMT-QA monitors and analyses regularly each path's data handling capability and makes data delivery adaptation decisions in order to select the qualified paths for concurrent data transfer. CMT-QA uses following three algorithms for efficient data transfer: Collecting a sample algorithm, data distribution scheduler algorithm, optimal retransmission policy algorithm[15]. Based on the output of the path quality evaluation, CMT-QA intelligently adjusts data distribution across the multiple paths. Data distribution is also considering time of data arrival at the destination forecast, to increase the in-order data packets arrival[17]. The optimal retransmission policy introduced by CMT-QA differentiates between different kinds of packet loss and accelerates the retransmission if required in order to improve data delivery efficiency. If the packet is not acknowledged within the specified time the node that failed to respond is marked as failure node[16].

- Accurately senses each path's current transmission status and estimates in real time each path's data handling capacity[18].

- Includes a newly designed data distribution algorithm to deliver optimally the application layer data over multiple paths and ensure the received data arrives in order[19].

In the two ends are data transmission and Video transmission .The Data Transmission includes Source ,Static approach, Dynamic approach and Destination. In Video Transmission, the things are Main Server, Main Router and Client.

The Data Transmission includes the module is developed to load the input data for transmission. It analyses the environmental condition such as congestion in the network before transmission. After loading the input data and source IP address data is transformed into series of Unicode characters. The binary code is then transmitted to source in static approach. The Steps are

- The data or text file to be transmitted to be transmitted is chosen from the computer
- Content of the text file is read and displayed in the screen until end of line in the text is reached.
- Get the IP address of the host and the client
- New socket is created for transmission for the IP end point created due to the IP address of host and client.
- chosen data or text file is transferred from source form to static or dynamic form.

In Static approach, data are transmitted using stream control transmission protocol. In SCTP multiple streams are established the sender and the receiver. Packets are transmitted through any one of the available path and the remaining path remains idle. When packet occurs in the path then node associated with the path is denoted as failure node and remaining packets are transmitted through alternate path. Number of bytes transmitted from source to destination is counted and stored in text file.The Steps are

- IP address of host and client is given
- Socket is created to enable communication between the host and the client
- Data transmitted from the source form is received in the static approach form
- Single path is used for transmission from host to client
- After transmitting packet from source retransmission timer stars running
- If the acknowledgement is received before the expiry of retransmission timer packets are successfully transmitted
- The packet is not acknowledged before retransmission time out the node associated with the path is marked as failure node and alternate path is chosen for successful transmission

In Dynamic Approach, data from the sender is transmitted to receiver using CMT-QA SCTP protocol. Here multiple paths are used for used for transmitting the data concurrently from sender to rreceiver. At the Sender there are two major CMT-QA blocks which are the Path Quality Estimation Model (PQEM) and Data Distribution Scheduler (DDS). CMT-QA aims to intelligently adjust data distribution for each path and support in order data packet arrival at destination. The Steps are

- IP address of host and client is given
- Socket is created to enable communication between the host and the client
- Data transmitted from the source form is received in the dynamic approach form
- Multiple paths are used for transmission from host to client using CMT-QA mechanism.
- After transmitting packet from source retransmission timer stars running
- If the acknowledgement is received before the expiry of retransmission timer packets are successfully transmitted
- I ft he packet is not acknowledged before retransmission time out the node associated with the path is marked as failure node
- Using TCP/IP spoofing to pass packets through failure node.

In Destination module, a graph is developed based on maximum and minimum transmission bandwidth available for effectively transmitting the data from sender to receiver. Graph obtained from dynamic approach has higher probability of bandwidth compared to static approach. The Steps are

- IP address of the client is given
- New socket is created to receive data transmitted by source
- Data received from either static or dynamic approach
- Acknowledgement is sent to the sender indicating successful transmission

In main Server, IP address of the sender and the video to be transmitted is loaded in server. The video file should have the following standards MPEG-1, MPEG-2, MPEG-4.The Steps are

- The video file to be transmitted to be transmitted is chosen from the computer
- Video file is read and encoded for transmission.
- Get the IP address of the host and the client
- New socket is created for transmission for the IP end point created due to the IP address of host and client.
- chosen data or text file is transferred from main server to main router

In Main Router**,** Here video files are made to transmit from source to destination using CMT SCTP mechanism. It also uses reconfiguration planning algorithm for detecting failure in the network and to make necessary configuration in network by collecting information from the neighbouring routers. It gives importance to local configuration thereby overcoming the disadvantages channel-assignment which reduce the

requirement of network changes by changing settings of only the faulty link. However, this greedy change might not be able to realize full improvements, which can only be achieved by considering configurations of neighboring mesh routers in addition to the faulty link.The Steps are

- ARS in every mesh node monitors the quality of its outgoing wireless links at every time and reports the results to a gateway via a management message.
- Once it detects a link failure(s), ARS in the detector node(s) triggers the formation of a group among local mesh routers that use a faulty channel, and one of the group members is elected as a leader using the well-known bully algorithm, for coordinating the reconfiguration.
- The leader node sends planning request message to a gateway. Then, the gateway synchronizes the planning requests if there are multiples requests—and generates a reconfiguration plan for the request.
- The gateway sends a reconfiguration plan to the leader node and the group members. Finally, all nodes in the group execute the corresponding configuration changes, if any, and resolve the group.

In Client mode, IP address of the destination and the location of where the file need to be stored is given. After successful transmission video will be stored in the prescribed location. The Steps are

- IP address of the client is given
- New socket is created to receive data transmitted by source
- Data is received from main router
- Acknowledgement is sent to the sender indicating successful transmission

IV .COMPARATIVE ANALYSIS

The Comparison between existing and proposed methods are as follows

Existing Method

- Packets are transmitted using SCTP protocol
- Waits for the lost packets to receive data in order before pushing the whole data to the upper layer causing receiver buffer blocking leading to performance degradation.
- Uses round robin method to transmit data chunks over all the paths equally
- If the retransmission timer expires without receiving acknowledgement then the node is denoted as failure node blocking further transmission through the node.
- Introduce bursty cross load traffic to simulate congestion in routers
- Less available bandwidth
- Network throughput decreases with increase in link loss.
- Takes more time to detect and handle packet loss.
- Need large receiver buffer

Proposed Method

- Packets are transmitted using CMT-QA SCTP protocol
- Transmit the received packets without waiting for lost data reducing receive buffer blocking increasing the performance of transmission in dissimilar paths
- Transmits data based on the quality of the path.
- Data is made to transmit through failure node using IP spoofing.
- Eliminate cross load traffic reducing congestion in routers.
- More available bandwidth.
- Network throughput is enhanced compared to existing method using Autonomous Reconfiguration System algorithm in cause of link failure.
- Takes less time to detect and handle packet loss
- Need receiver buffer with capacity less than the one used in existing method.
- Aware of characteristics difference between paths and adapts to each path delivery condition intelligently
- Congestion is minimised using slow start threshold algorithm

V. RESULTS AND DISCUSSION

Figure 1 shows the Front display for uploading and encryption. It is for uploading the text or file that need to be transmitted.

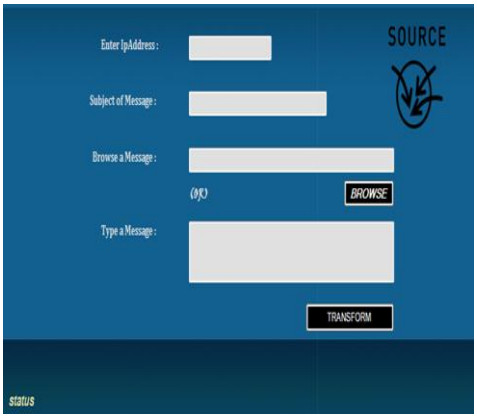

Fig.1 Front display for uploading and encryption

Figure 2 & 3 show the static and dynamic approach.Here in static approach, data are transmitted only through primary path and secondary path remains idle .But the dynamic approach, data are transmitted through multiple path from sender tor receiver.

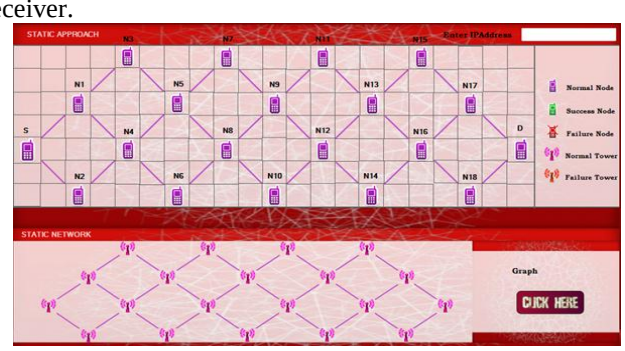

Fig. 2 static approach

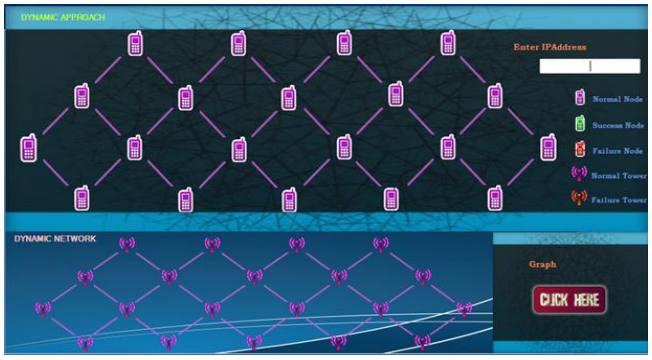

Fig. 3 Dynamic approach

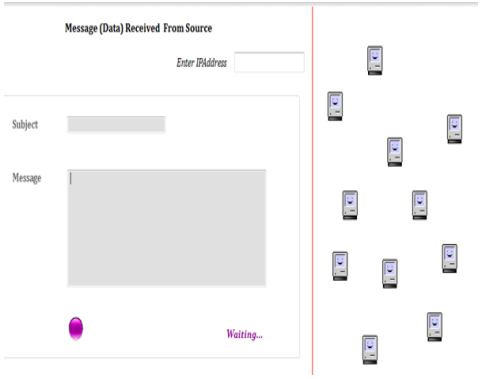

Fig. 4 Destination

Figure 4 shows the message being transmitted from source to destination.

Fig. 5 Data uploaded for transmission

Fig. 6 Transmitting message from source

Figure 5 shows the Data to be transmitted can be written or browsed should be in text file format and figure 6 . After uploading the file it is ready for transmission.

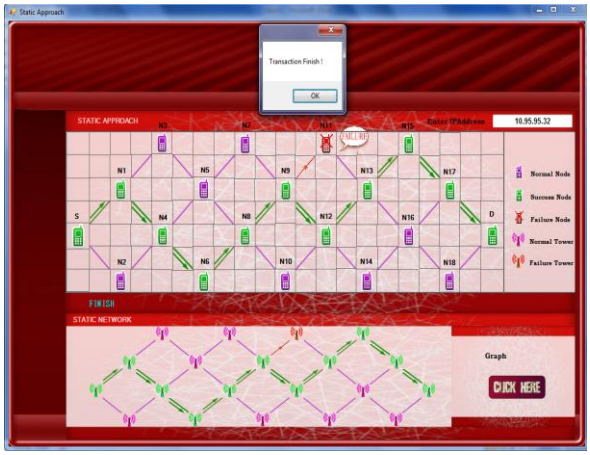

Fig 7 After data transmission in static approach

Figure 7 shows the static approach data transmission. During transmission data is not transmitted through failure node. It chooses normal node for transmission.

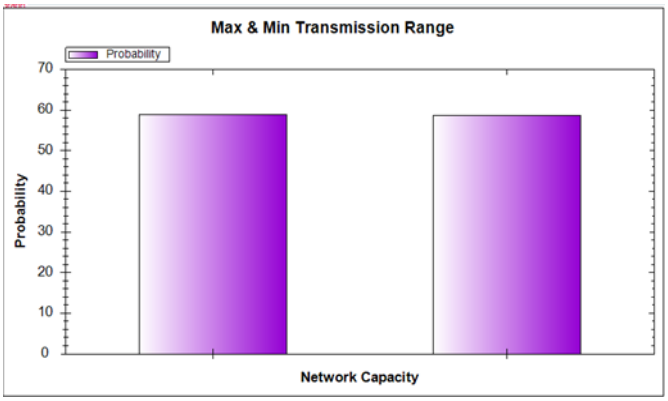

Fig 8 Transmission range in static approach

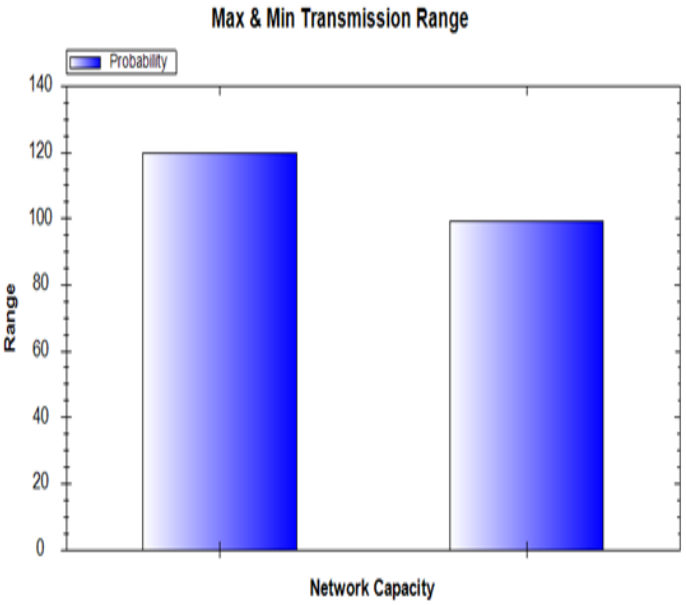

Fig 9 Transmission range in dynamic approach

In figure 8, 9 show the graph comparison between static and dynamic approach. In dynamic approach, nodes that experience failure are encircled and TCP/IP spoofing is done

to transmit packets through failure node. Bandwidth available for dynamic approach is greater than static approach.

TABLE I
DATA TRANSMISSION IN WIRELESS 3G NETWORK

Data	Static Approach Bandwidth (HZ)		Dynamic Approach Bandwidth (HZ)	
	Max value	Min Value	Max value	Min Value
253 KB	290.709	290.584	119.429	99.066
335 KB	776.21	776.08	119.846	99.174
671 KB	932.99	932.01	119.611	99.174
1.18 MB	944.993	944.024	119.426	99.004

Table 1 shows the Data Transmission in Wireless 3G Network, When compared to static approach, Dynamic approach is much smaller.

VI. CONCLUSION AND FUTURE WORK

SCTP without retransmitting the lost packets is analyzed in case in both static and dynamic condition. In static approach, packets are transmitted simultaneously and path that fails to transmit is marked as failure preventing further transmission through the node. In dynamic approach, packets are transmitted concurrently using CMT mechanism. Here the packets are made to pass even through failure nodes thereby increasing the bandwidth available for transmission using TCP/IP spoofing. Probability of bandwidth is increased in dynamic approach compared to static approach.This paper is currently implemented using 3G technology with the frequency band of 1.8-2.5 GHz. It can also be implemented using 4G technology with a frequency band of 2-8 GHz. Throughput for 3 G is up to 3.1 Mbps with a average speed range between 0.5 to 1.5 Mbps whereas for 4G it is 2 to 20 Mbps. Performance of throughput gets increased as 3G supports only packet switching whereas 4G supports both path switching and message switching.

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