International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

Improved IPv6 sphuTikA process in 6LoWPAN base IOT network

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ABSTRACT - *Wireless Sensor Network (WSN) is one of the key innovations nowadays, while it is an exceptionally dynamic and testing research region. It is about the sensor hubs associated in a low power wireless personal area network (LoWPAN).This requires transmission of IPv6 packets over 6LoWPAN. A challenge is that an IPv6 bundle may not fit in a IEEE 802.15.4 link layer because this layer size is only 127 octet. It is small, compare to IPv6 bundle size 1280 octet. In 6LoWPAN three main aspect are use for this problems that header compression & decompression, fragmentation, reassembly. In header compression, we want to wrap the IPv6 header with not needed field pull out, same content field erase. In fragmentation, A frame carrying 6LoWPAN fragmentation data and part of a datagram as payload. Data come from IPv6 are dived in some size and go one by one data to destination. Normally, fragmentation and reassembly process are complete in every node but we want to change this technique by not doing reassembly process to every node. And reassembly process doing simultaneously. which allow different fragmented packet to take priority and provide efficient way to fragment to packet with critical sensor information.*

KEYWORD *:* 6LoWPAN, IOT, IPv6, Header compression, fragmentation, reassembly.

I. INTRODUCTION

Today, Internet application advancement request is extremely high. So IoT is a significant innovation by which we can deliver different helpful web applications. Essentially, IoT is a system wherein every single physical item are associated with the web through system gadgets or switches and trade information[1]. IoT permits articles to be controlled remotely across existing system framework. IoT is an excellent and savvy strategy which diminishes human exertion just as simple access to physical gadgets[2]. This strategy likewise has self-ruling control highlight by which any gadget can control with no human cooperation. "Things" in the IoT sense, is the blend of equipment, programming, information, and administrations. "Things" can allude to a wide assortment of gadgets. These gadgets accumulate valuable information with the assistance of different existing advances and offer that information between different gadgets.

Mainly four fundamental are important for working IOT devices that are Sensors, Connectivity, data processing, User Interface[3,4]. Application of IOT is that Activity Trackers, Smart outlets & Thermostats, Parking Sensors, Smart city, supply chain & home, Connect Health. Web Protocols are utilized in such IOT based applications because of different advantages. 1st, IP based gadgets don't need any types of interpretation gateways to interface with other IP networks. Henceforth it gives appear less association. 2nd, existing system structure can be utilized by IP organize. 3rd, the advantages and disadvantages of IP organize are notable as it is currently decade old system. Also, in conclusion its documentation and instruments are notable, effectively accessible and broadly satisfactory[7].

Making smart devices, all devices have their own IP address. And if you are interested to working with IP address with smart work then most famous protocol is IPv6 because IPv6 have large address length 2^{128} compare to others[5,6]. Internet protocols and wireless technologies are not straightforwardly perfect to one another. Wireless technologies are working with low duty powers but IP consume more powers. 1280 B packet size for IP that is maximum and 127 B maximum packet size for wireless technologies like 802.15.4. basically any IP are not working with low powers that's why introduce the 6LoWPAN it means working with IPv6 protocols, low power & wireless personal area networks. In 2007 IETF 1st introduce 6LoWPAN[8]. And 6LoWPAN packet have data transmission range from 10-30 ms, rate are 20-240 kbps & memory device of RAM 16 kb, ROM 128 kb[9].

Header	Security Header	Fragment Header	IPv6 Header	UDP Header	Payload	Footer
23 bytes	21 bytes	5 bytes	40 bytes	8 bytes	28 bytes	2 bytes

$\longleftrightarrow$ 76 Bytes

Fig. 1 IEEE 802.15.4 frame format

IPv6 packet size are 1280 B and in down layer MAC layer have only 127 B. This out of 127 B many different types of field are provided. Like link layer header have 23 B, security header have 21 B, fragment header have 15 B, and footer have only 2 B[10]. After these only have 76 B remaining for headers of upper layer and payload. Out of 76 B, 40 B for IPv6 header consumed, 8 B for UDP header consumed, then after only 28 B remaining for payload. Thus Header compression turns into a need in 6LoWPAN to give sensible number of bytes for payload. Despite the fact that Header compression can be applied on different layers of the convention stack show below,

Application Layer: CoAP,MQTT
Transport Layer:UDP,ICMP
Network Layer:IPv6,RPL
Adaptation Layer: Fragment Header, Mesh addressing Header.

The outline of the paper is as follows. Section II: Protocol stack about 6LoWPAN, Section III: Related works of 6LoWPAN, Section IV: Explain mechanism of proposed system, Section V: Implementation of proposed system, Section VI: analyses of results, Section VII: Conclusion of research.

II. PROTOCOL STACK ABOUT 6LoWPAN

In a previous section explain the whole thing about the packet is coming from the network layer to their not fit in the data-link layer because of IEEE 802.15.4 have the maximum packet size are 127 B only. So, solving this problem added the one layer it is called the adaptation layer. In this layer, we can be working low power with the IPv6 protocol.

- **6LoWPAN meaning:-**

IPv6 over Low power Wireless Personal Area Networks[11].

- **6 in 6LoWPAN:-**

The 6 is used because it is based on IPv6. IPv6 is the new Internet Protocol. IPv6 has replaced IPv4, because IPv4 runs out of address range. IPv4 offers 232 = 4,294,967,296 IP addresses in the Internet. IPv6 uses 128-bit addresses, so the new address space supports 2128 = 3.4×1038addresses[11].

- **Lo in 6LoWPAN: -**

Lo represents Low Power. IP interchanges and Low Power utilization is generally opposite. Furthermore 30 years prior our reality was not excessively green all things considered at present. We endeavor to spare power as regularly we can. At any rate, we do spare power since we might want to be green. We
need to spare power on the grounds that the sensors are remote on battery control[11].

- **WPAN in 6LoWPAN:-**

WPAN represents Wireless Personal Area Networks. A WPAN is an individual region arrange for associating gadgets around an individual. A famous WPAN is Bluetooth. Bluetooth is being used to interconnect our PC frill or our sound hardware like Bluetooth headset or hands free unit. 6LoWPAN is more. In 6LoWPAN you can make fit systems with higher separation. By utilizing 868/915 MHz rather than 2400 MHz the inclusion in structures is vastly improved.

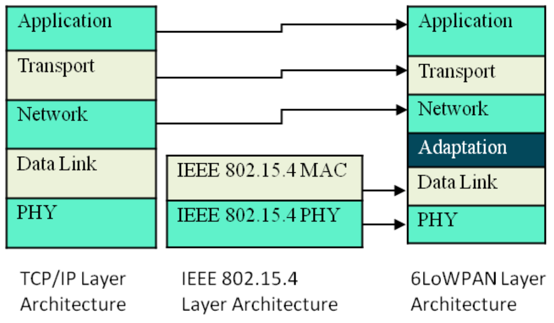

Fig.2 6lowpan stack protocol

According to this above figure, we can easily identify the adaptation layer. The adaptation layer is not only working with IPv6 protocol but it is used it IPv4 protocol. So, if we are use and network layer protocol with low power that's mean it is included in the adaptation layer. I am talking about IPv6 protocol that why call the 6lowpan. In 6lowpan do a header compression, fragmentation, reassembly, and decompression of header these four tasks are included. If we are working with the network layer then use the route over routing and if we are working with the adaptation layer then use the mesh under routing[10,12]. 6lowpan has supported to the communication of any network[12]. The data link layer is the detect and corrects the error which coming in the transmission of data bits. MAC is also present in the data link layer.

The data link layer senses the information with the use of the medium of collision transmission of the frame using a different protocol like CSMA/CD or CSMA/CA. adaptation layer is also compression of the header like UDP, IPv6, ICMP, and also handles the fragmentation and reassembly process. In my work use the UDP protocol because TCP protocol is more complex compare to UDP. 6lowpan is using the application which needs to be real-time data with UDP protocol to get less complexity[13]. For a security with UDP protocol use the

DTLS it means datagram transport layer security protocol[12]. In 6lowapn, COAP and MQTT protocols are used in the application layer. HTTP overuse the COAP because HTTP is the sleepy mode devise not supported[12]. IPv6 protocol header[5] is below figure which is understanding properly otherwise we can not easily understand this research.

Version (4 Bits)	Traffic Class (8 Bits)	Flow Label(20 Bits)		
Payload Length(16 Bits)			Next Header (8 Bits)	Hop Limit (8 Bits)
Source Address(128 Bits)				
Destination Address(128 Bits)				

Fig.3 IPv6 Header Format

This diagram is present as an IPv6 protocol header field. In IPv6 protocol, a total of 8 fields are included with a different data type. The first field is the version it is denoted to a version name of the protocol with 4 bits. So, we are using IPv6 protocol that why the version is the 6. Traffic classis the second field. It is defined as the traffic which is included in the transmission process and bits are 8. This field used to give priority to a packet and used to traffic congestion. Then after flow label with 20 bits and it is defined as our data are going to a particular flow or not. The payload length is 16 bits. This is the length of the IP packet. The next header has 8 bits which are indicated to which header will be following next. Hop limit is defined as how many maximum numbers of the hop are included in our transmission of the packet and it has 8 bits. Source address has 128 bits which are indicated to the source IP address of transmission packet. The destination address is defined as an IP address of the final destination address in our transmission packet and it has 128 bits.

III. RELATED WORK

Shelby [14] is define to technical form of the 6lowpan as,"6lowpan wireless network of embedded internet using ipv6 over low rate and low power embedded devices".

Kushalnagar[8] have describe the ipv6 over low-power wireless personal area network(6lowpan).we learn overview,assumption,goals,problem statement for transmitting IP over IEEE 802.15.4 networks.In problem statements , data come from network layer that bundle size is big(1280 B) and that data go to link layer and link layer bundle size is small(127 B).So,data are not fit that's why we need 6lowpan in adaptation layer.Goal of this document is the low power and bandwidth consumption and packet overhead. Fragmentation,Reassembly,header compression is the main factor for this goals and problem statements.

Effnet[15] is define the simple ipv6 header compression technique.If bundle go to same flow then remove unnecessary header data form ipv6 header. This is the basic idea of header compression in ipv6.

Montenegro[9] is define the frame format of ipv6 header and suggested to stateless auto configuration of addresses done in IEEE 802.15.4 networks. In this document define HC1 technique for ipv6 header compression and this is the first technique in header compression.HC1 using concepts of shared context. In HC1 version is the 6, traffic class and flow label is always 0,payload 0, next header are used 2-bit, source and destination address are 0-bit. But hop limit is carried inline. This technique is used only for link local addresses.

Hui and culler[16] proposed mechanism of header compress in global unicast addresses.Its called HCg technique.At whatever point prefix of source and destination addresses to matches with the default pre-allocated prefix, it is compressed otherwise sent inline.

Ludovici[17] implemented they other technique of header compression it is called IPHC using link local,global and multicast addresses in 6lowpan. We can compressed hop limit using IPHC.In IPHC uses context identifier extension that's means additional byte is compressed when using global address.

Huiqin and Yongqiang[18] suggested IIPHC technique.This is improvements of IPHC.In IIPHC main focus is that compression the multicast addresses.

Samer Awwad[19] proposed SSFHC algorithm for ipv6 header compression.Main purpose of this algorithm is that fragmentation process performs with second and their subsequent fragments to the same ipv6 bundle. This technique work with 2 modes: standalone and integrated .In standalone 1st fragment send without header compression. Then second and their subsequent fragments are compressed using S&SFHC technique. In integrated , compressed header only in 1st fragment. This mode is not used in this paper because our technique is S&SFHC.

Awwad[20] is suggested to the updated version of

SSFHC.In this paper uses integrated method of SSFHC. This method implemented by using IPHC method for compressing header of first fragment.And its better results compare to previous method.

Ruchi garg and Sanjay Sharma[21] is gives the comperetive study of various header compression like HC1,IPHC,SSFHC.In this paper, comparison basis of source and destination address bits,comparison on the basis of ipv6 header field bits carried inline,various other parameter and performance analysis measures.

Ruchi garg and Sanjay Sharma[7] define proposed methodology for ipv6 header compression. The sensors in the system might be of heterogeneous nature, detecting diverse kind of data. Depending on that, the size of information to be transmitted from every sensor node may differ. there is a relationship between's the headers of the packets transmitted from a specific sensor node.In this papers used this concepts for 6lowpan environment. Consequently remove the excess fields of IPv6 header of associated packets is the center thought of their proposed research work.Fields of ipv6 header table is the UPI,ipv6 header included.UPI valid for transmission of packets for specific flow. And sender and receiver node is over then its entry free in header table.This technique better performs compare to IPHC.

Thomas Watteyne[22] gives the mechanism of fragment forwarding.Basically fragmentation and reassembly process implemented at every node and in reassembly causes high end to end latency, low end to end reliability. So that this paper making new technique for not performing reassembly process at every node and fragment packet is forwarded.

IV. PROPOSED SYSTEM

In 6lowpan sensor node environment is the different types of node have different types of parameters and the send the values to the server node or destination node. Sensor node size are different from every transition. In a heterogeneous natures sensor network are sense different types of information. In IPv6 protocol header have many field but all many are not important so, compression process are doing for IPv6 header. Because many field values are same for every node transition. So, remove same values of header in IPv6 and we get the small size header.

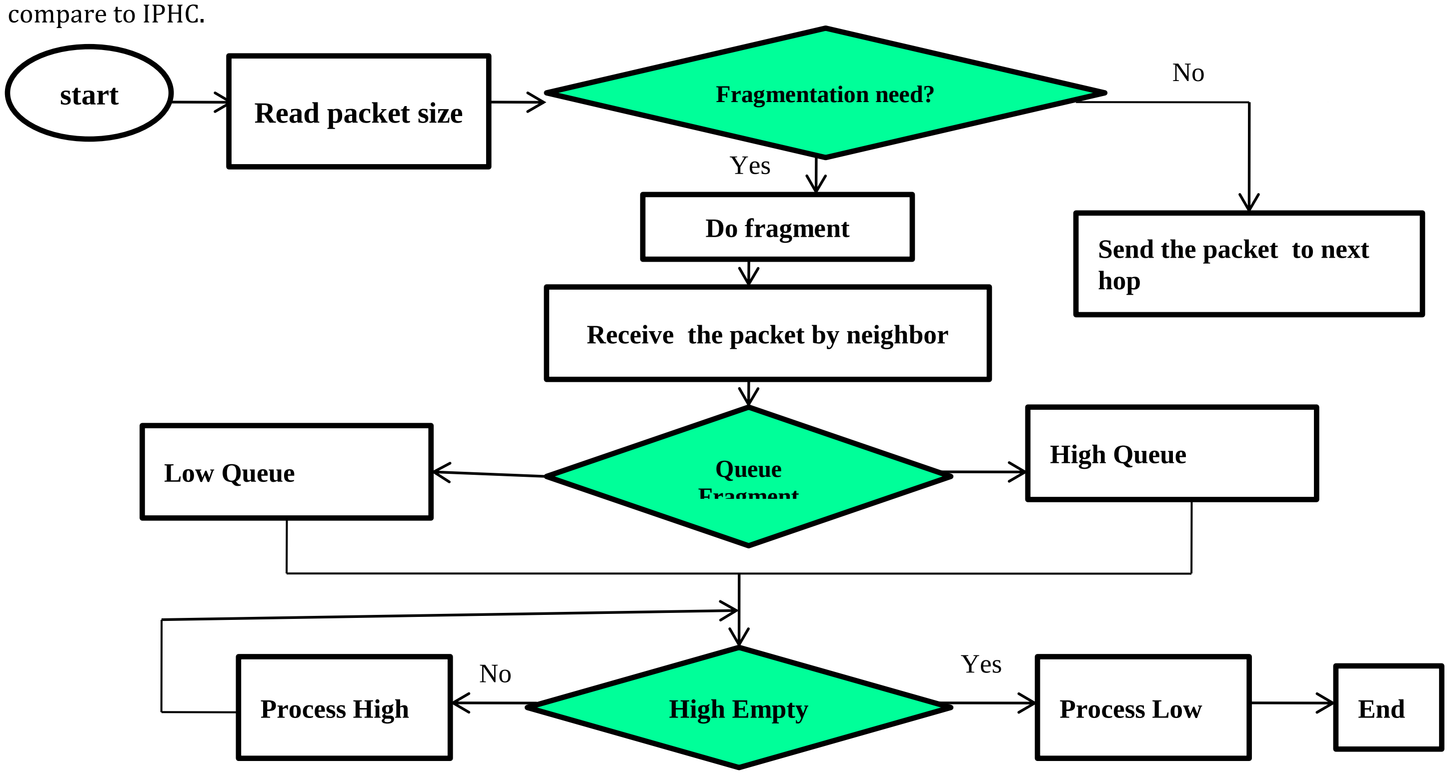

Fig. 4 Proposed System

Phase 1: Initialize the process for sensor networks.

Phase 2: Read the packet size from the node. Because packet size is an important factor for the processing of fragmentation.

Phase 3: Check the packet size. If packet size is more than 127 B then doing fragmentation process else sends the packet to normally next hop. 127 B is the maximum size of destination it means IEEE 802.15.4 size from the data link layer. If our packet size is not more then 127 B then go to the next hop or process with the regular transfer.

Phase 5: After doing fragmentation that fragment packet is received by the neighbor. Using neighbor discovery we can identify the nearest neighbor in our network.

Phase 6: Then after creating the queue of a fragmented packet. This queue is important because using this queue we have to create our two-parameter. That is Low and High. Using this parameter we can easy to process different types of fragment packet.

Phase 7: Using these two parameters we can easy to find low and high priority fragment packet. After then we put one condition to give high priority data first preference. I am using the if-else condition.

Phase 8: the condition is that if not empty high priority parameter then goes to this high priority fragment packet to next-hop else working with low priority or regular data fragment packet transfer.

V. IMPLEMENTATION OF PROPOSED SYSTEM

V.I Experiment Tools:

- **C As Programming Language**

- **Cooja:** Cooja is the ideal tool for simulation for the 6LoWPAN in WSN. Using these tools all challenges are cover. It is easy to use and open. Command "$ sudo run ant" for opening cooja simulation. This cooja simulation is used only in Contiki OS. Cooja fully supported IPv4 and IPv6.

- **OS-Contiki:** It is an open-source operating system for WSN and IoT. Lightweights, resource constraints, low-cost motes are used in WSNs which leads to major challenges in security applications. Contiki runs on tiny low-cost power microcontrollers and develops applications that make efficient use of the hardware while providing standardized low power wireless communication for the variety of hardware platforms.

- **Operating System: Ubuntu(VMWare)**

- Some simulator parameter and their value are set. mention below.

Parameters	**Values**
Mote Type	T-moto sky
Numbers of Motes	4
Radio medium	Unit Disk Graph Medium
MAC layer	CSMA/CA
Bit Rate	250 kbps
Mote placement model	Random and liner
Transmission range	50 m
Interference range	100 m
Network protocol	IPv6
Routing Protocol	RPL
Payload Size	90 B

Table V.I Simulator Parameter

- **Network Window:**

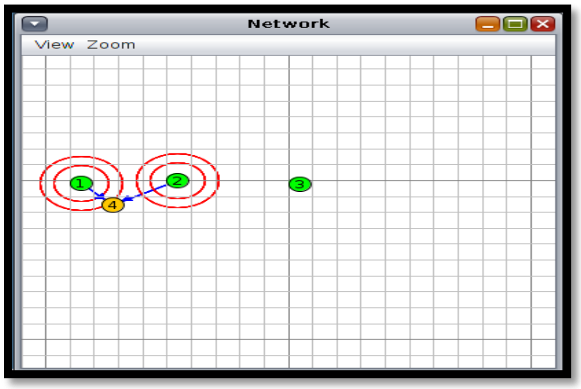

Fig. Network Window

This figure is shown as a network window. It is shown to the node which I have created. And if we are creating the confusion for the understanding node it means which are client node and which are server node so, the Contiki-cooja simulator provides the facility to identify the client and server node. In this figure green color is denoted as a client node and yellow color denoted as a server node.

VI. ANALYSES OF RESULTS

- **Throughput vs Data Payload:**

Throughput suggest to how much information can be moved starting with one area then onto the next in a given measure of time. Calculation is given below:

$$\sum_{i=1}^{n} \frac{(N_i)/(T_{i,f} - T_{i,s})}{n}$$

where N_i = Through node i, total number of bytes transmitted
$T_{i,f}$ = Node i, transmission finishing time
$T_{i,s}$ = Node i, transmission starting time
n = Total number of nodes.

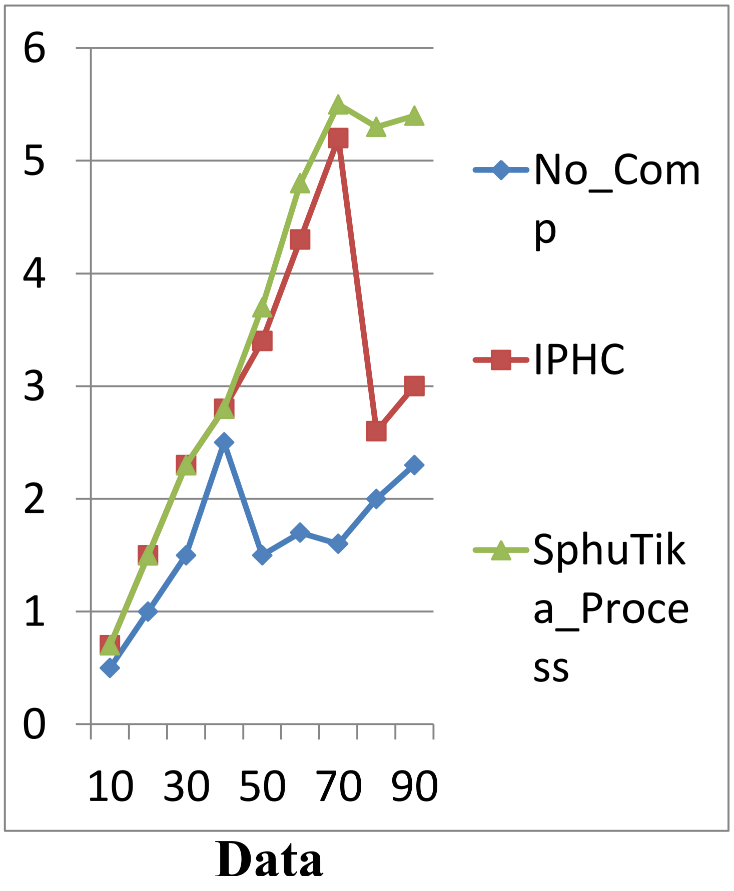

Fig 6.3.1 Throught vs data payload

In fig 6.3.1 shown the three types of cases No_comp,IPHC, SphuTika_Process respectively. Throughput is measured in KB/s. I take the different data payload values and the graph is created through this data payload vs throughput. Payload values are ranging from 10 to 90. So, it is a steady increase of 10 intervals. In my proposed algorithm it has shown good results compared to those two techniques. So, improvement is the SphuTika_process over No_comp is 74% and over IPHC is 10%.

In 6LoWPAN my proposed, if we take payload size as a smaller then it is no improvement. There is all most the same throughput till 40 B of payload size but after 40 B there is some increased result for throughput. Its result is improvement up to 40 B of payload then after also give the throughput incremented value till 70 B and it is good improvement compare to both other techniques. After 70 B of payload, my proposed throughput value is smaller decrement but it compares to the other two techniques it is a good result. The maximum payload carried in IPv6 packet are 90 B in SpuTika process but IPHC had only 70 B. So, these are the improvement of my proposed. There two other techniques are working with no fragmentation process but my proposed work with also fragment the packet.

- **Delay vs Data Payload:**

Measure the time stamp between the source to final/destination time is call delay. There are 4 types of delay. 1) Queuing 2) Transmission 3) Processing 4) Propagation.

• Queuing delay is the time spent by a bundle in line/queue. This happens when appearance pace of bundles is bigger than the administration pace of source bundle. The queuing delay is critical if there should arise an occurrence of burst appearance of packets.

• Transmission delay is the time passed when previously bit of the bundle got and it is pushed on the connection. This deferral is restricted by interface data transfer capacity.

• Processing delay acquires in handling on gathering of bundles. The time passed on looking at the headers and to figure out where that bundle is to be send is processing delay. It additionally incorporates the time used to mistake checking.

• Propagation delay is the time taken by bundle to venture to every part of the connection.

Below equation of Average end to end delay.

$$\sum_{i=1}^{n} \frac{D_{q,i} + D_{t,i} + D_{cpu,i} + D_{p,i}}{n}$$

where $D_{q,i}$ = node i, Queuing delay
$D_{t,i}$ = Node i, transmission delay
$D_{cpu,i}$ = Node i, processing delay
$D_{p,i}$ = Node i, propagation delay
n = total number of nodes.

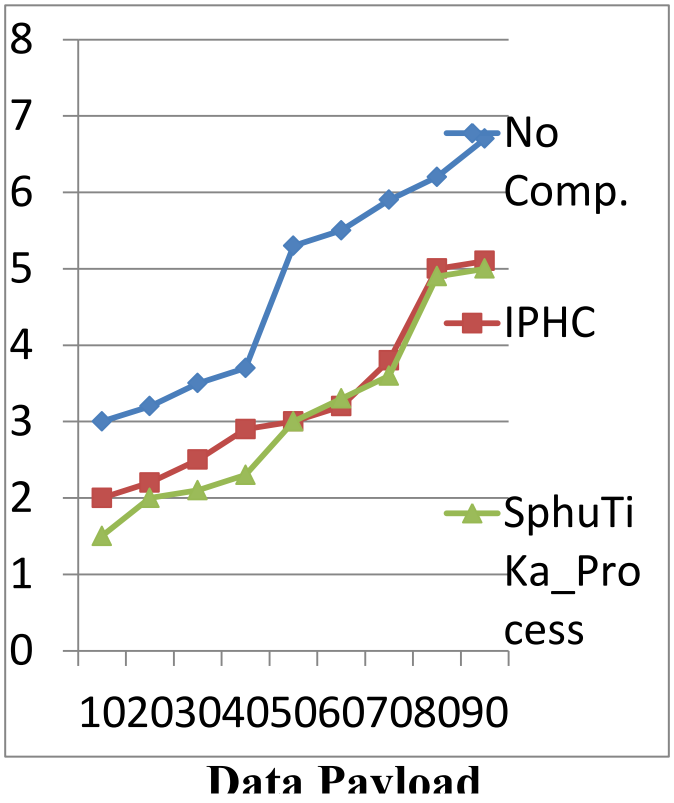

Fig. 6.3.2 Delay vs data payload

This figure compares the results of the delay with the IPHC and No_Comp technique. I take the payload value rang are 10 to 90, the interval of 10 B, and these payload values are in bytes. SpuTika_process has minimum delay compare to that of both techniques. Delay compare with IPHC over 7% and No_Comp over 32%. As shown as the result my proposed is less improvement compare with IPHC. In 10 to 50 B, my proposed delay value is increased compared to both techniques. In 50 B of payload value, IPHC and SpuTika process are the same result in a delay. In my proposed send the fragmented packet but two other techniques are not sending fragment packet till 90 B. so, delay vs data payload graph result are not more improvement.

- **Round Trip Time:**

Round-Trip Time (RTT) is the time span it takes for a bundle to be sent in addition to the time span it takes for an acknowledgment of that packet to be received. Also you can say that time between packet send to acknowledgments time. It is also known as ping time. It is estimated between a couple of source and destination node.

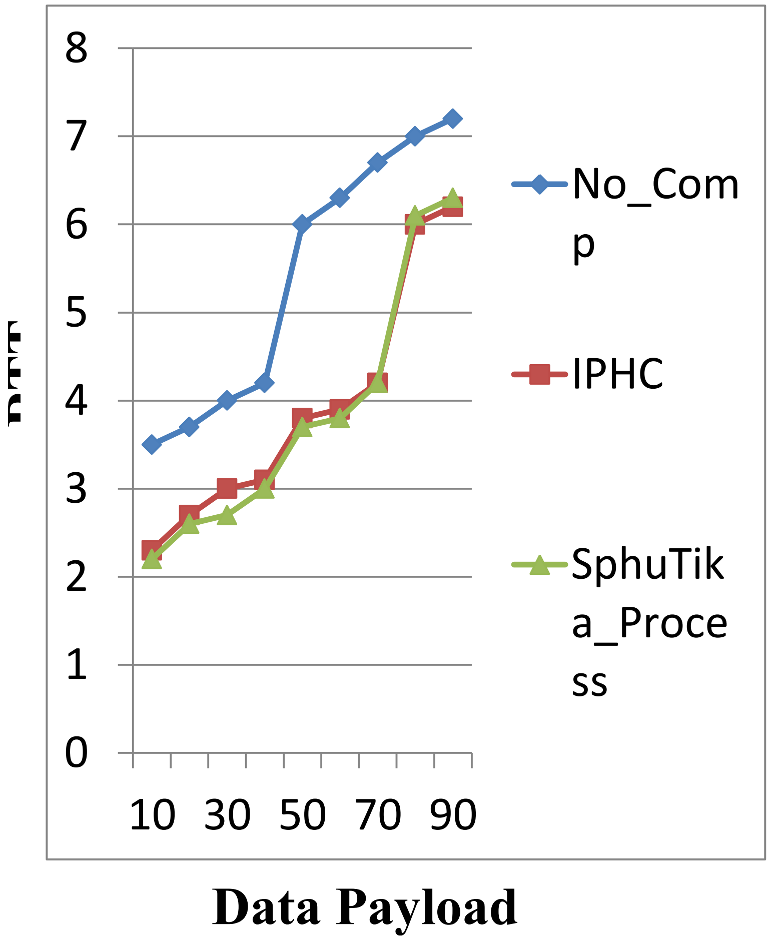

Fig. 6.3.3 RTT vs data payload

In this figure measurement of RTT(round trip time). In this graph also take the data payload value is between 10 to 90 B with 10 B of interval. In my proposed not more improve RTT value compare with two other techniques. SpuTika process is improved over IPHC is 4% and over No_Comp is 35%. So, it is not a more productive result but still, it is improving some percentage compare with both techniques. In this graph, IPHC and SpuTika_process are giving the same RTT value in 70 B of payload. So, after 70 B of payload value, SpuTika_process gives the improvement. Maximum 90 B of data payload value gives a good result. RTT measure fragment propagation time and added with acknowledgment message from the receiver side. In my proposed fragment packet is count from the after 70 B of the data payload. So, it is a good improvement compared to both.

VII. CONCLUSION

In this system, we are considering different types of header compression mechanisms that describe and learn how to compress the header of the IPv6 protocol. The basic idea of 6LoWPAN and describe the objective of our research work. In my proposed system working we fragmentation process because if data coming from network layer that size is 1280 B(IPv6 protocol) of data but in down layer data-link layer have only 127 B (IEEE 802.15.4). so, we need to fragmentation process in my exercise. In my research, I give the priority of fragment packet that why if any coming higher priority fragment packet then that packet goes to first. For this process make one queue with having two-parameter and shown the result. The results are good compare to the previous technique. Throughput is good enough but delay and RTT are not much good. So, in the future, we want to do a better technique for the delay and RTT improvements.

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