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# MOBILITY AND ENERGY EFFICIENT MECHANISM FOR 6LOWPAN DEVICES TO SUPPORT GLOBAL HEALTHCARE SYSTEM

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**ABSTRACT**

The enhancement of existing electronics healthcare (e-health) has used internet-based embedded sensing biomedical devices. The biomedical devices are capable to interact with other mobile applications to deliver healthcare services on a global scale. The Internet Engineering Task Force (IETF) working group has introduced IPv6 over wireless personal area networks (6LoWPAN). The 6LoWPAN technology has capability to support Internet over wireless sensor networks (WSN). This paper has introduced the convergence of mobility and energy consumption mechanism to support global healthcare communications services with the use of 6LoWPAN based biomedical sensors. The energy management mechanism helps to increase the lifetime of IETF-6LoWPAN devices during the movement of patient's in personal area networks (PAN). In this system, several biomedical sensors fixed on the patient's body area networks with the association of 6LoWPAN technology to support global communication. We have presented a smart hospital scenario for global healthcare monitoring applications such as ECG, PPG, Blood-pressure, Temperature etc.

**Keywords:** *6LoWPAN, WSN, Energy Consumption, Smart Hospital*

## 1. INTRODUCTION

The age span of elderly people is increasing step-by-step since last century and expected to be doubled by the end of 2025 [1]. Therefore, ubiquitous healthcare system is the one of key concerns of researchers. The healthcare technology keeps healthcare executives and managers up-to-date about the latest computer-based solutions for improving medical care and making healthcare organizations more efficient. The Internet Engineering Task Force (IETF) has presented 6LoWPAN technology to support internet connective over small devices [2].

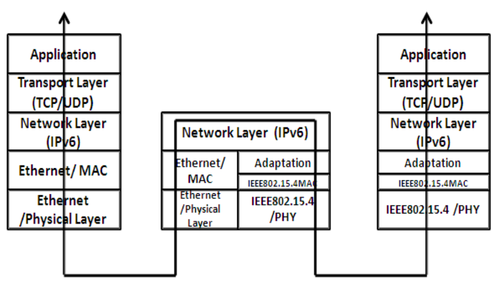


*Figure 1: A Functional Structure Of 6lowpan Stack.*

The 6LoWPAN technology has merged over data link layer as an adaptation layer after the compression of IPv6 protocol. Fig.1 has shown the functional diagram of 6LoWPAN stack. The 6LoWPAN stack has carried four types of frame in IEEE802.15.4 networks. Those are beacon frame (for synchronization purpose), MAC command frames, acknowledgement frames, and data frames. Hence, IPv6 packets must carry on data frames that acknowledgements are requested due to real-time services. The wireless IPv6 based biomedical sensor devices (W-IPv6BSD) has two mode one active mode for biomedical data transfer and other one is sleep mode for energy-saving always[3]. When devices are intended to an active mode then their radios goes to receive mode into the beacon slots and time synchronization can be maintained by 6LoWPAN devices.

The remaining of this paper is organized as follows. Section II covers the global healthcare system requirements and perspectives of the patient's body area networks and smart hospital scenario issues. Section III focuses on an energy efficient mechanism which is considering a more deep

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integration between the real and virtual worlds. Section IV concerns on mobility, and explain a process of how to patients moves one place to other in a hospital area and support global services and applications. Section V addresses the performance analysis of this proposed protocol and scenario and finally concludes in section VI.

## 2. GLOBAL HEALTHCARE SYSTEM

The smart hospital area has fixed a gateway in the center of the hospital rooms and W-IPv6BSD device placed on the patient's wearable.

*Table 1: Location Information of wearable devices at gateway*

| W-IPv6BSD | Location in terms of radius in cm | Location in terms of azimuthal angle in Radian ( α &β) |
|---|---|---|
| W-IPv6BSD (A) | R1 | α |
| W-IPv6BSD (A) | R2 | β |

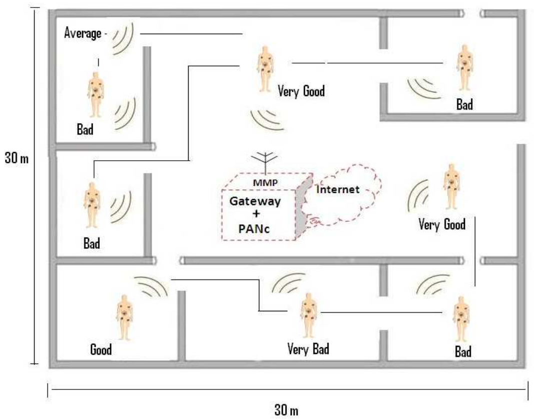


*Figure 2: An Internal Structure Of Smart Hospital Area Networks.*

The gateway always connected to the Internet and keeps the location information of all W-IPv6BSD devices as shown in Table 1. The W-IPv6BSD device knows its radius and maintains a routing table for W-IPv6BSD device. The intermediate W-IPv6BSD device maintains a route cache into gateway. The gateway broadcasts periodic route query messages to detect available W-IPv6BSD device in its wireless coverage. Responding to query messages, all W-IPv6BSD devices in the coverage field send route update messages. After the time has elapsed during the exchange of both control packets, the W-IPv6BSD device calculates the distance of the W-IPv6BSD device from the gateway and other nodes. With the help of this W-IPv6BSD device patients are associated with e-health technology as well as freely can move inside the hospital area.

This smart hospital network system is using point-to-point communication and without interruption of agent doctor can monitor his patient from anywhere using electronics devices. Figure 2 illustrates a typical e-healthcare monitoring applications inside the hospital area. Figure 3 has shown mobility model of the MMIPv6LoWPAN device. We have also developed a micro mobility IPv6 Lowpan protocol (MMIPv6LoWPAN) to calculate the exact location of the patient's inside the hospital area.

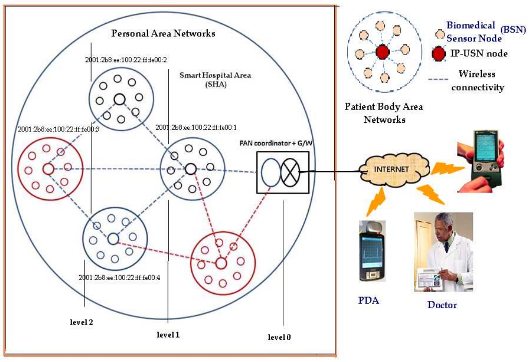


*Figure 3: A Functional Structure Of Smart Hospital Area.*

### 2.1 Patient's Body Area Networks

The W-IPv6BSD network consists of two devices, FFD (Full Function Devices) and RFD (Reduced Function Devices). The FFD (which is 6LoWPAN) node supports complete implementation of protocol stack and it can operate with gateway. The RFD (which is normal Biomedical Sensor) node is a simple device with minimum implementation of protocol stack and minimum memory capacity. The Biomedical sensor nodes (BSN) should communicate only with 6LoWPAN devices in a given instance of time. It should communicate with other 6LoWPAN and BSN.

The adaptive channel access mode, dependent on emergency state and on traffic loading is recommended for ensuring high channel availability for emergency data traffic and high energy efficiency for non-emergency conditions. The adaptive sleep cycle, dependent on battery energy remaining is recommended for ensuring high energy efficiency whilst suitably meeting the needs of medical monitoring. In order to meet requirements of the low latency Emergency state

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notification/management, Priority Management and QoS Management, a new MAC Layer emergency framework is recommended for IEEE802.15.6. Figure 4 has depicts to enable scheduling prioritization for data streaming traffic indexing to indicate priority. Biomedical applications such as ECG, EEG, temperature, may get high priority in emergencies.

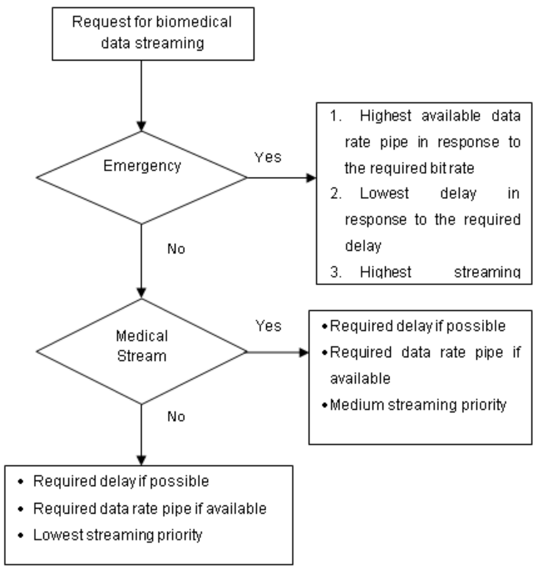


*Figure4: Emergency Induced Data Stream Scheduling.*

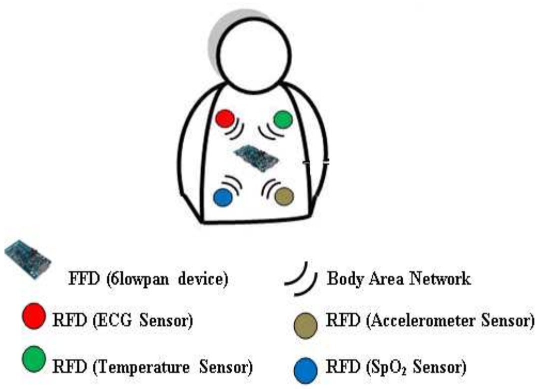


*Figure 5: Body Area Networks.*

Figure 5 depicts a prototype of a patient's body area networks. The 6LoWPAN devices and several biomedical devices are fixed on the patient's body. The biomedical sensors devices are using star network topology to transmit its biomedical data to 6LoWPAN in a particular time interval. The combination of biomedical sensors and 6LoWPAN devices are defined W-IPv6BSD, which transfers its data to the gateway. The W-IPv6BSD is responsible for establishing connectivity with the gateway. Table 2 shows healthcare application parameters and characteristics.

*Table 2: An Applications Of 6lowpan Devices.*

| Applications | Low Power Radio | ZeeBee IEEE802.15.4 IP-WSN | Patient Monitor -ing Case |
|---|---|---|---|
| *Transmission Methods* | Various | DSSS (Direct Sequence Spread Spectrum) | Various |
| *Wave Band Used* | Mainly 322MHz and below | 2.4 GHz band | 400MHz band |
| *Xmit Power* | 500 µV/m or less (field strength as 3 m) | 0dbm (1mW) etc. | 100mW and below |
| *Range* | Several m to 20 m | Several dozen m to 100 m | Several m |
| *Max. data transmission range* | Several 100 kbps | 20 to 250 kbps | Major variation with modulati on |
| *Power consumption current* | 0.3µA in stand by | Several dozen mW | Several mW |
| *Availability* | Various chips available now | Various chips available now | Various chips availabl e |

## 3. AN EFFICIENT ENERGY MANAGEMENT MECHANISM

In the process of global communication system, the doctor sends a query request message to the gateway, and then the gateway broadcasts query packet to all W-IPv6BSD devices. The query packets carry patient's IP*addr*, query data, and signal strength of level 1 with gateway's level 0. After query request is received from gateway, the W-IPv6BSD set their transmission power and reply to gateway its carry current position, energy consumption, and level. After data is received from W-IPv6BSD, the gateway can analyze energy consumption of all W-IPv6BSD devices. Whenever the energy consumption is at a level of two W-IPv6BSD devices, then it must satisfy the following conditions.

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*Highest EClevel – lowest EClevel >= (EClongest range – ECavg range)/2n*

Where *n* is the number of levels, Highest $EC_{level}$ means highest energy consumption at a level; lowest $EC_{level}$ means lowest energy consumption at same level; $EC_{longest}$ range means energy consumption for longest range at same field; $EC_{avg}$. range energy consumption for average at same field. Here are the properties of W-IPv6BSD devices

- The device has worked in to the patient's body area networks.
- The device has compressed 6LoWPAN stack for global connectivity.
- The device can compare more energy to other devices.
- The device can calculate their location from gateway.
- The device has its own IP-address.
- The device has more calculation power and data aggregation capacity for data compression
- The device avoids the redundant data in a PAN.
- The device has no collision between inter- and intra- W-IPv6BSD.
- The device has capability to adjust the transmission power to do single hop broadcast that's decided by gateway.
- If IP-W-IPv6BSD devices are near to gateway, then the level is high; if far, then the level is low and data flow is always from a higher level to a lower level.

Figure 6 depicts the energy-efficient routing algorithm of W-IPv6BSD devices which determines size of battery as well as the length of time that the sensors can leave in situate. Therefore, it is considered as one of the key concerns in W-IPv6BSD devices. In term of both dimension and weight, the battery is the largest single contributor to the size of the sensor apparatus. These factors are important to the implantable sensor as well as such factors carrying similar importance to the external sensor settings because they determine how "hidden" and "pervasive" the sensors are. To achieve the miniaturization of the power source, several strategies have been adopted. The development of micro-fuel cells is one such strategy, which could be used in the case of implantable sensors.

This will increase the lifetime of the battery and therefore the sensor, and also reduce the size of the power supply. High energy efficiency and density, along with the ability to rapidly refuel, etc., are the characteristics that make the fuel cells highly attractive for portable power generation. Examples of such technologies include polymer-electrolyte, direct methanol, and solid-oxide fuel cells, which have been proposed as an alternative to Lithium ion batteries in portable settings. After the end of any round, all the W-IPv6BSD devices send their energy efficient packet to gateway, such as IPaddr, level, EC, and PAN-id, for analysis of energy efficiency for each level. W-IPv6BSD devices have three main parts of energy efficiency; in our novel approach, we have assumed sensing component, transceiver component, and signal processing component.

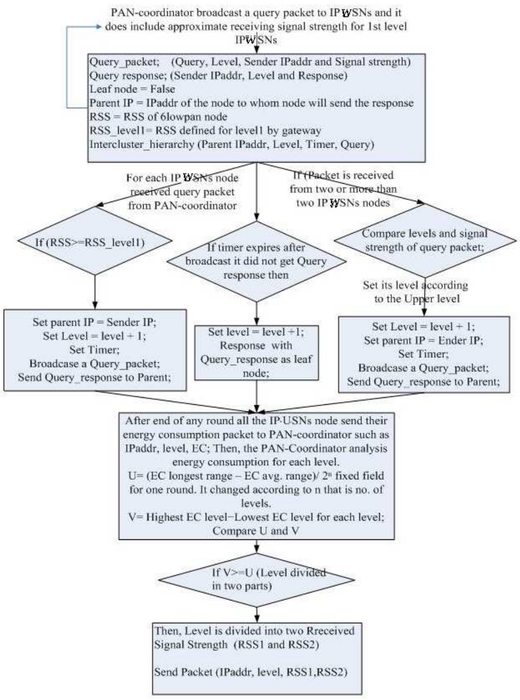


*Figure 6: Energy-efficient algorithms of W-IPv6BSD devices networks.*

The energy-efficient measurement metric depends on the percentage of energy consumed by IP-WSN node during the delivery process. For the analysis of energy efficiency, it depends on the percentage of consumed energy at W-IPv6BSD devices, which it has calculated as initial energy. In networks system, the percentages of energy consumed by all W-IPv6BSD devices are measures of energy efficiency of each node, such as the percentage of consumed energy equal to the (Initial energy minus final energy) Initial energy and the average of consumed energy equal to the sum of consumed energy percentage by all nodes/total no. of nodes. The paper has presented the results of energy efficient approaches. For that, the following components are investigated.

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### 3.1 Energy Management Mechanism for W-IPv6BSD Device

The sensing devices have used only body sensor networks (BSN) sensing data; however, the consumed energy in sensing component is simply given by:

$$Esense\ (l) = \check{y}1, \qquad (1)$$

Where ÿ is power efficient of *1* bit sensing data and l is the packet length per bit which the sensor node sensed in every round. Generally, the value of l is constant.

The Etx(r, l) and Erx (l) are the required energy of a node to transmit and receive a packet of l bits over r distance

$$Etx\ (r, l) = (\alpha r^n + \beta)\ 1 \qquad (2)$$

$$Etx\ (l) = \beta 1 \qquad (3)$$

Where $\alpha r^n$ is the radiated power that is necessary to transmit over a distance of r between source and destination, β is the energy dissipated in the transmitter circuit (PLLs, VCOs, etc.), which depends on the digital coding, modulation, etc. and n is the value of path loss exponent depending on the surrounding environment.

Generally: α= 10pJ/bit/m2

When: n=2, α=0.0013pJ/bit/m4

When: n=4, β=50nJ/bit.

The signal processing component usually consists of complicated and expensive gear such as Digital Signal Processors (DSP), Field Programmable Gate Arrays (FPGA), etc. Since the basic BSN sensor nodes only do sensing, they do not contain the signal processing components. The cluster-heads (IP-WSN) nodes have these above-defined components and the ability of data-fusion. The energy consumed by aggregating k streams of l bits and typical value δ is 5nJ/bit/stream of raw information into a single stream is given by:

$$E_{aggr}(k,l)=k\delta l \qquad (4)$$

Energy cost of receiving n packet of length l is denoted by Erx(l,n). The energy cost of transmitting a packet of length l is denoted by Etx(l). Aggregating n packets of length l is denoted by Eaggr(l,n). Thus,

$$PIP\text{-}WSN = (\alpha r^n + \beta)l + \beta l + k\delta l \qquad (5)$$

$$P= r\ l + (\alpha r^n + \beta)\ l \qquad (6)$$

In the simulation side, the radio propagation model is very important for analysis of signal strength in IP-WSN node.

$$P_{rec}, \text{ideal } (d) = Pt\ (l/l+dn) \qquad (7)$$

Where $P_{rec}$, ideal is the ideal RSS at a distance *d*, *Pt* is the transmitting power, n is the propagation constant it is vary from 2 to 4. However, simulation RSS is different from ideal RSS.

$$P_{rec}\ (i,j) = P_{rec}, \text{ideal } (d_{i,j});\ \{\ 1+\alpha\ (d_{i,j})\}\ (1+\beta\ (t)\}$$

Where α and β are constants, α depends upon distance and β depends upon time.

## 4. MOBILITY MECHANISM

We have proposed a novel Micro Mobility Sensor Protocol (MMSP) with logical channel association technique for detection of a neighboring PAN. It is a common channel-based gating protocol, algorithms to diffuse common interest across collocated PAN, and methods to define and regulate gating scope. The smart hospital scenario has the same region but is sharing information of common interest amongst PAN and accessing Internet from other PAN. The proposed algorithm has to systematically allow neighboring PANs to communicate with each other by diffusing into each other. The diffusion takes place through gating operation performed by nodes. The identification of PAN used common channel-based gating mechanism. The figure 7 has depicts mobility between PAN networks. The mechanism has to diffuse common interest (query/response) across collocated PAN, and regulate gating scope.

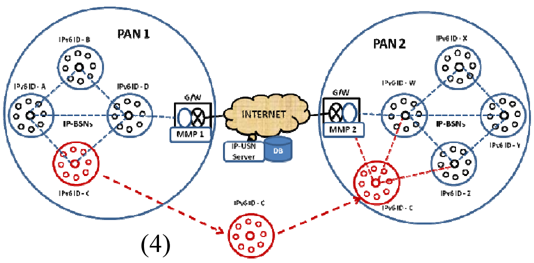


*Figure 7: Patient moves one PAN to other PAN.*

The PAN association procedure has specified logical channel assignment procedure in IEEE802.15.4 networks that prevents interference amongst overlapping PAN. It Relates channel

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assignment as the bottleneck for diffusion across PAN.

***Problem 1:*** The IEEE802.15.4 specification of each PAN has unique PAN ID and logical channel such that there is no conflict with (PAN ID, Logical Channel) in the hospital. If patient moves one PAN to other, logical channels are different; neighboring PAN do not become aware of each other, let alone communicate.

***Problem 2:*** The logical channels of the two collocated PAN are different; however, their PAN-IDs are the same. How could two such PAN discover and communicate with each other, while avoiding addressing conflicts?

***Proposed Mechanism:*** Parameters indicates that the channels are to be scanned and scan time per channel for logical channel association techniques.

*Table 3: Channel based Mobility management algorithms*

***Active or Passive***

1. Network layer issues NLME-NETWORK-DISCOVERY. request [*Active Mode*] (ScanChannels, ScanDuration)
2. Network layer issues NLME-NETWORK-DISCOVERY.request [*Passive Mode*]

On the receipt of MLME-SCAN.confirm and NLME-NETWORK-DISCOVERY.confirm

1. Network layer issues MLME-SCAN.request
2. NLME selects a tuple (PANId, LogicalChannel)

*Such as*

(PANId, LogicalChannel) New ≠ (PANId, LogicalChannel) Existing ⇔ A. V B.

*Where*

A. (PANId)New ≠ (PANId)Existing
B.[(PANId)New = (PANId)Existing ^ (LogicalChannel)New ≠ (LogicalChannel) Existing]

However, in this scenario gateway keeps the location information of all W-IPv6BSD devices, as shown in table 4. The MM6LRP knows its radius and maintains a routing table for the W-IPv6BSD devices. The intermediate W-IPv6BSD devices also maintain a route cache in gateway. The gateway broadcasts periodic route query messages to detect available W-IPv6BSD devices in its wireless coverage. Responding to query messages, all W-IPv6BSD devices in the coverage field send route update messages. After the time has elapsed during the exchange of both control packets, the MM6LRP calculates the distance of the W-IPv6BSD devices from the gateway and other nodes. The table 4 has shown current W-IPv6BSD devices radial component is $R_1$.

*Table 4: Gateway keeps the location information of all IP-WSN nodes*

| **W-IPv6BSD seq. no.** | **Location in terms of radius in cm** | **Location in terms of azimuthal angle in Radian (α &β)** | **Shortest path** |
|---|---|---|---|
| W-IPv6BSD devices (A) | R1 | α | MM6LRP1 |
| W-IPv6BSD devices (A) | R2 | β | MM6LRP1 |

The angle of the antenna lobe, in which it receives maximum strength from a particular W-IPv6BSD device, is taken as approximately equal to the azimuthal angle α, between the two. The values of the angles are tabulated as the current positions shown in table 4 after the completion of consecutive control message exchanges; the MM6LRP again records the R2 and β for the W-IPv6BSD devices.

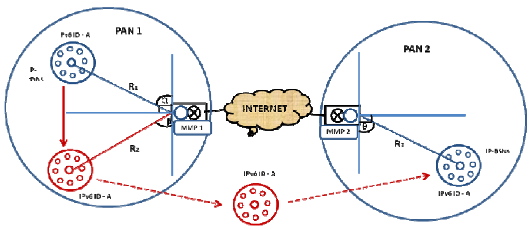


*Figure 8: Micro mobility 6LoWPAN routing protocol.*

The gateway maintains a route table for the W-IPv6BSD devices as shown in table 4 with its position information. All position entries are taken in circular coordinates. Table 4 has been updated with R2, β, using these two position values as well as the time delay between the two entities, the approximate velocity of the W-IPv6BSD devices has been calculated and further updated in table 4. Whenever the W-IPv6BSD device receives a route update packet from the W-IPv6BSD devices, the MM6LRP updates its route cache. If it receives a route update packet for the first time, when new W-IPv6BSD devices enters its area of coverage, a new entry is made for the W-IPv6BSD devices and the route validation time is set. If the gateway receives a route update message from an old IP-WBSN, it refreshes the old route. Besides the route update packet, the W-IPv6BSD device sends a periodic

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page update packet to the nearest W-IPv6BSD devices.

## 5. PERFORMANCE ANALYSIS

In our simulation scenarios we do not assume large networks that are densely deployed; we consider 500 × 500 $m^2$ a network for sensor surveillance system with continuous streaming data. Surveillance systems are mainly deployed for organization, smart home and hospital for remote monitoring. We will be simulating CRB traffic to be sent every 0.20 second to prevent buffer overflow and to replicate streaming data.

In Figures 9–11, we analyzed the performance of the number of 6 hops on the proposed MMSP (Micro Mobility Sensor Protocol) scheme by developing a complete simulation in NS 2.33 and through numerical analysis. W-IPv6BSDnodes are deployed in a 4 ×4 logical grid. The main reason of dividing the whole area into a grid is to examine the W-IPv6BSD node behavior at each step. We have used the random way point mobility model and the fluid flow mobility model. The minimum speed of W-IPv6BSDnode is 1 m/s, and the maximum speed varies to 20 m/s, 25 m/s, 30 m/s, and 35 m/s. The W-IPv6BSDnode pause time is 30 sec. MMSP is used as a routing protocol. The simulation is run for 500 seconds and there are 20 simulations run.

The performance metrics are analyzed for End to End Delay and Packet Delivery Ratio: Figures 9 and 12 describe the end-to-end delay and the packet delivery ratio of the packets from W-IPv6BSDnode to the gateway when the speed of W-IPv6BSDnode and the number of hops between them varies. After a certain number of hops, the end-to-end delay increases linearly with the increasing number of hops between the W-IPv6BSDnode and the gateway. Also the end-to-end delay increases when the speed of the W-IPv6BSDnode increases. This is because as the speed of the W-IPv6BSDnode increases, the association of the W-IPv6BSDnode with its biomedical sensor node breaks, triggering off the handoff process. Thus when the W-IPv6BSDnode moves with high speed, most of the time is spent to complete the handoff process by the new W-IPv6BSDnode and the old W-IPv6BSDnode. Some spikes in the graph can also be observed for some early hops. There are several cases which cause these spikes.

The mobility model (the random way point) because, the W-IPv6BSDnode abruptly changes its position according to the mobility model, speed of W-IPv6BSDnode, and pause time between movements that causes handoff and some nodes might not have routing information.

MMSP broadcasts packets bring traffic in the network that not only cause collision but also introduce hidden node problem. The issues could be fixed with different network topologies, different speed, and pause time of the W-IPv6BSDnode; and with the use of static routing etc. The packet delivery ratio, when the W-IPv6BSDnode is far away from the gateway, i.e., 5 hops, is just about 0.4 for an W-IPv6BSDnode moving with the speed of 20 m/s. As the number of hops between the gateway and the W-IPv6BSD node decreases packet delivery ratio increases. As the W-IPv6BSDnode reaches closer the gateway the success ratio approaches to 1, and the end-to-end delay to 0.01 seconds. Moreover, it can be seen from Figure 11 that when the speed of the W-IPv6BSDnode is 20 m/s the packet delivery ratio is better than when the speed is 25 m/s. This is because as speed increases the number of handoff increases, which can lead to a significant packet loss. Also, when the speed increases exponentially, there is a possibility that the W-IPv6BSDnode will be lost in the PAN. This is because, as the new W-IPv6BSDnode wakes up for the handoff process, the W-IPv6BSDnode may have already crossed the new W-IPv6BSDnode. As shown in Figure 10, when the W-IPv6BSDnode is 5 hop away from the gateway, the packet delivery ratio at the speed of 30 m/s is almost double than that of speed of 25 m/s. It should be noted that this type of anomaly in the graph is observed due to speed of the W-IPv6BSDnode that triggers routing path discovery more frequently, link congestion, and duty cycle of W-IPv6BSDnode. Note that the link congestion is not caused by the W-IPv6BSDnode which are relaying packets, but the W-IPv6BSDnode around the W-IPv6BSDnode which are participating in broadcast messages for MMSP. Also note that we have used standard MAC Protocol of 802.15.4, i.e., CSMA/CA, as underlying MAC protocol. The results of the packet delivery ratio, and the end-to-end delay could be improved significantly for MAC Protocols.

The performance of our MMSP scheme in terms of end to end delay and packet delivery ratio is good when the W-IPv6BSD node is closer to the gateway. But usually it is not the case, because the W-IPv6BSDnode can roam anywhere within the network. Moreover, if the network size increases the performance of our MMSP scheme decreases dramatically. Also as the speed increases the number of handoff increases, thus degrading the network lifetime as shown in Figures 9 and 10 are

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representing the speed of the W-IPv6BSDnode, the data packets are always bridged over five hops. It is observed that, at any time instant, the W-IPv6BSD node finds itself within the vicinity of MMSP and there is a fix cost from MMSP to the other MMSP, or to the gateway. Moreover, unlike the case of our MMSP scheme, the end to end delay and packet delivery ratio do not change significantly even at different speeds of the W-IPv6BSDnode. Even though, when the W-IPv6BSDnode is moving in a high speed and incurring frequent handoffs, the number of hops between the MMSP and the gateway are reduced.

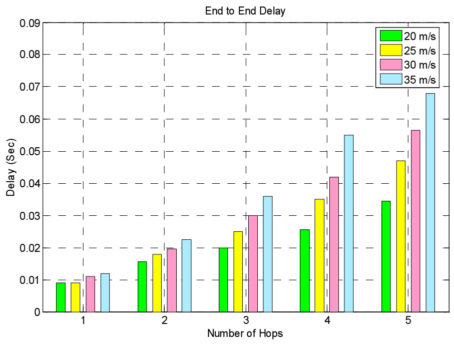


*Figure 9. End to End Delays without route optimization.*

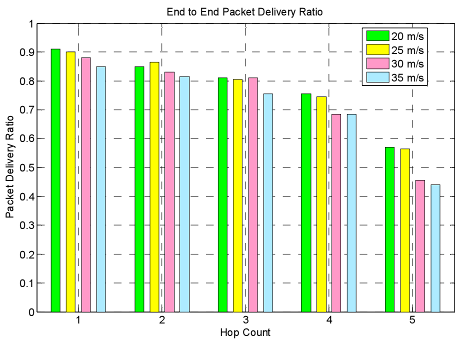


*Figure 10. End To End With Route Optimization.*

The end to end delay for the MMSP scheme has been reduced up to twice of the delay as recorded in the MMSP scheme. Similarly the packet delivery ratio is observed to 79%, as compared to 40%, as observed in the MMSP scheme. This because the number of hops in the MMSP is less as compared to the original scheme. This decreases the delay and increases the packet delivery ratio in MMSP.

The results are similar to the aggregate throughput, in that, the more channels involve for transmission, the more packets are delivered. This clearly showed that contention based network perform poorly when the hops are increasing. Moreover, the additional overhead experienced during channel switching along with the mobility affect the performance. There are many factors that can influence the date delivery performance in wireless network with no exception to WSNs: the environment, network topology, traffic patterns, etc.

Also, the 2.4GHz frequency band is already overcrowded with activities of other networks sharing the same unlicensed band. WSN gives a better performance at short range and with continuous streaming data long range transmission may experience many of the mentioned factors which result in poor performance and as such long range transmission not recommended for WSN.

## 6. CONCLUSIONS

In this paper, we propose an energy efficient MMSP and super frame algorithm for the 802.15.4 protocols. This algorithm allows node to have access to multiple non-overlapping channels by accessing channels dynamically through channel switching after a set threshold has been met. During the channel based design we analyzed and discussed the need for multichannel assignment in W-IPv6BSD. The results from the simulation results proved futile for future development in this area for 802.15.4 networks.

We have presented the performance with MMSP the first multi-frequency protocol for 802.15.4 network. It has been proven that MMSP gives a better performance to operate small data rate packet sizes of up to 523 kbps. We observed that better performance is achieved when using multichannel in analyzing the impact of W-IPv6BSD in the 802.15.4 network. Overall, MMSP exhibited prominent ability to utilize multichannel transmission for the future with 802.15.4 for wireless sensor surveillance system that is low-cost, reliable, easy to manage, easy to deploy and can process video data for automated real-time alerts. Researchers will be able to achieve the goal of long term, independent operation of sensor network deployments under this constraint. Also 802.11 will be able to operate within the same frequency band in the capacity of 802.15.4 which is predicted to encounter severe problems when the proposed 802.11n networks become popular.

In the future, we plan to setup test-bed W-IPv6BSD systems and evaluate the MMSP performance. We also plan to address the high switching delay experience at the sink node when receiving data from multiple sources.

**ACKNOWLEDGEMENT:**

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**LIST OF FIGURES**

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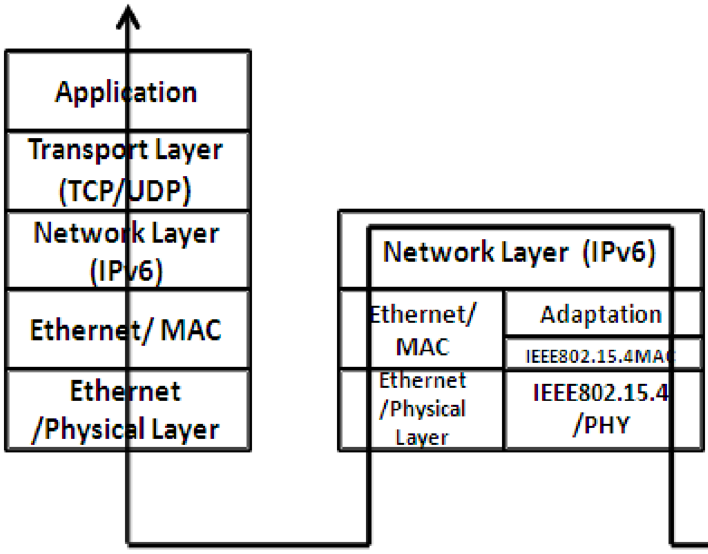


*Figure 1: A Functional Structure Of 6lowpan Stack.*

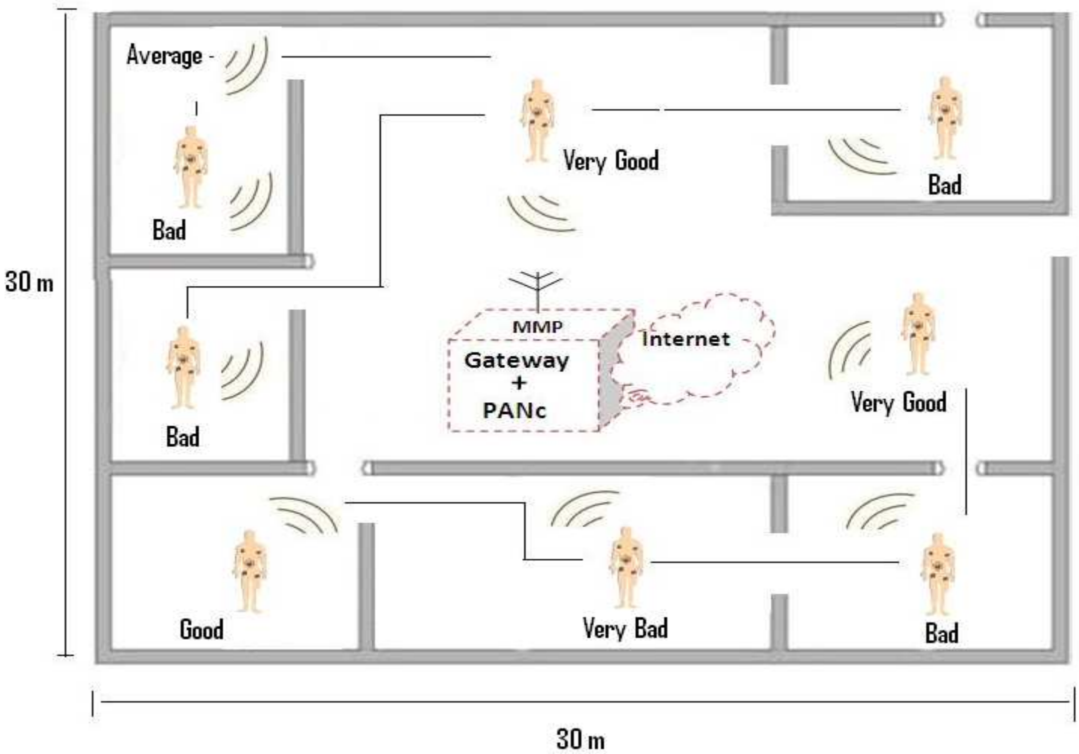


*Figure 2: An Internal Structure Of Smart Hospital Area Networks.*

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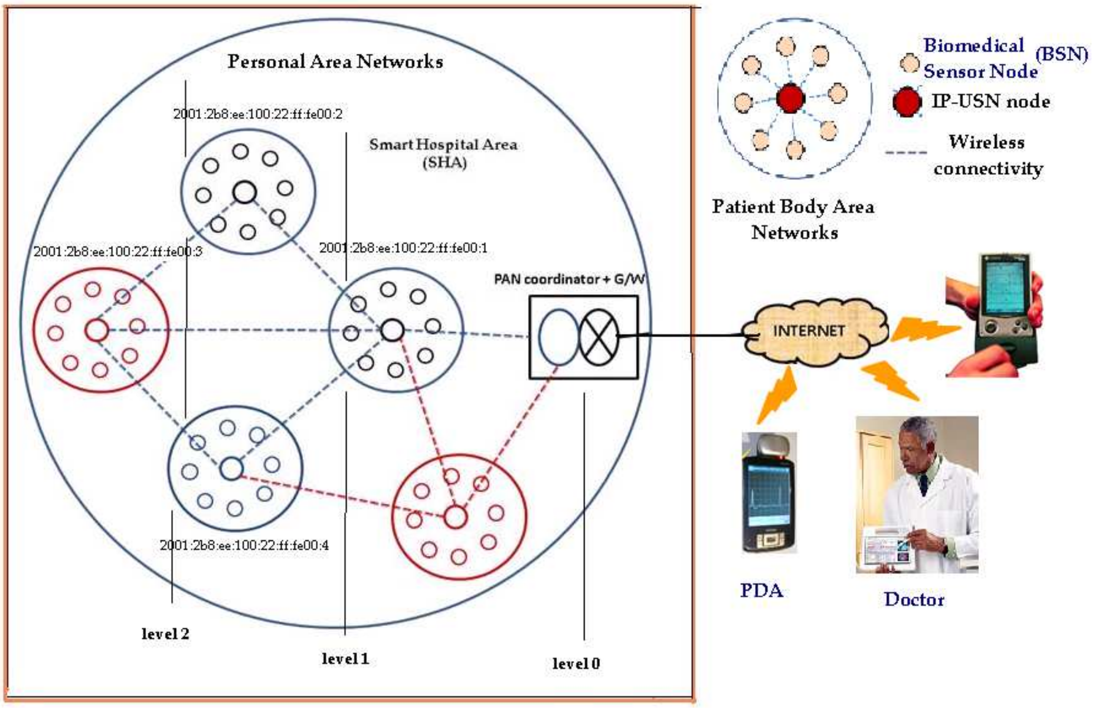


Figure 3: A Functional Structure Of Smart Hospital Area.

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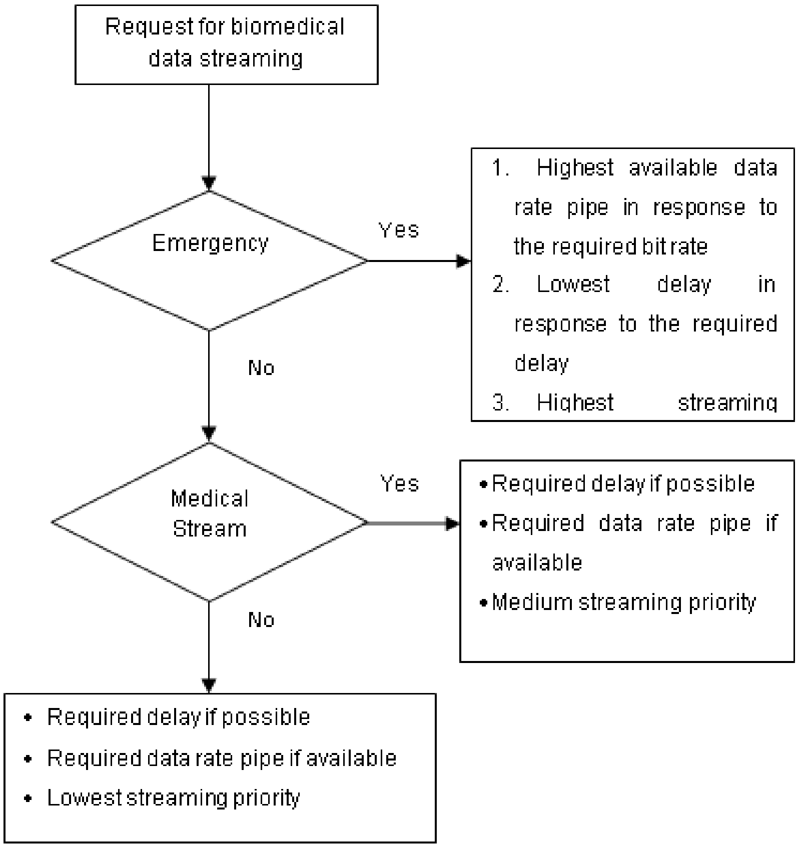

*Figure4: Emergency Induced Data Stream Scheduling.*

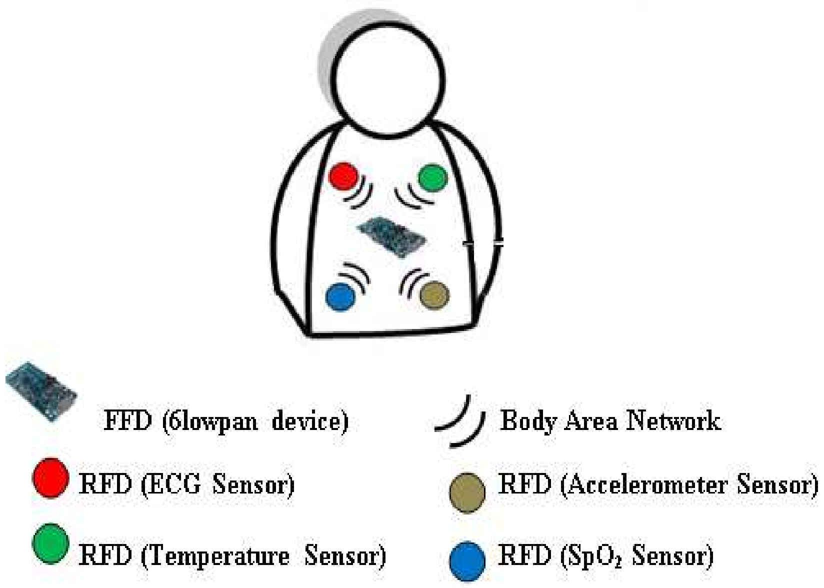

*Figure 5: Body Area Networks.*

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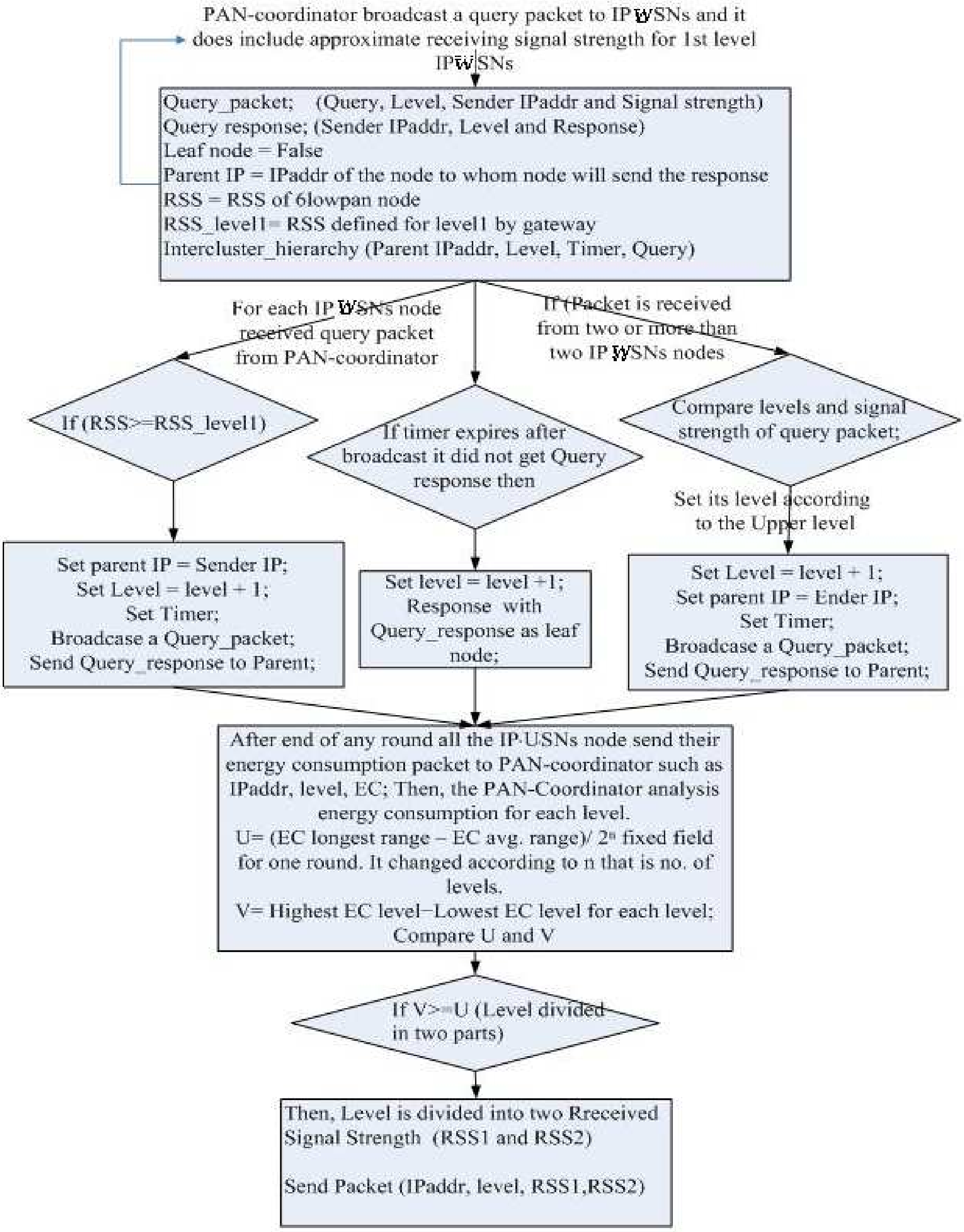

*Figure 6: Energy-Efficient Algorithms Of W-Ipv6bsd Devices Networks.*

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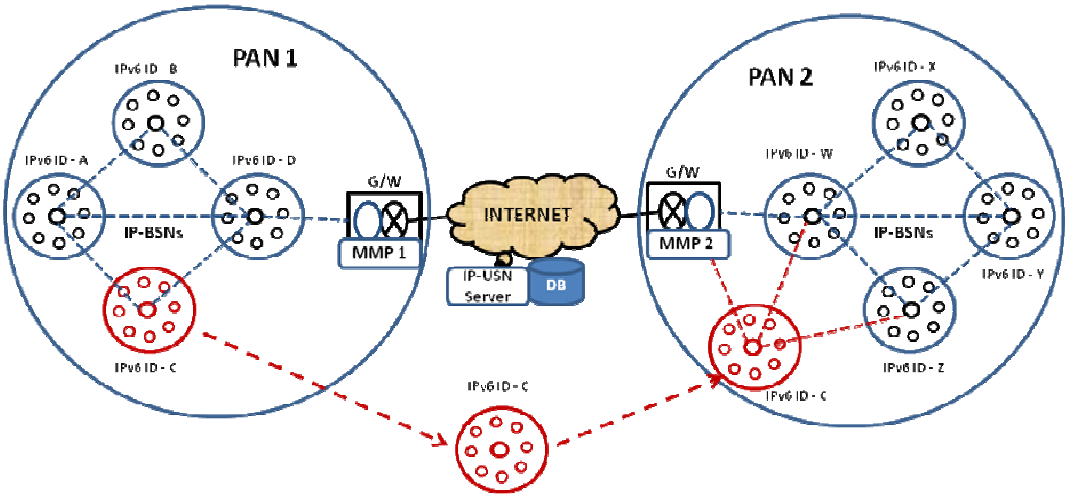


*Figure 7: Patient Moves One PAN To Other PAN.*

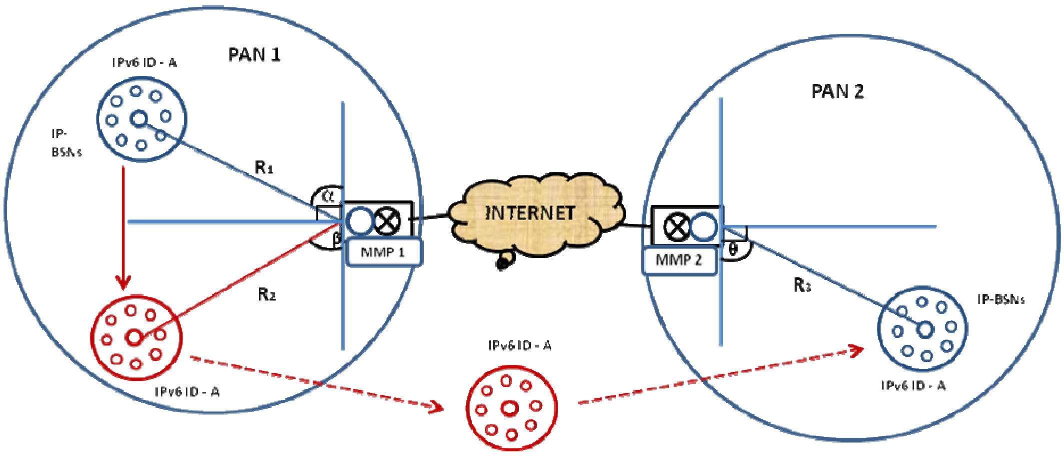


*Figure 8: Micro Mobility 6lowpan Routing Protocol.*

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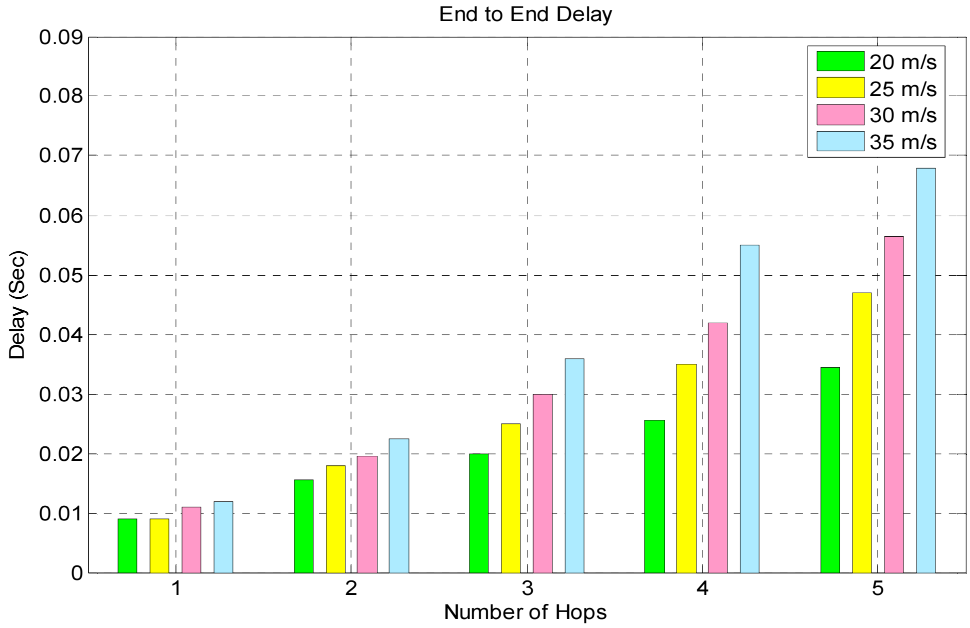


*Figure 9. End To End Delays Without Route Optimization.*

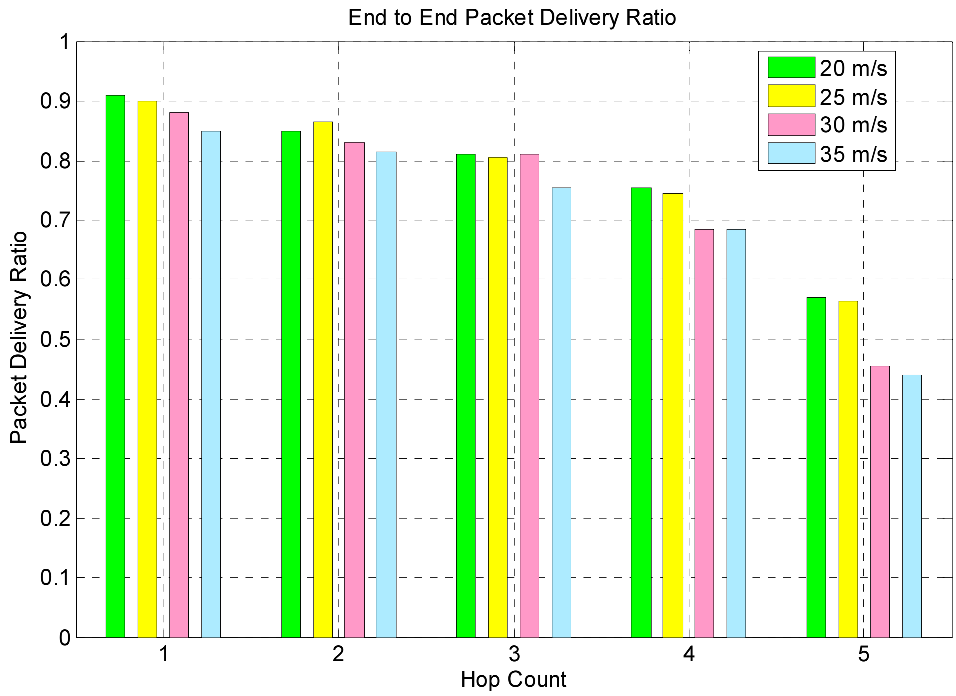


*Figure 10. End To End With Route Optimization.*