A New Framework of 6lowpan node for Neighboring Communication with Healthcare Monitoring Applications

Dhananjay Singh*, Hoon-Jae Lee** and Wan-Young Chung***
*Graduate School of Design and IT, Dongseo University Busan
**Division of Computer and Information Engineering, Dongseo Univrsity
***Division of Electronics, Computer and Telecommunication Eng., Pukyong National University
(wychung@pknu.ac.kr)

ABSTRACT

The proposed technique uses cyclic frame structure, where three periods such as beacon period (BP), mesh contention access period (MCAP) and slotted period (SP) are in a data frame. This paper studies on a mechanism to allow communication nodes (6lowpan) in a PAN with different logical channel for global healthcare applications monitoring technology. The proposed super framework structure system has installed 6lowpan sensor nodes to communicate with each other. The basic idea is to time share logical channels to perform 6lowpan sensor node. The concept of 6lowpan sensor node and various biomedical sensors fixed on the patient BAN (Body Area Network) for monitoring health condition. In PAN (hospital area), has fixed gateways that received biomedical data from 6lowpan (patient). Each 6lowpan sensor node (patient) has IP-addresses that would be directly connected to the internet. With the help of IP-address service provider can recognize or analyze patient data from all over the globe by the internet service provider, with specific equipments i.e. cell phone, PDA, note book.

The NS-2.33 result shows the performance of data transmission delay and data delivery ratio in the case of hop count in a PAN (Personal Area Networks).

Keyword

Healthcare, Personal Areae Network; 6lowpan; Framework; Patient Monitoring; Neighbor discovery

I. Introduction

IEEE802.15.4 radios are characterized by low bit rate, low power, and low cost. IEEE802.15.4 has been already used in various protocols for wireless connections and indirectly gain its popularity due to its unique advantages. The IPv6 protocol over IEEE802.15.4 designed to operate on low-power devices. 6lowpans support many features such as handling fragmentation, compression of the packet headers etc. The 6lowpans (IPv6 over low power wireless personal area networks) stack contains additional interface that support UDP packets. IEEE802.15.4 working groups have presented four frame formats viz. beacon frame, MAC command frame, acknowledgement frame and data frames. IPv6 packet carry on data frame and requested for acknowledgements

There are two type of IEEE802.15.4 network, which can be non-beacon enabled and beacon enabled. In healthcare applications monitoring technique both are used. The sensor nodes have non-beacon enable network technique which is defined as data frames, are sent through contention- based channel. The 6lowpan node has beacon-enabled network technique which maintains coordination between two 6lowpan devices or beacons enabled network. Contention- free Guaranteed Time Service (GTS) is allowing in super frames. Coordinator beacon or 6lopwan beacons are not useful for synchronization in non-beacon enabled networks. However, beacons are useful either in association or disassociation connectivity for link-layer device discovery. This paper has proposed super frame formate for 6lowpan nodes with healthcare monitoring applications.

II. Background

The time synchronization with IEEE802.15.4 2006 MAC has defined beacon enabled and non-beacon enabled modes. The beacon enabled mode used only star topology networks, it can

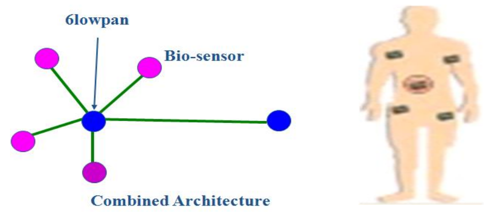

Fig.1 Connectivity between beacon and non beacon enable mode.

not support mesh topology. During frame loss or collision period it uses beacons scheduling algorithm and periodic a overhead time has a lots of traffic overhead.

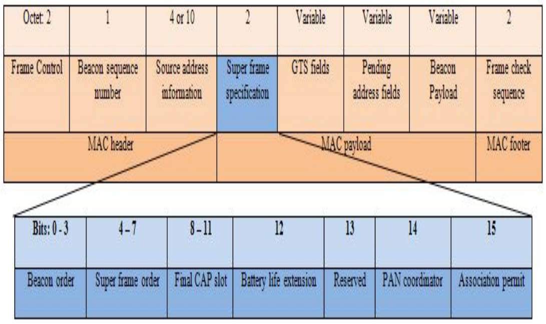

Fig.2 IEEE802.14.5 MAC frame format.

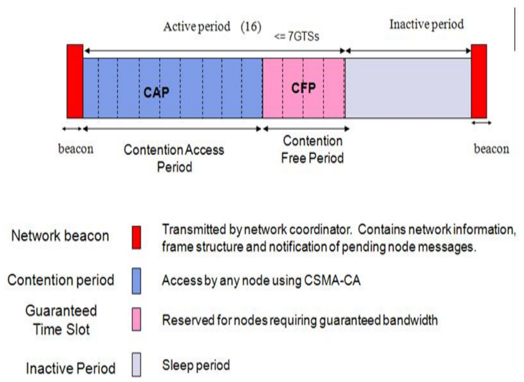

Fig.3 IEEE802.15.4 Data Frame Formate.

However Non beacon mode required long idle listening in high power consumption. This frame formate is not suable for 6lowpan stack, it needs modification. For Global health care monitoring applications technique needs peer to peer & multi-hop mesh topology with beacon and without beacon enable network technique. It must be used time synchronization with guarantee time accuracy within error boundary and robust in change of topology.

II.a Problem in Current Super frame

IEEE802.15.4 super frame is not flexible to accommodate dynamic traffic and channel hopping technique. Channel hoping technique provides high reliable link-level connectivity but current channel may not be sufficient to established requested channel connections. The Quality of services provision may required more robust control of bandwidth requests instead of competing with data frame in contention access period. Flexible but robust out of band control frame may provide efficient channel access.

Problem in GTS: The GTS (Guaranteed Time Slot) requests should compete with data frame in CAP (Contention Access Period) then it would increase collision probability, which reduces reliability. The acknowledgement in the next beacon period, so latency is the major problem. Maximum number of GTS is limited to 7 so inefficient overload network. Quality of Services provision is difficult between Contention Access Period vs. Contention Free Period.

For global healthcare applications, required reliable and fast channel access for communication because 6lowpan node broadcast req. packet by MAC layer to other neighbour 6lopwan nodes then it announces destination node id.

III. Proposed Frame Format

The proposed technique used cyclic frame structure in this technique hast three period beacon (BP), mesh contention access (MCAP) and slotted (SP) in a data frame.

Beacon Interval

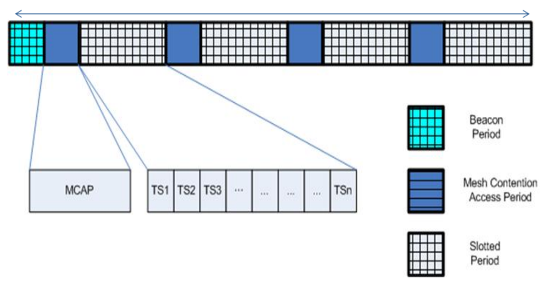

Fig.4 Proposed Cyclic frame structure.

III.a. Beacon Period: It broadcast a predefined channel time slot period beacon frames.

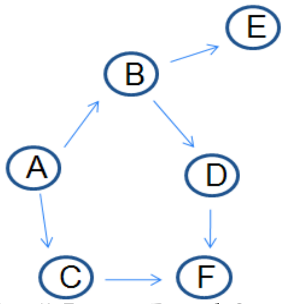

Fig. 5 Beacon Period Structure.

A beacon frame contains cyclic frame structure formate such as beacon interval value, beacon period duration, star topology support flag, time synchronization information and channel hoping information as channel hoping sequence and offset value.

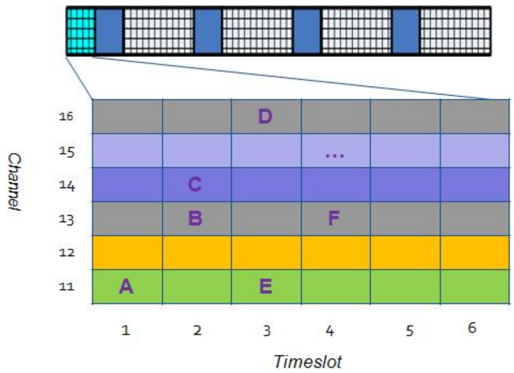

Fig.6 Beacon channel vs. period frame format.

III.b. Mesh Contention Access Period (MCAP)

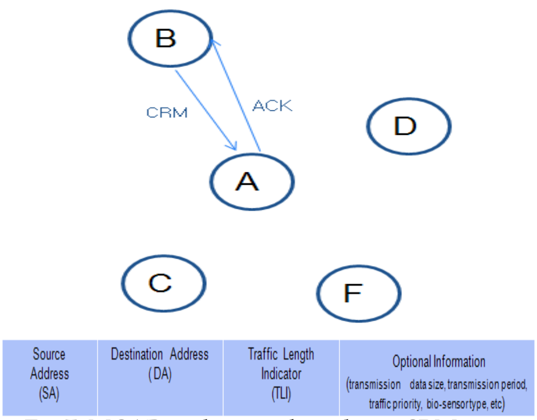

Fig.7 MCAP technique based on CRM.

The channel request/Ack frames are transmitted via CSMA/CA. In fig. 7 has shown the node B who has packets to transmit channel request message frame (CRM) to node A and node A sends ack frame to node B with Tx scheduling.

III.c Slotted Period (SP)

The no. of multiple time-slots during a single cyclicframe duration will be based on the Traffic

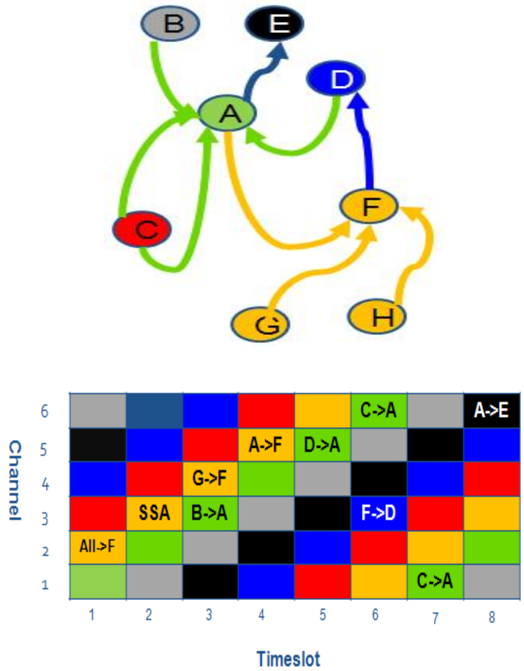

Fig.8 Slotted Period frame format.

Length Indicator and optional information such as transmission data size, transmission period, traffic priority, bio-sensor type, etc. based on CRM in a single node. The node assigned time slots tunes its channels to recipient node's channel sequence for transmission.

IV. System Architecture

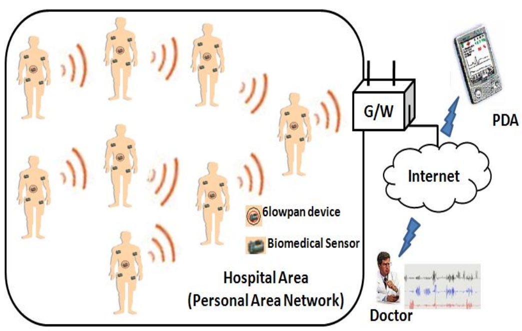

Fig.9 Global connectivity between patient to doctor via GPRS enabled cell phone.

We design a prototype for global healthcare monitoring applications. In this technique 6lowpan node has fixed each patient with several biomedical sensors. The patient can mover in the range of personal area networks (PAN). the 6lowpan node has internet connectivity and individual identity thus the doctor can monitor patient from any where at any time.

The gateway has capability to establish connectivity between movable patient in a Personal Area Networks to wired IP-based networks. The gateway broadcast IP-address (request) in PAN via routing protocol LOAD a set of instruction then patient's node transmit requested application data to the doctor and the doctor can analyze patient's biomedical data from any where at any time.

IV.a Neighbor discovery Algorithm

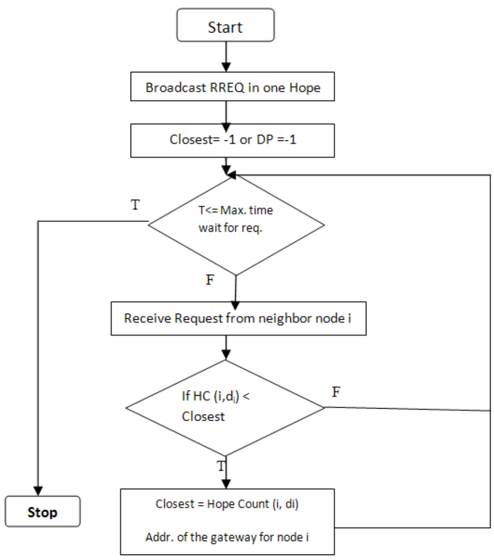

Fig.10 Neighbour Discovery Methods

In fig.10 has describe the neighbor discovery technique in personal area networks.

V. Performance Evaluation

The application-based architecture is build to increase the overall system performance in terms of proximity-based access, 6lopwan node discovery overhead, node discovery delay and node availability. The main purpose is to provide a mechanism that can establish the communication. In order to meet the objectives, minimize the patient node discovery control traffic, find the proximity-bases node in the network, and reduce the node discovery.

V.a Mathematical Analysis

Patient Discovery Overhead: For a single gateway the node discovery overhead is the sum of packet generated by PREG, PACK, PREQ and PREP in the entire network. Their N, SP, PT, PA is the total no. of nodes, service provider, patient type, patient agent. Y is the avg, no. as instances for each patient and H is the avg. no. of hopes with in a path. T is the time in second for overhead. RpREQ, RpREG, RpADV, RdADD are defined in sequentially rate of patient request, patent registration, patient advertisement and directory advertisement. However, for an X number of gateway in the entire network, the total patient discovery overhead is the sum of the all the gateway discovery overhead and information exchange between the gateways and communication cost between patients. Thus, the total number packet overhead for the whole network is:

OTOTAL = $\sum_{i=1}^{n}$ ODAP + ODXA + OPXA

The total bandwidth utilization for the whole system can be calculated by averaging the size for PREQ, PREP, PREG, and DADD message in respective equation.

V.b Simulation Analysis

In order to evaluate our architecture and protocol, we have modified the AODV implementation and simulated our protocol in the network simulator-2 (NS-2). The simulation setup consists of several 6lopwan nodes are moved within certain proximity area and transmitted data to the a gateway.

Table-1. Simulation Parameters

Parameter	Value
Transmission Range	15m
Simulation Time	120 s
Topology Size	200m * 200m
Number of Mobile Nodes	7
Number of Sources	1
Number of PAN Coordinator	1
Traffic Type	Constant bit rate

Packet Type	15 packets/s
Packet Size	36 bytes
Power loss	0.28J
Maximum Speed	2 m/s

Each node connected to each other and has its own IP-address. Initially, the gateway energy is very much because it is connected to the fixed power supply and it's not resource constraint but the simulation purpose used 100J. The initial energy of 6lowpan stack enable node is 1.5J and normal node 0.5J that is by default. Each 6lowpan node knows the location to other 6lowpan nodes. The 6lopwan node transmit its information to the gateway via multi-hop routing. The simulation parameter are shown in table no. 1. The simulation time is 100s for a transmission range of every node is 15m. The frame error and packet rate is controlled and directly related to the delivery rate. The frequency of transmission is depending on the traffic of the network. In this paper we have selected hop count as for better performance of data delivery to the gateway because 6lowpan is adhoc networks where the hop count plays an integral part in the system performance. The delay and delivery ratio is depend are affected hugely by the average path length. In fig.11 has shown the no. of hop increase in the path then the packet transmission delay increases. We can say that the access to the closest 6lowpan node or patient in term of hop count shall reduce the patient discovery and access delay.

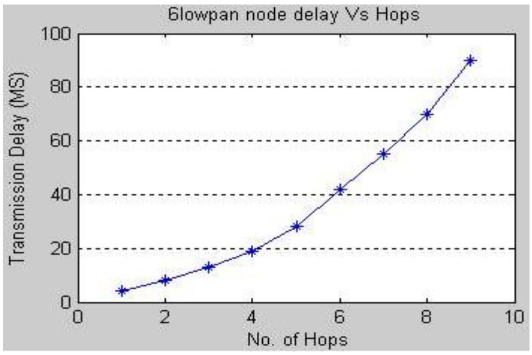

Fig.11 6lowpan node delay Vs Hop count.

In the same thing, the path length plays a crucial role in the data delivery ratio. In fig.12 has shows the packet delivery ratio deteriorated considerably when the path length increase in term of hop count.

In the case of healthcare monitoring system needs minimum hop. because its death and live of the person.

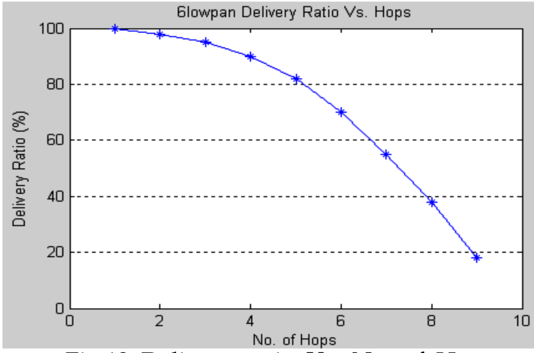

Fig.12 Delivery ratio Vs. No. of Hops.

V. Conclusion

This paper propose super frame structure for 6lowpan node discovery. The nodes are uniformly distributed in the PAN. The performance of transmission delay between patient and the gateway is surveyed and the data delivery ratio in the case of hops count is also evaluated. The number of hop is less then success full ratio better. In healthcare applications monitoring case less no .of hops is the best data delivery options. Emerging global healthcare technology supports IP-based networks to assist status of the patient in hospital-based PAN.

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