Chapter 7

Conclusions and Future Work

7.1 CONCLUSIONS

The thesis is concluded by highlighting few points which correlate the proposed methods by comparing some of the performance parameters that are common in all three proposed methods. Initially an analysis is done to understand the existing methods that try to avoid collisions in mobility based wireless networks and sensor based wireless networks. Most of the research studies emphasis a standard backoff mechanism that prevents collisions while accessing a medium in any wireless networks.

In the second chapter literature review is done on those methods that had been implemented using 802.11 medium access protocol (Krishna et al., 2010) and 802.15.4 MAC protocol (Ha et al., 2007). As research studies says that 802.15.4 is an appropriate MAC protocol for cyber physical system, so literature survey is done on sensor actuator based MAC protocols. Many methodologies implemented using 802.15.4 protocol that functions in a slotted mode of it. Some of the investigation studies focused on sensitive sensor based applications to avoid collisions.

In the research studies most of the collision avoidance techniques were achieved in a time slotted mode of sensor actuator based wireless networks. Very few approaches used the unslotted mode of sensor based MAC protocol. Research studies also showed that collision prevention is done at single stage rather than preventing at next levels. Considering above mentioned issues, proposed approaches are initiated with mobile wireless networks and moved onto cyber physical system (Shafi, 2012) based MAC protocol to avoid collisions. And also to prevent collisions while accessing a channel in any sensor based wireless networks.

The third chapter discusses the proposed approach called as Energy Hashed Virtual Backoff Algorithm (EHVBA) which made an enhancement in the existing virtual backoff procedure of 802.11 MAC protocol (Krishna et al., 2010). In EHVBA energy is considered as an important factor in deciding the performance efficiency of the whole wireless system. This approach enlighten that when energy consumption is
minimal then the delivery of packets are more. And the overall throughput of the system also gets enhanced.

Most important aspect of EHVBA is hashing the energy values of nodes in a network to obtain number of attempts for each node. Number of attempts made by any node from any wireless network is attained from the modal optimal method which is a new approach introduced in this proposed method. Along with the number of attempts each node is checked for its residual energy. This confirmation is to avoid packet drop as well as to avoid collisions in this CPS (Shafi, 2012) based wireless network. At last this EHVBA had succeeded in achieving better results than existing approach by consuming less energy while accessing a channel.

The proposed approach called Virtually Prioritized Backoff Procedure (VPBP) explained in the fourth chapter focuses on sensor actuator based wireless network which uses 802.15.4 protocol (Ha et al., 2007). The main feature of this approach is to assign each node priority with critical value. This is to ensure that a node carrying important data should not be neglected due to priority. Though the priority is key point in sensor based wireless networks criticality holds more significant position when an emergency situation arises. Moreover the VPBP functions in an unslotted mode of 802.15.4 MAC protocol (Wang et al., 2009).

The VPBP approach is applied for two data rate variants. In both data rate transmission of packets, the proposed approach had come up with elevated results compared to existing method. This approach also shows that channel access is given to almost all nodes fairly which is shown through fairness index value of this CPS based wireless network. The performance of average packet throughput in VPBP is better than existing prioritized method. The network reliability of CPS based wireless network using multi rate of data is achieved up to 60%, which is better than the existing prioritized method.

The fifth chapter explains about the proposed collision avoidance technique called Priority with Counter Modified Backoff (PCMB). The proposed procedure tries to avoid collisions that occur at two levels of data transmission. The first level of collision avoidance is at Centre Coordinator whereas the second level of collision
avoidance is at gateway. In the first level of PCMB packet throughput is successfully obtained by forwarding high prioritized packets to the gateway.

In the second level of PCMB packets received at the gateway are maintained through two buffers. This is to ensure that no node should wait for longer period. However the starving node gets access to the medium rather than dropped at this stage immediately. So the packet drop scale in PCMB at gateway is 20% to 23% which is a minimal drop scale. Additionally the time taken to deliver the packets at gateway has packet delay that varies between 23ms to 28ms.

When comparing three proposed methods, while considering energy consumption parameter, the EHVBA is better than other two methods PCMB and VPBP. If fairness factor is considered the VPBP is superior to other two approaches. Since the VPBP methodology emphasise more on critical factor, its channel accessibility is better. The successful transmission of packets is efficiently done in PCMB since it gives more preference to top prioritized data. Above all the performance parameters delay and collision ratio have approximately equal values in these three proposed methods. The collision ratio is less in single and two level stages of CPS based proposed methods. At the same time delay is minimal in all these three proposed methods to ensure effective packet transmission.

The last chapter of the thesis discusses the applications that can be carried through sensor cum actuator built devices. The smart automobile parking zone application describes the implementation of VPBP. In the smart hospital application it is shown that how EHVBA process is applied to consume less power. The PCMB approach is applicable to smart highway application where priority is given more importance at each stage. Overall case study is explained for cyber physical system based applications to prove that the proposed methods can be effectively applied in the said scenarios.
7.2 CONTRIBUTIONS

The specific contributions are made as follows:

1. Designed energy efficient medium access control method for cyber physical system based Wireless Network.

2. Devised a priority focused method to avoid collision in Wireless Sensor Actuator Networks for cyber physical system.

3. To overcome the issue of consecutive collisions a two stage medium access control method is designed for cyber physical system based Smart Wireless Networks.

7.3 FUTURE WORK

As cyber physical system is a combination of various wireless networks a security enhanced methodology to be developed to avoid collision in CPS based wireless network. Since smart devices are part of cyber physical system, an effective key mechanism need to be applied on most important data to perform successful transmissions in smart wireless networks. To enhance the performance of the cyber physical based wireless systems, multi-level collision avoidance methodology can be carried out in heterogeneous wireless networks.