ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 7, July 2015

Dynamic Packet Length Optimization in Wireless Sensor Network

Mr. Sudip Tembhurne[1], Miss. Radhika Rane [2], Mr. Sachin Deshpande[3]

M. E. Student, Computer Engineering, VIT Mumbai, India[1,2]

Associate Professor, Department of Computer Engineering, VIT Mumbai, India[3]

Abstract: In wireless sensor networks, dynamic packet length control is more efficient in terms of channel utilization and energy efficiency. In previous packet length optimizations for sensor network often employ a fixed optimal packet length scheme, while dynamic packet length provide accurate radio link estimation and increase system throughput. The adaptation of dynamic packet length is 802.11 wireless system. The packet delivery ratio keeps high i.e. 95% above and link estimated error within 10% for 95% link. The experiments provide optimization of dynamic packet length achieves best performances related to the previous experiments.

Keywords: Link estimation, packet length optimization, wireless sensor networks, DPLC.

I. INTRODUCTION

A basic problem in wireless networks is that radio links tends to fading, transmission power, and interference, which result in decreasing the data delivery performance. This problem is solved in wireless sensor networks (WSNs), in which resource constraints and severe energy already include the use of many techniques which can be found in other wireless systems but not always [1][3]. For example, (i) effective forward error correction (FEC) which needs the amount of redundant data transmitted to be tuned to match the link qualities which is really difficult to achieve in dynamic WSNs[3] (ii) Bit rate adaptation protocols, requires special hardware which is not available on general sensor nodes.

Initailly, 802.11 WLANs designed for tiny networks with limited traffic only, and are thus were not able to handle high traffic situations. However, as wireless LANs commonly used everywhere, the design limitations become greatly stressed. Usually neglected tunable parameter is packet length of MAC layer, while packet length can be of any variable size in the 802.11 standard, it is most often simply set to the maximum value to reduce the impact of overhead. However, in topology with hidden nodes and weaker channels shorter packets may be preferable due to their lower susceptibility to loss.

Packet length adaptation gives lower probability of loss for shorter packet length. To address the tradeoff between lower overhead for l ong packet lengths. There has been a enough amount of research already done on packet length adaptation. In current packet length adaptation scheme, a basic and simple packet loss model is typically used everywhere, Here assume that the channel have a constant BER (bit-error rate), and neglect staggered collisions [1, 2]. We assumes this, due to random bit errors in the packet payload most of the packet losses occurs. However, it has experimentally been shown that for lower modulation rates in 802.11a, most packet loss occurs due to failure to synchronize to the packet preamble. While using constant BER model, this type of packet loss cannot be taken in consideration because it requires channel fading model [2].

The ultimate purpose of this study is to find out the optimal packet length for the real time channel conditions. The basic idea is: if the packet length is too small, much transmission is spent on handling packet headers which result in low effective data throughput. Therefore, we need some optimal packet length exists to achieve maximal throughput[10] on the other hand, if the packet length is too large, due to packet error rate, packet retransmission rate will be high. This packet optimization scheme applicable in sensor networks only. These sensor network must have the following features.

(i) *Dynamic* Packet Length Adaptation Scheme: Fixed packet length optimization scheme is very old technique now. Previously it was the only way for communication in WLAN sensor networks. Because of spatial temporal link quality diversity IN WSN this scheme is not used.

(ii) *Accurate* link estimation: Link estimation accuracy decides the performance improvement in packet length adaptation scheme. There are some unique characteristics of WSNs, which are not considered in previous work e.g. Resource constraints of sensor nodes, which leads to inaccurate link estimation in wireless sensor networks.

(iii) *Easy* to use: No prior work is done to address the application programmability issues on packet length adaptation scheme in wireless sensor network.
The rest of the paper is organized as follows. Section II discussed related work. In section III comparative analysis of various techniques with the help of table. In section (iv) Research design is explained. Finally dynamic packet optimization scheme it proposes.

II. RELATED WORK

A) *Packet Loss Model:*

Wireless LANs Signal losses can be broadly classified into two types:

Copyright to IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 7, July 2015

i) Channel errors
ii) Collisions

Channel error are the result of unfavorable channel conditions whereas collision is the result of unfavorable traffic condition. Both can occur anytime anywhere.
The total packet loss probability *PL* can be computed as:

$$PL = 1 - (1 - PC)(1 - Pe)$$

Where,
PC : Probability of collision
Pe : Probability of channel error, which is assumed to be independent of *PC*.

In the above analysis, we are considering that packets which are collided are lost and not captured. Probability of ACK loss is very much negligible compared to other loss.

Figure 1. Figure 1(a) assumes a constant BER, and Figure 1(b) assumes SNR to have a log-normal distribution.

The shapes of the curves are noticeably different. This is because in the case where SNR is modeled probabilistically,the actual value of SNR has a much higher impact on anindividual packet's successful transmission than the packet'slength. While a constant BER model might suggest using a packet length of only 400 bytes, a more accurate modelincluding SNR distribution shows that maximum packet length would be superior.

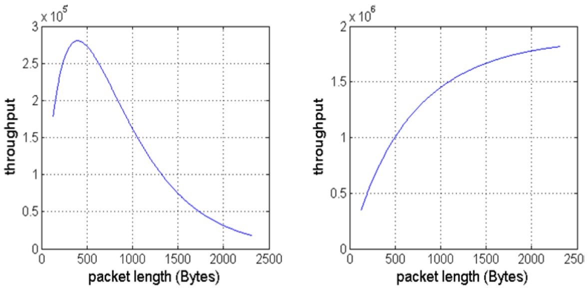

Figure. 1. Throughput vs packet length assuming no collisions for (a) SNR fixed at 9dB, and (b) SNR with mean of 9dB with standard deviation of 3dB.

B) Dynamic Packet Length Adaptation:
At different locations, different environmental factors affects wireless link qualities greatly. To check out how link diversity is?, For that we are going to setup one TelosB which will measure strength of signal at resolution of 1ms. The experiments are conducted both outdoor (the environment is quiet) and indoor (the environment is noisy because of 802.11 interferences) respectively.
We can see that the channel conditions vary drastically: in the quiet environment the RSSI value can go low as −96 dbm while in the noisy environment the RSSI value can be as high as −62 dbm.
The above experiment shows that, to get a good efficient performance in wireless sensor network, packet length adaptation schemes must be dynamically adapted in physical channel condition.

C) Accuracy of Link Estimation:
We evaluate the accuracy of the link estimation method in terms of absolute error.
Each node transmits 200 packets in turn. All other nodes record each packet's reception. The estimated link qualities are compared against the ground truth values. Figure 8 shows the CDF of absolute error (i.e. estimated value - real value).
We can see that the errors keep within 10% for 95% links, indicating that the link estimation method yields accurate results.

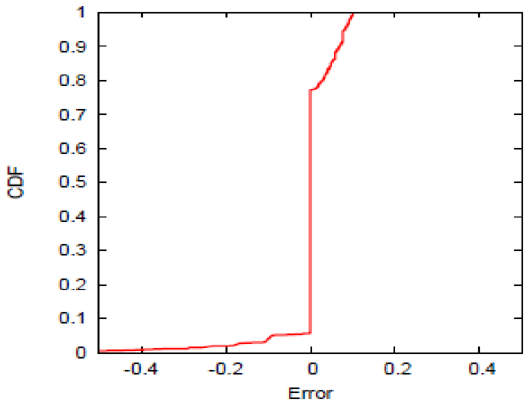

Figure 2. Accuracy of link estimation.

III. Comparative Analysis

Paper	Packet Loss	Average Delay (ms)	Bit-Distortion−rate performance for streaming(b/s)	Scheme /Algorithms
Packet Data Transmission Over Mobile Radio Channels	7.01 %	314	124	Network path diversity, streaming of packetized length.
Dynamic Packet Length Control in Wireless Sensor Networks	9.13%	421	122	Error-cost optimized transmission of a single data unit in isolation.
Packet Length Adaptation in WLANs with Hidden Nodes and Time-Varying Channels	5.21%	214	124	Multiple access networks, integer programming problem.
Adaptive Design for the Packet Length of IEEE 802.11n Networks	2.12%	131	54	Cross-layer optimization, optimal packet length, distributed coordination function (DCF).

Copyright to IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 7, July 2015

IV. PROPOSED SYSTEM

In research design section, we going to present design of DPLC. We have identified major design goals which are as follow.

- DPLC should be dynamic in nature. It should provide dynamic adaptation scheme which result in performance improvements.
- It should be give the result in time varying sensor networks.
- Accurate link estimation is important factor. It should be able to capture interference (from hidden or exposed terminals) and physical channel conditions (power degradation, mobility and channel fading).
- Ease of programming. DPLC should provide easy-touseservices to facilitate upper-layer application programming.
- Lightweight Implementation: DPLC should be lightweight for resource constrained sensor nodes.

A. Flow chart:

The flowchart of dynamic packet length optimization approach is described with the following diagram:

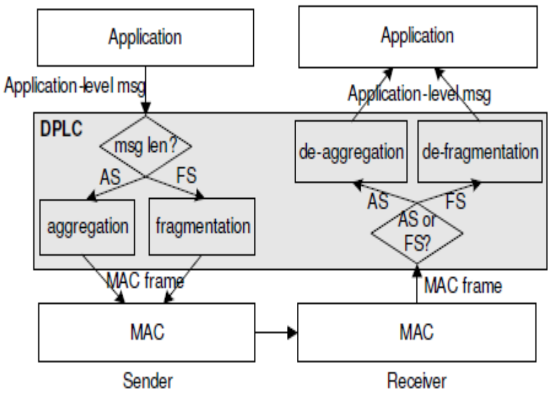

Figure 3: DPLC Overview

A. Proposed Methodology

The DPLC scheme works as explained below. For transmission, the application-level message passed by application. The DPLC module at the sender end decides whether to use the aggregation service or not (AS, if the message length is small, aggregate small messages together) or the fragmentation service (FS, if the message length is larger than the maximum packet length supported by the radio then fragment them, i.e., 128 bytes for CC2420). DPLC have link estimator which dynamically estimates the appropriate length of packet for transmission. Based on this, the DPLC module at the sender decides how many messages should be aggregated (for AS), or how many frames the message should be fragmented into (for FS). When a frame is ready for transmission (enough messages have been aggregated or time is out in AS), DPLC transmits it out via the MAC layer. When the DPLC module at the receiver receives a MAC frame, it deaggregates or defragments the frame in order to obtain the original message. When the message is ready (all frames in the message have been received or the receive buffer is full in FS), the DPLC module at the receiver notifies the upper layer for further handling. The DPLC scheme provides two services for upper-layer applications, i.e., the aggregation service (AS, for small messages) and the fragmentation service (FS, for large messages).

(i) AS is useful for small data collection, e.g., CTP [7].
AS provides three different mechanisms follows as

1. Reliable transmissions (AS ∞),
2. Unreliable transmissions with fixed number of retransmissions (ASn, where $n \geq 1$ is the retransmission number), and
3. Unreliable transmissions (AS0). Both AS ∞ and ASn requires L2 ACKs provided by link layer, reason behind is we habe to retransmit packets (at least once) when they are lost. For AS0, we additionally provide a more efficient ACK scheme called AggAck that does not rely on L2 ACKs, and thus mitigate the ACK overhead (we use AS0-L2 to denote AS0 with L2 ACKs and AS0-AA to denote AS0 with AggAck afterwards).

(ii) FS is useful for bulk data transmission, e.g., Flush.
FS provides reliable transmissions as a large message is usually very important for upper-layer applications. FS doesnot necessarily depend on L2 ACKs. As mentioned above, weadditionally provide the AggAck mechanism to mitigate theACK overhead, and more importantly, to deal with data packet retransmissions (we use FS-L2 to denote FS with L2 ACKs and FS-AA to denote FS with AggAck afterwards).

V. IMPACT OF DYNAMIC OPTIMIZATION MECHANISM

This mechanism proposed here will provide the accurate link estimation, efficient utilization of channel in outdoor environment. This will improve the system throughput and packet delivery ratio in wireless sensor networks.

VI. EXPECTED OUTCOME

This dynamic packet length optimization appraoach provide the packet delivery ratio keeps high i.e. 95% above and link estimated error within 10% for 95% link.

VII. CONCLUSION

This proposed dynamic packet length optimization approach will provide accuracy in link estimation that capture physical channel condition, increase packet delivery ratio, increase system throughput and efficient energy utilization.

ACKNOWLEDGEMENT

I am currently pursuing M.E in Computer Engineering and the work in this paper is under process. The dynamic packet length optimization approach will be implemented using the software modules. Further, dynamic packet length optimization approach will be used for accuracy of link estimation, efficient channel utilization and increase system throughput.

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 7, July 2015

REFERENCES

[1]Wei Dong, Chun Chen, Xue Liu, Yuan He,Yunhao Liu, Jiajun Bu, Xianghua Xu, " Dynamic Packet Length Control in Wireless Sensor Network," in Proc. 2014 IEEE Transactions.

[2] M. N. Krishnan, E. Haghani, and A. Zakhor, "Packet length adaptation in WLANs with hidden nodes and time-varying channels," in Proc. 2011 IEEE GlobeCom.

[3] W. Dong, X. Liu, C. Chen, Y. He, G. Chen, Y. Liu, and J. Bu, "DPLC: dynamic packet length control in wireless sensor networks," in Proc.2010 IEEE INFOCOM.

[4] B. Chen, Z. Zhou, Y. Zhao, and H. Yu, "Efficient error estimating coding: feasibility and applications," in Proc. 2010 ACM SIGCOMM.

[5] J. Huang, G. Xing, G. Zhou, and R. Zhou, "Beyond co-existence: exploiting WiFi white space for ZigBee performance assurance," in Proc. 2010 IEEE ICNP.

[6] O. Gnawali, R. Fonseca, K. Jamieson, D. Moss, and P. Levis, "Collection tree protocol," in Proc. 2009 ACM SenSys.

[7] S. Ganeriwal, I. Tsigkogiannis, H. Shim, V. Tsiatsis, M. B. Srivastava, and D. Ganesan, "Estimating clock uncertainty for efficient duty-cycling in sensor networks," IEEE/ACM Trans. Netw., vol. 17, no. 3, pp. 843–856, 2009.

[8] P. R. Jelenkovi´c and J. Tan, "Dynamic packet fragmentation for wireless channels with failures," in Proc. 2008 ACM MobiHoc.

[9] G. Hackmann, O. Chipara, and C. Lu, "Robust topology control for indoor wireless sensor networks," in Proc. 2008 ACM SenSys.

[10] F. Zheng and J. Nelson, "Adaptive design for the packet length of IEEE 802.11n networks," in Proc. 2008 IEEE ICC.

[11] K. Jamieson and H. Balakrishnan, "PPR: partial packet recovery for wireless networks," in Proc. 2007 ACM SIGCOMM.

[12] S. Kim, R. Fonseca, P. Dutta, A. Tavakoli, D. Culler, P. Levis, S. Shenker, and I. Stoica, "Flush: a reliable bulk transport protocol for multihop wireless networks," in Proc. 2007 ACM SenSys.

[13] L. Sang, A. Arora, and H. Zhang, "On exploiting asymmetric wireless links via one-way estimation," in Proc. 2007 ACM MobiHoc.

[14] X. Liu, Q. Wang, W. He, M. Caccamo, and L. Sha, "Optimal real-time sampling rate assignment for wireless sensor networks," ACM Trans. Sensor Netw., vol. 2, no. 2, pp. 263–295, 2006.

[15] H. Zhang, A. Arora, and P. Sinha, "Learn on the fly: data-driven link estimation and routing in sensor network backbones," in Proc. 2006 IEEE INFOCOM.

[16] K. Srinivasan and P. Levis, "RSSI is under appreciated," in Proc. 2006 EmNets.

[17] M. Buettner, G. Yee, E. Anderson, and R. Han, "X-MAC: a short preamble MAC protocol for duty-cycled wireless sensor networks," in Proc. 2006 ACM SenSys.

[18] J. Polastre, R. Szewczyk, and D. Culler, "Telos: enabling ultra-low power wireless research," in Proc. 2005 ACM/IEEE IPSN.

[19] H. Dubois-Ferrière, D. Estrin, and M. Vetterli, "Packet combining in sensor networks," in Proc. 2005 ACM SenSys.

[20] J. W. Hui and D. Culler, "The dynamic behavior of a data dissemination protocol for network programming at scale," in Proc. 2004 ACM SenSys.

[21] T. He, B. M. Blum, J. A. Stankovic, and T. Abdelzaher, "AIDA: adaptive application-independent data aggregation in wireless sensor networks," ACM Trans. Embedded Comput. Syst., vol. 3, no. 2, pp. 426–457, 2004.

[22] Y. Sankarasubramaniam, I. F. Akyildiz, and S. W. Mclaughlin, "Energy efficiency based packet size optimization in wireless sensor networks," in Proc. 2003 IEEE International Workshop Sensor Netw. Protocols Applications.

[23] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: a survey," Comput. Netw., vol. 38, pp. 393–422, 2002.

[24] E. Modiano, "An adaptive algorithm for optimizing the packet size used in wireless ARQ protocols," Wireless Netw., vol. 5, no. 4, pp. 279–286, 1999.

[25] P. Lettierri and M. B. Srivastava, "Adaptive frame length control for improving wireless link throughput, range, and energy efficiency," in Proc. 1998 IEEE INFOCOM.

[26] J. D. Spragins, J. L. Hammond, and K. Pawlikowski, Telecommunications: Protocols and Design. Addison Wesley Publishing Company,1991.

[27] C. K. Siew and D. J. Goodman, "Packet data transmission over mobile radio channels," IEEE Trans. Veh. Technol., vol. 38, no. 2, pp. 95–101,1989.

BIOGRAPHIES

Sudip Tembhurne, M.E. student in Vidyalankar Institute of Technology, Department of Computer Engineering, Mumbai

Radhika Rane, M.E. student in Vidyalankar Institute of Technology, Department of Computer Engineering, Mumbai

Prof. Sachin Deshpande, Associate Professor in Vidyalankar Institute of Technology, Department of Computer Engineering, Mumbai