

The performance analysis and discussion of RFID queueing networks combining MPLS networks

姜玲鳳、戴江淮

E-mail: 211274@mail.dyu.edu.tw

ABSTRACT

In this thesis, we point out the critical design 's parameters which significantly influence the system performance. We also proposed the schemes which are more appropriate for application of the access scheme and the RFID [1-6] polling scheme to decide the location of students when they enter the classroom. To share the common communication channel among these RFID tags, anti-collision resolution of the ISO/IEC 18000-6 standard [7-9] is analyzed. Inherently, this anti-collision resolution algorithm incurs only a small delay and a high throughput with a large number of lightly loaded tags within the coverage of a RFID reader. We also describe the system operation of FTA hierarchy structure based on the concept of the MPLS network. The mean waiting time from our established M/G/1 with capacity c queueing is derived.

Keywords : RFID、MPLS、Hierarchical Wireless Communication、Throughput performance、mean delay time performance、handoff rate

Table of Contents

| | |
|---|------|
| CONTENTS SIGNATURE PAGE LETTER OF AUTHORITY----- | iii |
| ENGLISH ABSTRACT----- | iv |
| CHINESE ABSTRACT----- | v |
| ACKNOWLEDGMENTS----- | vi |
| CONTENTS----- | vii |
| LIST OF FIGURED----- | x |
| LIST OF TABLE----- | xiii |
| Chapter 1: Introduction | |
| 1.1 RFID system ----- | 1 |
| 1.2 Multi-link Protocol ----- | 3 |
| 1.3 Major Contributions ----- | 5 |
| 1.4 Thesis Outline ----- | 8 |
| Chapter 2: The Performance of Collision Arbitration for ISO/IEC 18000-6 RFID Standard | |
| 2.1 Description of anti-collision algorithm for ISO/IEC 18000-6 standard ----- | 11 |
| 2.2 System Performance ----- | 14 |
| 2.2.1 ISO/IEC 18000-6 standard ----- | 15 |
| 2.2.2 Throughput performance ----- | 23 |
| 2.2.3 Delay Performance ----- | 28 |
| 2.3. Numerical results ----- | 28 |
| Chapter 3: The Performance Analysis of RFID Polling System on Lesson Learning in University ----- | 32 |
| 3.1 Introduction ----- | 32 |
| 3.2 System architecture and operations ----- | 33 |
| 3.2.1 The design of entrance controller ----- | 34 |
| 3.2.2 The polling procedure to find the student 's seat ----- | 35 |
| 3.3 System Queueing model ----- | 37 |
| 3.4 Performance analysis ----- | 42 |
| 3.4.1 Throughput ----- | 43 |
| 3.4.2 Mean delay time performance ----- | 44 |
| 3.5 Numerical results ----- | 50 |
| 3.6 Summaries ----- | 52 |
| Chapter 4: The Relationship Between RFID System and MPLS Networks ----- | 52 |
| 4.1 MPLS ----- | 53 |
| 4.2 Cross-layer design ----- | 56 |
| 4.3 RFID combining with MPLS ----- | 57 |
| Chapter 5: Hierarchical Wireless Mobile MPLS Mechanism ----- | 57 |
| 5.1 Introduction ----- | 58 |
| 5.2 Hierarchical mobile MPLS system ----- | 62 |
| 5.3 Waiting time in M/G/1 queueing with capacity c ----- | 64 |
| 5.3.1 The derivation of queueing length ----- | 65 |
| 5.3.2 Mean delay time ----- | 65 |
| 5.3.3 M/M/1 queueing with capacity ----- | 65 |
| 5.3.4 ----- | 65 |

REFERENCES

- [1].S.L. Garfinkel, A. Juels, and R. Pappu, " RFID Privacy: An Overview of Problems and Proposed Solutions, " IEEE Security & Privacy, vol. 3, no. 3, 2005, pp. 34 – 43.
- [2].J. Landt, Shrouds of Time: The History of RFID, Assoc. Automatic Identification and Mobility (AIM) Publication, ver. 1.0, 1 Oct. 2001; www.aimglobal.org.
- [3].EPC Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID, EPCglobal, Jan. 2005.
- [4].M. Roberti, " Understanding the EPC Gen 2 Protocol, " RFID J. Special Report, 28 Mar. 2005.
- [5].L. Zongwei, T. Chan, and J.S. Li, " A Lightweight Mutual Authentication Protocol for RFID Networks, " Proc. IEEE Int ' I Conf. e-Business Eng., IEEE CS Press, 2005, pp. 620 – 625.
- [6].A. Juels, " Minimalist Cryptography for Low Cost RFID Tags, " Proc. 4th Int ' I Conf. Security Comm. Networks, " Radio-frequency identification for item management – part 6C: parameters for air interface communications at 860 MHz to 960 MHz, " ISO/IEC CD 18000-6C, Jan. 2005.
- [7].ISO/IEC 18000-6:2004/FPDAM 1, Amendment 1, extension with type C and update of type A, ISO/IEG; www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=43923.
- [8].ISO/IEC FDIS 18000-6:2003(E, Information Technology Automatic Identification. and Data Capture Techniques, ISO/IEC, JTC 1/SC 31/WG4, Nov. 2003.
- [9].Marcelo C. de Azambuja, Cesar A. M. Marcon, Fabiano P. Hessel, " Survey of Standardized ISO 18000-6 RFID Anti-Collision Protocols " , The Second International Conference on Sensor Technologies and Applications, pp. 468-473, 2008.
- [10].E. Rosen, A. Viswanathan, and R. Callon, " Multiprotocol Label Switching Architecture " , RFC-3031, January 2001.
- [11].G. Armitage, " MPLS: The Magic Behind the Myths", IEEE Communications Magazine, pp. 124-131, January 2000.
- [12].Charless E. Perkins, " Mobile IP " , IEEE Communications Magazine, pp. 84-99, May 1997.
- [13].Seldon M. Ross, Introduction to Probability Models, fifth edition, Academic Press, Inc., 1193.
- [14].Henk C. Tijms, Stochastic Models: An Algorithmic Approach, John Wiley & Sons, 1994.
- [15].K. Lyytinen, and Y. Yoo, " Issues and Challenges in Ubiquitous Computing " , CACM, Vol. 45, No. 12, pp. 63-65, 2002.
- [16].Martin, S.; Gil, R.; Bravo, J.; Hervas, R.; Castro, M.; Peire, J., " Increasing throughput and personalizing the examination process in universities using RFID " , RFID Eurasia, 1st Annual, pp. 1-6, 5-6 Sept. 2007.
- [17].Nagurney, L.S., " Work In Progress: Integrating the RF Characteristics of RFID into Undergraduate EE Courses " , Frontiers in Education Conference, 36th Annual, pp. 21-22, Oct. 2005.
- [18].Mitsuhara, H.; Ogata, H.; Kanenishi, K.; Yano, Y., " Real World Interaction Oriented Edutainment using Ubiquitous Devices " , Fourth IEEE International Workshop on Wireless, Mobile and Ubiquitous Technology in Education, pp. 150-152, Nov. 2005.
- [19].Zixue Cheng; Shengguo Sun; Kansan, M.; Tongjun Huang; Aiguo He, " A personalized ubiquitous education support environment by comparing learning instructional requirement with learner's behavior " , 19th International Conference on Advanced Information Networking and Applications, Volume 2, pp. 5657-573, 28-30 March 2005.
- [20].Christian Floerkemeier, " Bayesian Transmission Strategy for Framed ALOHA Based RFID Protocols " , 2007 IEEE International Conference on RFID, Gaylord Texan Resort, Grapevine, TX, USA, pp. 228-235, March 26-28, 2007.
- [21].Ogata, H.; Yano, Y., " Context-aware support for computer-supported ubiquitous learning " , Proceedings. The 2nd IEEE International Workshop on Wireless and Mobile Technologies in Education, pp. 27-34, 2004.
- [22].Sakamura, K.; Koshizuka, N., " Ubiquitous computing technologies for ubiquitous learning " , IEEE International Workshop on Wireless and Mobile Technologies in Education, 2005, pp. 11-20, 28-30 Nov. 2005.
- [23].Slivovsky, L.A., " RFID in a Computer Engineering Capstone " , Frontiers in Education Conference, 36th Annual, pp. 22-27, Oct. 2005.
- [24].Dave Friedlos, " Exam papers to be RFID-tagged " , in <http://www.computing.co.uk/computing/news/2189685/exam-papers-tagged-rfid>
- [25].Jeremy Reimer, " RFID being tapped to stifle exam cheaters " , <http://arstechnica.com/news.ars/post/20070513-rfid-being-tapped-to-stifle-exam-cheaters.html>.
- [26].Kishor S. Trivedi, Probability and Statistics with Reliability, Queueing, and Computer Science Applications, John Wiley and Sons, 2001.
- [27].Aliakbar M. Haghighi, and Dimitar P. Michiev, " Analysis of a two-node task-splitting feedback tandem queue with infinite buffers by dfunctional equation " , Int. J. Mathematics in Operational Research, Vol. 1, Nos. 1/2, pp. 246-276, 2009.

- [28].Aliakbar M. Haghighi, and Dimitar P. Michev, " The Tandem Queueing System with Task-Splitting, Feedback, and Blocking " , Technical report, MDTRS No. 5, November 1, 2005.
- [29].J.W. Dai, " The Scheduling to Achieve Optimized Performance of Randomly Addressed Polling Protocol " , Journal of Wireless Personal Communications, Vol. 15, pp. 161-179, 2000.
- [30].T. Yang, and D. Makrakis, " Hierarchical Mobile MPLS: Supporting Delay Sensitive Applications over Wireless Internet " , 2001 International Conferences on Info-tech and Info-net, Vol. 2, pp. 453 – 458, 29 Oct.-1 Nov. 2001.
- [31].Xingchuan Yuan, Lishan Kang, and Yuping Chen, " An adaptive hierarchical mobile MPLS scheme " , Proceedings. 2005 International Conference on Wireless Communications, Networking and Mobile Computing, Vol. 2, pp. 1018 - 1021, 23-26 Sept. 2005.
- [32].H. Zhon, et al., " Dynamic Hierarchical Mobile MPLS for Next Generation All-IP Wireless Network " , IEEE 61st Vehicular Technology Conference, Vol. 4, pp. 2230 – 2234, 30 May-1 June 2005.
- [33]. P.G. Harrison, " Teaching M/G/1 theory with extension to priority queues " , IEE Proceedings-Computers and Digital Techniques, Vol. 147, Issue 1, pp. 23-26, January 2000.
- [34]. J.A. Schormans and J.M. Pitts, " Solution for M/G/I queues " , ELECTRONICS LETTERS, Vol. 33 No. 25, pp. 2109-2111, December 1997.
- [35].Donald Gross, and Carl M. Harris, Fundamentals of Queueing Theorem, 2nd edition, John Wiley&Sons, 1985.
- [36].Leonard Kleinrock, Queueing System Volume 1: Theory, John Wiley&Sons, pp. 137-139, 1975.
- [37]. Scott Fowler, and Sherali Zeadally, " Fast Handover over Micro-MPLS-based Wireless Networks " , Proceedings of the 11th IEEE Symposium on Computers and Communications (ISCC'06), pp. 181-186, June 2005.
- [38].Edward P.C. Kao, An Introduction to Stochastic Processes, Duxbury Press at wadsworth Publishing Company, 1997.
- [39].Seidler. RFID Opportunities for mobile telecommunication services, ITU-T Lighthouse Technical Paper. May 2005.
<http://www.itu.int/ITU-T/techwatch/rfid.pdf>.
- [40].S.M. Birari, S. Iyer. Mitigating the reader collision problem in RFID networks with mobile readers. In Proceedings of the 13th IEEE International Conference on Networks, 2005.
- [41]. http://en.wikipedia.org/wiki/Indicator_function