Research of routing protocol in RFID-based internet of things

Songsen Yu
Department of Computer .South China Normal University
Foshan, China
yss8109@163.com

Yun Peng
College of Computer Information Engineering, Jiangxi Normal University, Nanchang, China
pengyunmail@126.com

Jian Yang
College of Automation, Guangdong University of Technology
Guangzhou, China
jimmyyoungyj@163.com

Abstract—**Under the environment of the Internet of Things, The applications of RFID and WSN have a trend of mutual infiltration. RFID reader with the function of WSN is called RFID node. On one hand, it can recognize the tags within its communication range, on the other hand, with the help of WSN it can coordinate with its neighbor nodes through wireless handshaking. In order to make an efficient datum collection to the destination node, the most important things we must take into consideration are routing problems. Routing protocols of RFID-based internet of things are similar to those of WSN for they are both multi-hop routing protocols, but due to the differences between their main tasks, working environments and contexts, they also have a lot of differences. At present there are non researches on this aspect. This article researches this problem, proposes a context-aware computing based model of RFID routing protocol and illustrates the main research contents of this model.**

Keywords-Internet of things; RFID-based routing; contexts; context quantification

I INTRODUCTION

WSN (Wireless Sensor Network) can get information from physical world and RFID (Radio Frequency Identification) can build a bridge between physical world and information world, so due to they have a subset that they can inter-infiltrate perfectly. For example: Ubisensor is a connection of wireless sensor and RFID module [1]. In reference [2] temperature sensor is integrated on a RFID chip. RFID reader acts as a sensor for locating and identifying servicers [3]. RFID readers developed by ALIEN and AWID corporations can be triggered by sensors and then identify tags. We call the RFID reader with the functions of WSN RFID node. On one hand, it can identify tags within its communication range, on the other hand, with the help of WSN it can coordinates with its neighbor nodes through wireless handshaking (shown in figure 1). In order to make an efficient datum collection to the destination node, the most important things we must take into consideration are routing problems.

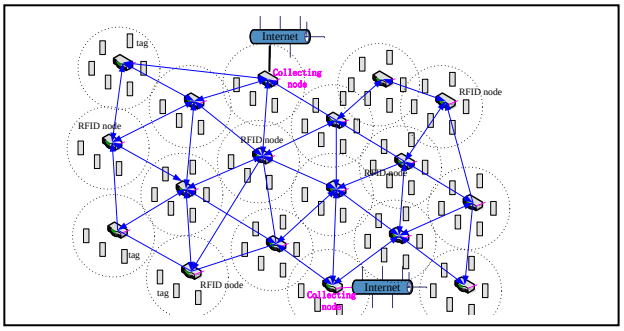

figure1. sketch map of RFID node of the internet of things

II CURRENT RESEARCHES STATUS

There are few researches on RFID routing protocols. The searched references [4-5] introduce problems of using RFID to locate mobile nodes; In reference [6] Cabrera still apply the simple multi-hop corresponding protocol of WSN to wireless routing based on WSN and RFID in Smart Home; Lu Xu [7] considers RFID routing is just as the same as WSN routing. So at present research on RFID routing protocol of the internet of things is almost blank. But there are a lot of existing routing protocols of WSN, among them, the most representative plane routing protocols are: Flooding routing protocol, SPIN routing protocol, Directed Diffusion routing protocol, Rumor routing protocol, Gossiping routing protocol and ACQUIRE routing protocol. The typical geographical location information based routing protocols are: LAR

(Location-Aided Routing) routing protocol, GAF (Geographical Adaptive Fidelity) routing protocol, GPSR (Greedy Perimeter Stateless Routing) routing protocol, GEAR (Energy and Location Aware routing protocol) and so on. Cluster based routing protocols mainly include: LEACH (Low Energy Adaptive Clustering Hierarchy), PEGASIS (Power-Efficient Gathering in Sensor Information System), TEEN (Threshold Sensitive Energy Efficient Sensor Network Protocol), APTEEN (The Adaptive Threshold Sensitive Energy Efficient Sensor Network Protocol), HEED (Hybrid, Energy-Efficient, Distributed) routing protocol, TTDD (Two-tier Data Dissemination) routing protocol, multi-layer clustering algorithm and so on.

At present there are few reports about researches on routing protocol using context information: Rahul C.Shah [8] and Mohamed Younis [9] together with their colleagues design an Energy Aware routing protocol. Energy Aware routing protocol uses the residual energy of next hop node as the parameter to design a cost function and selects the route with the least cost to transmit data packet. Li Rui [10] of Hunan University proposes a divisional mobility aware routing protocol-MAFZP in MANET. The protocol perceives the link-state of mobile node to insulate the nodes adaptively who move abnormally so as to avoid computing and requesting invalid routes frequently, then reduces routing cost. This protocol mainly concerns on link-states and just can be applied in ADHOC. Qin Huaifeng [11] of Northwestern Polytechnical University builds a context sensitive routing service (CARS) which takes location and energy related information as contexts of routing algorithm. Owing to CARS mainly concerns on energy effectiveness, so it may not select the route with shortest distance and least energy cost to transmit data.

III DIFFERENCES BETWEEN RFID ROUTING AND OTHER WIRELESS ROUTINGS

RFID routing is different from WSN routing although they are both multi-hop wireless communication protocols. For example: On one hand, the main tasks of RFID node are identifying tags within its communication range and reading from or writing to them. Its secondary task is relaying data to sink node, and its available bandwidths for relaying data are influenced by the number of tags within its communication range; on the other hand, WSN nodes are often deployed in severe No Man's Land through plane dispensing or manual deployment whose batteries are not rechargeable. The main factor WSN routing protocol must take into consideration is energy conservation for the processes of sensors collecting repetitive data and transmitting them to sink node consume a lot of energy. WSN routing protocols are optimized mainly from the aspect of improving utilization ratio of energy. Under the environment of the internet of things RFID nodes are mainly used in supply chains. Energy is one of but not the main factor of designing RFID nodes. Energy supply can be ignored in the region where energy is sufficient such as: logistics warehouse, shelf of retail store etc. So RFID routing problems need lucubrating. Solving this problem can set a basis for developing and deploying RFID nodes.

IV RESEARCHES ON CONTEXT-AWARE COMPUTING BASED RFID ROUTING

Context-aware computing is a hotspot of study recently. The characters of RFID and wireless sensors are especially fit for context-aware computing. Context sensitive system has an ability of active computing, namely actively obtaining contexts and deciding how to act according to the obtained information next step. Context sensitive computing merges the information of user and environment into the state space of RFID node, which makes RFID node get rid of the traditional mode and builds a bridge between virtual and real world. The adaptive decisions made by RFID node according to the information of user and environment fit user's needs better.

Researches of context sensitive computing based RFID routing include following sections:

1) Make it clear what the contexts are

Existing WSN routing protocols point out the factors influence routing are: energy, location, link-state of adjacent node etc, where energy is the main factor. We should make it clear what the new contexts considered by RFID routing are, whether number of tags, distance between nodes, existing of mobile node, interference between wireless signals are also its contexts, which aspect of routing protocol each context influences, how to define the context.

2) Approaches of obtaining routing contexts

It is the precondition of the implement of routing protocol that obtaining routing contexts effectively which can be divide into physical contexts and logical contexts. Physical context such as: temperature, humidity, residual energy, location etc, can be obtained by sensors. Logical contexts such as: numbers of tags, level of energy, mobility of node, interference between wireless signals, security etc, can be obtained through deuterogenic methods.

3) Quantification of routing contexts

a) Raw datum of contexts can be utilized by upper layer only after being quantized. Processes of quantification of context specifically include: selecting quantification strategy.

b) Normalization of different contexts with different dimensions.

c) Measurement of different influences on property of routing protocol caused by different contexts.

d) Construction of optimal model of contexts based routing

First, optimal model of contexts based routing should be flexible enough to meet the requirements of the diversity of contexts and usage modes. Second, the model must be simple and efficient for complex model of optimal routing will cause the complexity of total system finally decrease applicability of this model.

Processes of construction of the model include:

a ） Define metrics of routing protocol.

b ） Make it clear the requirements of personalized services.

c ） Construction of the optimal RFID routing model.

4) Introduction of security mechanism into the processes of routing optimization.

Obtaining security does not mean simply adding encryption methods to existing algorithm. If security were not considered in the design of routing protocol later introduction of security mechanism would largely increase cost.

Introduction of security mechanisms into the processes of RFID routing optimization should according to the characters of node, so as to ensure the consistency with optimal RFID routing model.

V CONCLUSION

This paper researches on RFID routing in the internet of things. In light of contexts of real time perceptive RFID node, quantification of information and context-aware computing make RFID routing has ability of cognizance. Security mechanisms are introduced to construct a lightweight perceptive framework of context based routing protocol, which lays a foundation for quick development and deployment of RFID nodes in the internet of things.

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REFERENCES

[1] KOHVAKKAM, HANNIKAINENM, TIMO D. Wireless sensor proto-type platform[C]//Proc of the 29th Annual Conference on the IEEE Industrial Electronics Society. Virginia:[s.n.], 2003: 1499-1504.

[2] ALIPPIC, VANINIG. An application-level methodology to guide the design of intelligent processing, power-aware passive RFIDs[C]//Proc of IEEE ISCAS. Kobe: IEEE Press, 2005: 5509-5512.

[3] MESAR NAM, LYONG, PRADHAN S, et al. Demo abstract: automating server tracking for data centers[C]//Proc of the 2nd International Conference on Embedded Networked Sensor Systems. New York: ACM Press, 2004: 307.

[4] Shahbazi Saeed, Harwood Aaron, Karunasekera Shanika, Achieving ubiquitous network connectivity using an RFID tag-based routing protocol, Proceedings of the 2008 14th IEEE International Conference on Parallel and Distributed Systems, p391-398

[5] Zuniga Marco,Hauswirth Manfred, Hansel: Distributed localization in passive wireless environments,2009 6th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks, SECON 2009

[6] Cabrera Altamirano Iván, Rodríguez Henríquez Francisco, A scalable intelligent room based on wireless sensor networks and RFIDs , Program and Abstract Book - 2010 7th International Conference on Electrical Engineering, Computing Science and Automatic Control, CCE 2010, p434-439

[7] LuXu , The research on the cluster-based RFID wireless sensor network routing protocol, PHD thesis of Guangdong University of Uechnology, 2009

[8] Rahul C.Shah and Jan M.Rabaey, “Energy aware routing for low energy ad hoc sensor networks, ” in Proceedings of IEEE Wireless Communications and Networking Conference(WCNC ′ 02) , PP.350-355, Orlando, Florida, USA, Mar.2002.

[9] Mohamed Younis , Moustafa Youssef , and Khaled Arisha , “ Energy-Aware Routing in Cluster-Based Sensor Networks , ” in Proceedings of the 10th IEEE/ACM International Symposium on Modeling , Analysis and Simulation of Computer and Telecommunication Systems (MASCOTS′ 02), Fort Worth, Texas , USA, Oct.2002.

[10] LiRui , Research on Some Key Techniques of Context-Aware Computing, PHD thesis of Hunan University, 2007

[11] QinHuaifeng , Research on Sensor Net Oriented Context-Aware computing, PHD thesis of Northwestern Polytechnical University, 2006