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"Improving Bulk Data Dissemination in Wireless Sensor Network Based on Centralized Multichannel Approach"

Anjali V. Bhatkar
Department of CSE, NIT
Nagpur University , INDIA

Prof. Subhangi Borkar
Department of CSE, NIT
Nagpur University, INDIA

Vikram S. Vairagade
Department of CSE, NIT
Nagpur University, INDIA

Abstract-To assurance reliability, bulk data dissemination depend on the negotiation scheme through a three-way handshake procedure in which senders and receivers negotiate transmission schedule. However, we find negotiation suffers a long dissemination time and extremely defers the network-wide convergence. On the other hand, the flooding approach, which is conventionally considered incompetent and energy-consuming, can facilitate bulk data dissemination if appropriately incorporated. This inspires us to follow a delicate tradeoff between negotiation and flooding in the bulk data dissemination. We propose Survival of the Fittest(SurF), a bulk data dissemination protocol which adaptively adopts negotiation and leverages flooding resourcefully. SurF incorporates a time-reliability model to estimate the time efficiencies (flooding vs. negotiation) and with dynamism selects the suitable one to facilitate the dissemination process. We implement SurF in TinyOS and evaluate its presentation with 40 TelosB nodes. The results show that SurF, while retaining the dissemination reliability, decreases the dissemination time by 40% in average, compared with the state-of-the-art protocols.

Index Terms—*Wireless Sensor Networks, Bulk Data Dissemination, Deluge Protocol, SurF Protocol.*

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1. INTRODUCTION

Wireless sensor networks (WSNs) have been useful in a variety of application areas such as environmental monitoring [2], structural protection [3], and military surveillance and so on. Most WSNs, once deployed, are intended to operate unattended for a long time. During the period of a WSN, it is often necessary to fix bugs, reconfigure system parameters, and software upgradation. Bulk data dissemination is one of the building blocks of WSNs that enable the above-mentioned important tasks. Now we focus on the bulk data dissemination from the sink to the nodes, which is usually used for over the- air firmware updates and reprogramming. The updates are not uncommon. For example, in the decade of TinyOS development, Eleven major versions are released. Each version contains several major changes and numerous bug fixes. Bulk data dissemination is then necessary to fulfill the demands. We envision that the operating system of WSN will have even more frequently updated as the operating system of smartphone such as Android. Besides the operating system updates, we need to fix the bugs in the application software which makes the bulk data dissemination more frequent. Generally, bulk data dissemination in WSNs must meet 2 necessities. First, it should be reliable despite of the unreliable wireless links in the network. Second, they should be time-efficient to converge for the entire network. A long dissemination time means sustained interruptions in the normal network operations, which is not desired. It is therefore significant to shorten the dissemination process. Most of the existing bulk data dissemination protocols disable duty cycling and keep the radio wakeful during the dissemination process to restore to normal system functions as soon as possible. Hence, a little dissemination period usually provides good energy efficiency because radio activity accounts for most of the energy consumption on sensor nodes. A number of protocols have been proposed in recent years, such as, Deluge which accepts the negotiation scheme proposed in to assurance reliability and reduce redundant transmissions. Three types of messages are defined in Deluge. ADV messages are advertisement messages that a node uses to announce the version of the data it keeps. REQ messages are invitation messages that a node uses to request its interested data after receiving the ADV messages. The demanded data will be packaged into DATA messages. Every Deluge node periodically broadcasts ADV messages to announce its own newest version of data. Neighboring nodes hear the ADV messages and send REQ messages to the ADV sender if a latest version is found. After receiving the REQ messages, the node starts sending DATA messages. We have notice that the negotiation scheme, although effective for ensuring the reliability of data delivery, incurs a big overhead in terms of dissemination period. In a typical experiment with two TelosB nodes transmitting 10KB data using Deluge, the time spent on 2 negotiation comprises 71% of the total dissemination time, which is far beyond the normal expectation. The analysis and experiment outcomes motivate us to selectively use the negotiation scheme only when absolutely necessary throughout the entire dissemination process, so as to improve the dissemination efficiency while remembering reliability. On the other hand, dissemination without negotiation (so-called flooding) makes each node probabilistically transmit a packet n times. We observe that (1) for a certain success ratio of dissemination, flooding often has a much smaller dissemination period. This is because it can quickly increase reliability in the initial phase from the time when most of the nodes don't have the latest data. On the other hand, for a higher dissemination success ratio, flooding becomes inefficient because blind flooding without feedback tends to result in large amounts of redundancy and not satisfactory results. In contrast, the usage of negotiation in that phase may effectively avoid redundancy by explicitly ask for the missing packets. In this paper, we suggest SurF (Survival of the Fittest), a bulk data dissemination protocol which selectively uses negotiation to improve efficiency. Flooding is adopted as a substitute for negotiation resourcefully. SurF adaptively decides the finest strategy and switches between flooding and negotiation to achieve improved dissemination efficiency while remaining reliable. A key issue in SurF's design is to determine when and how nodes transit between the two schemes (flooding vs. negotiation). Bad transition timing may result in a longer dissemination period. SurF incorporates a time-reliability model to calculate the time efficiency of the two schemes. Based on that model, each SurF node estimates the potential benefit brought by either of the two schemes, respectively and makes a decision dynamically about the most appropriate dissemination scheme in a distributed manner. We implement SurF based on TinyOS 2.1.1 and evaluate its performance on a 40-nodes test bed. The evaluation results demonstrate that (1) the model within SurF can exactly predict the completion time of 2 schemes. (2) SurF reduces the dissemination time by 40%, compared to Deluge.label axes with a ratio of quantities and units.

2. LITERATURE SURVEY

a) "Data Dissemination Protocol with Network Coding for Wireless Sensor Networks" Nildo dos Santos Ribeiro J_unior1, Ribeiro J_unior1, Marcos A. M. Vieira1, Luiz F. M. Vieira1, and Omprakash Gnawali2 .

This paper present CodeDrip, a data dissemination protocol for Wireless Sensor Networks. Dissemination is typically used to query nodes, send commands, and recon_gure the network. CodeDrip utilizes Network Coding to improve energy e_ciency, reliability, and speed of dissemination. Network coding allows recovery of lost packets by combining the received packets thereby making dissemination robust to packet losses. While previous work in combining network coding and dis- semination focused on bulk data dissemination, we optimize the design of CodeDrip for dissemination of small values. We perform extensive evalu- ation of CodeDrip on simulations and a large-scale testbed and compare against the implementations of Drip, DIP and DHV protocols. Results show that CodeDrip is faster, smaller and sends fewer messages than Drip, DHV and DIP protocols.

b) "Bulk data dissemination in wireless sensor networks: Modeling and analysis" Wei Dong a, Chun Chen a, Xue Liu b, Guodong Teng a,c, Jiajun Bu a, Yunhao Liu., 2012

In this paper Wireless sensor networks (WSNs) have recently gained a great deal of attention as a topic of research, with a wide range of applications being explored. Bulk data dissemination is a basic building block for sensor network applications. The problem of designing efficient bulk data dissemination protocols has been addressed in a number of recent studies. The problem of accurately analyzing the performance of these protocols, however, has not been addressed sufficiently in the literature. In this work, we show a way of accurately analyzing the performance of bulk data dissemination protocols in WSNs. Our model can be applied to practical network topologies by use of the shortest propagation path. Our model is accurate by considering topological information, impact of contention, and impact of pipelining. We validate the analytical results through testbeds and detailed simulations. Results show that the analytical results fit well with the testbed results and simulation results. Further, we demonstrate that the analytical results can be used to aid protocol design for performance optimizations, e.g., page size tuning for shortening the completion time. 4

c) "Authentication for Bulk Data Dissemination in Sensor Networks Using Symmetric Keys, 1Limin Wang., Mahesh Arumugam., Sandeep S. Kulkarni 2013 .

In this paper author discussed about the multihop coarse-grained pipelining, multihop fine-grained pipelining, and single hop. In the second and third scenarios, we show that the time to transmit 3-4 KB of data is less than (or, close to) sending even a single packet using public keys. For the first scenario, we argue that the use of symmetric keys would marginally improve the performance. For this scenario, we also propose additional techniques to reduce the cost of secure data dissemination by more than 70%.

d) "Delay Analysis of Real-Time Data Dissemination" Gidon Gershinsky, Avi Harpaz, Nir Naaman, Harel Paz, Konstantin Shagin .

This paper addresses the way of collecting sensor data faces a revolution when the newly developing technology of distributed sensor networks becomes fully functional and widely available. Smart sensors acquire full interconnection capabilities with similar devices, so that run-time data aggregation, parallel computing, and distributed hypothesis formation become reality with off-the-shelf components and sensor boards. This revolution started around in 1996, and now hardware and network are converging on the first convincing solutions. Exploring and exploiting this paradigm are a renovated challenge for the pattern recognition and data mining community. This paper attempts a survey on state-of-the-art of wireless sensor technology, with an eye on data-related problems and technological limits. Although the possibilities seem promising, the limited computational resources of individual nodes hamper the elaboration of data with computationally-intensive algorithms. New software paradigms must be developed, both creating new techniques or adapting, for network computing old algorithms of earlier ages of computing.

e) "Bulk Data Dissemination in Wireless Sensor Networks: Analysis, Implications and Improvement" Xiaolong Zheng, Member, IEEE, Jiliang Wang, Member, IEEE, Wei Dong, Member, IEEE, Yuan He, Member, IEEE, and Yunhao Liu, Fellow, IEEE.,2015

To guarantee reliability, bulk data dissemination relies on the negotiation scheme in which senders and receivers negotiate transmission schedule through a three-way handshake procedure. However, we find negotiation incurs a long dissemination time and seriously defers the network-wide convergence. On the other hand, the flooding approach, which is conventionally considered inefficient and energy-consuming, can facilitate bulk data dissemination if appropriately incorporated. This motivates us to pursue a delicate tradeoff between negotiation and flooding in the bulk data dissemination. We propose SurF (Survival of the Fittest), a bulk data dissemination protocol which adaptively adopts negotiation and leverages flooding opportunistically. SurF incorporates a time-reliability model to estimate the time efficiencies (flooding vs. negotiation) and dynamically selects the fittest one to facilitate the dissemination process. We implement SurF in TinyOS 2.1.1 and evaluate its performance with 40 TelosB nodes. The results show that SurF, while retaining the dissemination reliability, reduces the dissemination time by 40% in average, compared with the state-of-the-art protocols

Comparative study of survey

SR. NO	AUTHORS	NAME ON PAPER	METHODOLOGY	DISADVAN-TAGE
1	Nildodos Santos Ribeiro Junior, Marcos A. M. Vieira, Luiz F. M. Vieira, and Omprakash Gnawali	“Data Dissemination Protocol with Network Coding for Wireless Sensor Networks”	Testbed experiments involve implementing and running the protocol code on physical motes and collecting instrumentation data to understand the performance.	The impact of different topology types and link qualities on the performance of CodeDrip. Develop new policies to combine messages using more complex operators.
2	Wei Dong a, Chun Chen a, Xue Liu b, Guodong Teng a,c, Jiajun Bu a, Yunhao Liu d	“Bulk data dissemination in wireless sensor networks”	Computation approach uses distributed model, in which sensor nodes use their processing abilities to carry out some mining tasks locally and transmit only the required and partially processed data	Entire raw data collected from WSNs is transferred to central server which maintains a database of readings from all of the sensors.
3	Limin Wang., Mahesh Arumugam., Sandeep S. Kulkarni.,	“Authentication for Bulk Data Dissemination in Sensor Networks Using Symmetric Keys”	Symmetric key distribution algorithms from to ensure that the base station can communicate securely with each sensor in the network. Based on the security of the key distribution, our protocol allows sensors to conclude that the data is truly transmitted by the base station.	Due to the facts that the symmetric key operation is very fast and these secrets are used only a few times during data dissemination, this increase in the cost of Signing / verification is negligible. Hence, the performance of data dissemination changes minimally when we increase the level of collusion resistance.
4	Gidon Gershinsky, Avi Harpaz, Nir Naaman, Harel Paz, Konstantin Shagin	“Delay Analysis of Real-Time Data Dissemination”	Develop an analytic model for congestion in data dissemination protocols and investigate the effect of transmission rate on message delivery latency	The presented analytic model can be incorporated in transmission rate control logic to attain high probability of timely delivery.

3. PROBLEM STATEMENT

In the previous work the researchers have proposed a SURF technique for dissemination of bulk data. In this approach they are using either 3 way handshake or flooding of the data. In bulk data dissemination protocols, the negotiation scheme is widely adopted to guarantee the reliability of bulk data dissemination. The negotiation-based bulk data dissemination protocols can be categorized into 2 categories: the structure less protocols and the structure-based protocols. By decreasing the negotiation overhead, SurF can shorten the completion time while still retaining high reliability. But this approach is very inefficient due to the fact that 3 way handshake requires lot of time for authentication while flooding causes packet loss and suffers from data delay for large size data. Our problem statement is to remove these drawbacks and modify both these protocol to improve the efficiency of network.

4. PROPOSED APPROACH

1) Creation of a wireless sensor network.
2) Modification of flooding technique to form multichannel flooding which will reduce the delay and improve the packet delivery.
3) Replacing 3 way handshake protocol with a global inspector based centralized approach for fast authentication and speedy communication
4) Integration of both this technique with SURF.

1) Creation of a wireless sensor network.

A wireless sensor network (WSN) are spatially distributed autonomous sensors to monitor physical or environmental surroundings, such as sound, pressure, temperature, etc. and to cooperatively pass their data over through the network to central location. The further modern networks are bi-directional, also enabling control of sensor activity. The advancement of wireless sensor networks was motivated by military applications such as battlefield surveillance; Nowadays such networks are used in various industrial and user applications, such as industrial process monitoring and control, health machine monitoring etc. The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to 1 (or sometimes more) sensors. Each such sensor network node has typically more than a limited parts: a radio transceiver with aditional internal antenna or connection to an external antenna, a microcontroller, an electronic circuit interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting.

2) Modification of flooding technique to form multichannel flooding which will reduce the delay and improve the packet delivery.

Flooding A straightforward way to carry out bulk data dissemination is flooding. In flooding, each node immediately rebroadcasts the received packets; hence, the flooding process can be quite quick. However, from the time when the data are transmitted by broadcasting, which has no ACK or NACK, the reliability cannot be guaranteed. Considering the non reliable wireless links, the reliability can be very lower, so to improve the reliability, retransmission is required. However, without the support of ACK or NACK, the senders have no idea of which packets are missing. Hence, all packets have to be retransmitted, resultant in the so-called blind retransmission problem. The blind retransmission problem incurs needless retransmissions and extends the completion time of achieving high reliability. No assurance of reliability is the biggest obstacle for flooding to be adopted in bulk data dissemination.

3) Replacing 3 way handshake protocols with a global inspector based centralized approach for fast authentication and speedy communication:

In bulk data dissemination protocols, the negotiation scheme is widely adopted to guarantee the reliability of bulk data dissemination and the negotiation-based bulk data dissemination protocols can be classified into two categories: the structure less protocols and the structure-based protocols. To overcome the problem of the negation based transmission of data we replace the 3 way handshake protocol with the global inspector based centralize approach for fast authentication and speedy communication.

4) Integration of both this technique with SURF

We proposed the integration of multi-channel flooding technique and global inspector based centralized approach with SURF. A SURF technique for dissemination of bulk data in this approach they are using either three way handshake or flooding of the data. But, these approaches are inefficient due to some drawbacks.

The multichannel flooding is work as replacement of flooding technique because flooding causes packet loss and suffers from data delay for large size data.

Global inspector base centralized approach is a healthy replacement of three way handshake protocol because it requires lot of time for authentication.

5. METHODOLOGY

Our method is based on modification of the flooding technique and replacing it with multichannel flooding; so that the network delay is reduce.

Example: If we need to send 1000 bytes of data at 10 bytes /sec then the time needed will be T1= 10,00/10sec. Suppose we use a multichannel approach with 10 channels then time needed T2=(1000/10)/10 = 10 sec. Therefore, improvement in delay = (100-10)/100 = 90%. This will increase the speed of the network by 90%.

The 3 way handshake procedure will be replaced by a global inspector based centralized approach. In this approach the routing is done through a central global inspector will only pass the packet if the sender and receiver are both in the list of trusted nodes. This process will happen so fast that it will only take 1 hop to and data from 1 legitimate to other and data will be drop only if any of the nodes are not register.

This will improve the speed of the communication system and can be demonstrated as follows.

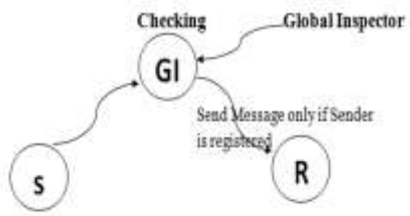

Fig. 5.1 Global Inspector Based Centralized Approach

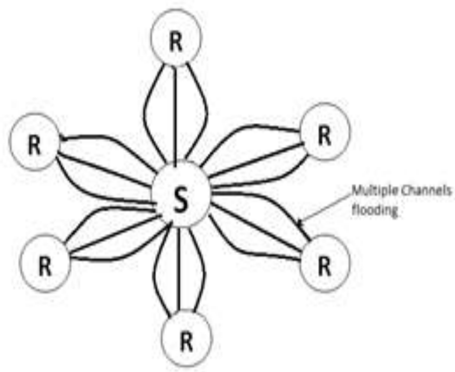

Fig. 5.2 Multiple Channels Flooding

SURF(Survival of the Fittest), a data dissemination protocol which selectively adopts negotiation and leverages flooding opportunistically. SURF shortens the completion time while still retaining high reliability. Moreover, SURF does not depend on special protocols. It can be incorporated with other flooding-based and negotiation- based methods. In the future, we plan to integrate other protocols into SurF and further study the potential performance improvements. SURF incorporates a time-reliability model to estimate the time efficiencies of the two schemes (flooding vs. negotiation) and dynamically selects the fittest one to facilitate the dissemination process.

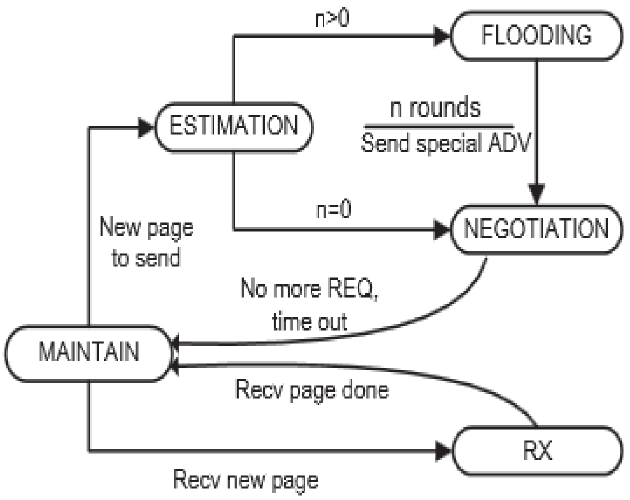

Fig. 5.3 State transaction diagram of SURF

6. EXPECTED OUTCOME

Our method is based on modification of the flooding technique and replacing it with the multichannel flooding so that the network delay is reduced. SURF, a novel bulk data dissemination protocol which selectively uses negotiation and opportunistically adopts flooding. We find that neither flooding nor negotiation is efficient when only one of them is used during the whole process. We then design SurF to effectively integrate the schemes for shorter completion times. SurF selectively uses the negotiation scheme, that is, only when necessary instead of throughout the entire dissemination process. Based on an accurate analysis model, SurF predicts the efficiency of two schemes (flooding and negotiation) and adaptively selects the fittest strategy to disseminate data. By reducing the negotiation overhead, SurF can shorten the completion time while still retaining high reliability. Moreover, SurF does not depend on special protocols and it can be incorporated with other flooding-based and negotiation-based methods. In the future, we plan to integrate other protocols into SurF and further study any potential performance improvements.

By applying the multichannel flooding technique and global inspector based centralized approach the expected outcome will as follows:

1) Delay time for system will reduce
2) Energy efficiency will improve
3) Security of the system will be optimized

7. CONCLUSION

In this paper, we present SurF, a novel bulk data dissemination protocol which selectively uses negotiation and opportunistically adopts flooding. We find that neither flooding nor negotiation is efficient when only one of them is used during the whole process. We then design SurF to effectively integrate the schemes for shorter completion times. SurF selectively uses the negotiation scheme, that is, only when needed instead of throughout the entire dissemination process. Based on an accurate analysis model, SurF predicts the efficiency of two schemes (flooding and negotiation) and adaptively selects the fittest strategy to disseminate data. By reducing the negotiation overhead, SurF can shorten the completion period while still retaining maximum reliability. Moreover, SurF does not depend on special protocols and it can be incorporated with other flooding-based and negotiation-based methods. In the future, we plan to integrate other protocols into SurF and further study any potential performance improvements

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