2010년도 한국통신학회 하계종합학술발표회 논문 초록집
Vol. 42

일시: 2010년 6월 23일(수) ~ 6월 25일(금)
장소: 라마다프라자 제주호텔
주최: (사)한국통신학회
후원: 제주특별자치도, 제주대학교, 전자신문사, 제주대학교 첨단기술연구소, ETRI, TTA
협찬: 삼성전자, SKT, KT, LG유플러스, LG전자, 콜컴코리아, 대한전선, GSI, 엠에이, 하이트론시스템즈, 준와일리앤드손, 알토소프트, 키테스산학연정보자

KICS
한국통신학회
[세션명: 유선통신]
[8C-18] 정보통신장비의 공공시설기관 안정실크 프로그램 분석
이재정, 유한영, 남기동(한국전자통신연구원).................410
[8C-19] 피어의 안정성과 자원을 동시에 고려한 오버레이 멀티커스트 트리 구성 알고리즘
권오찬, 송승준(포항공과대)..............................411
[8C-20] 스마트 그리드를 위한 전력선 통신에서의 신뢰적인 패킷 전송 기법 연구
김요철, 김윤현, 김진영(당온대).........................412

[세션명: 인터넷기술]
[8C-21] 메모의 자동분류방법에 관한 연구
김영돈, 서민석, 박현주(한밭대)............................413
[8C-22] P2P기법을 이용한 멀티미디어 스트리밍 서비스 모델 연구
현욱, 김성해, *이창규, 강신각(한국전자통신연구원, *파화기술연합대학원대).........414
[8C-23] Linked Data 기반 ICT 통합정보(ITFIND) 서비스 방안
송홍철, 문병주, 이재경, 안범식(정보통신산업진흥원)....415
[8C-24] RIA 기반의 영어 학습용 Web Component 시스템 설계
김봉현, 조동욱, 배영래(충북도립대)..........................416
[8C-25] 인터넷 동영상 인기 강사의 음성화학 특징 분석
김봉현, 김명조, 김범준, 가민경, 조동욱(충북도립대)..................417
[8C-26] 정주지역 30-40대 여성의 인터넷 읽음습관 집중 실험 분석
김봉현, 엄용훈, 이주영, 가민경, 이재환, 조동욱(충북도립대)....................418
[8C-27] 이미지 SaaS 플랫폼과 매쉬업체의 연동을 지원하는 매쉬업 매니저 설계
임예준, 이승용(경희대)..................................419
[8C-28] 이 메일 공유를 위한 웹 기반 협업 시스템
박유리, 최정욱, 조동석(이화여자대)..........................420
[8C-29] DNS에서의 다국어도메인 절의 처리 개선에 관한 연구
박형종, 김윤정, *정의현(한국인터넷진흥원, *한양대)..................421
[8C-30] A duty-cycle based MAC for wireless sensor networks handling diverse traffic
Muhammad Mostafa Monowar, Md. Obaidur Rahman, Choong Seon Hong(Kyung Hee University)..............422

[세션명: 통신 및 미래네트워크]
[8C-31] 이동 Ad-hoc 네트워크에서 시뮬레이션을 통한 네트워크 연결성 측정에 관한 연구
박수범, 이동준(주)LIG 백스원).................................423
[8C-32] IEEE 802.11 Wireless LAN 기반 멀티호출 네트워크에서 실수 노드 문제의 분석
정창근, 이태영, *이주용, 신지태(성균관대, *KAIST).................424
[8C-33] 무선 매쉬 네트워크에서 감시 기반 자원 분배 프레임워크
손혁진, 김강남(고려대)..................................425
[8C-34] AOMDV(Ad hoc On-demand Multipath DistanceVector)에서 서비스중류를 고려한 동적 경로 선택
기술..................................................426
홍혁진, 이재훈(동국대)
고상, 축문민, 박형근(한국기술교육대)..........................427
A duty-cycle based MAC for wireless sensor networks handling diverse traffic

Muhammad Mostafa Monowar, Md. Obaidur Rahman, Choong Seon Hong
Networking Lab, Department of Computer Engineering, Kyung Hee University
{ monowar, rupam}@networking.khu.ac.kr and cshong@khu.ac.kr

Abstract
This paper presents a duty-cycle based MAC scheme for wireless sensor networks (WSNs) considering the existence of diverse traffic in the same network. It employs a hybrid approach combining synchronous and asynchronous wake-up scheme to provide differentiated service among different traffic classes. The scheme is simulated using ns-2 which shows its effectiveness.

I. Introduction
The rapid proliferation of miniature wireless networking technologies drives to devise different sensor network applications with diverse QoS requirements. The existence of this heterogeneous traffic in the same network demands the handling of traffic according to their respective QoS requirements. The current duty cycle based MAC protocols [1], [2] are mainly focused on energy consumption and treat each traffic independently. Hence, although energy optimized, but these protocols failed to meet the diverse requirements of the traffic. Nonetheless, there exists some TDMA based protocols [3], which considers the prioritized medium access, however, it incurs huge overhead for TDMA scheduling and are not energy optimized.

Being motivated on these, in this paper, we propose a duty-cycle based MAC for WSNs which handles traffic with diverse QoS requirements. Simulation results show the effectiveness of the proposed scheme.

II. Proposed Scheme
In the proposed scheme, we assume a sensor network forming data gathering tree where nodes are arranged in different depth of the tree from the sink as shown in. In a particular routing path, if a node sends data to a node toward the sink, then the recipient node is referred to as parent node and the sending node is referred to its child node. We define all the nodes in the same depth as sibling nodes.

In this paper, we classify the traffic as follows:

Class 1: Real time, loss intolerant traffic
Class 2: Real time, loss tolerant traffic
Class 3: Delay tolerant, loss intolerant traffic
Class 4: Delay tolerant, loss tolerant traffic

The proposed solution is a hybrid approach which combines both synchronous and asynchronous wake up scheduling.

A. Synchronous wake-up: In our proposed duty cycle MAC, every node, i, maintains a regular interval, \( t_{reg}^{i} \) for communication with all of its neighbors following the synchronous wake-up approach. All the nodes maintain a common schedule for wake up as proposed in [1]. Like the other synchronous approach, the regular interval is divided into two periods: listen period and sleep period. The listen period is further divided into the following three periods:

Synchronization period (SP): In this period, nodes exchange synchronization information.

Broadcast period (BP): This period is for broadcast packet transmission among neighbors.

Delay tolerant period (DTP): This period is for transmitting both class 3 and class 4 traffic.

All the nodes go to sleep state after the listen period ends.

B. Asynchronous wake-up: The asynchronous wake-up is employed to transmit class 1, class2 and retransmitted traffic of class 3 only. In this case, nodes maintain their own wake-up schedule during the sleep period of regular interval.

For the real time traffic provisioning, a delay efficient wake up schedule is created. We adopt the receiver initiated transmission scheme for asynchronous communication in
which a node transmits a beacon upon wake up and data transmission in initiated after beacon reception. Initially, every node selects a random wake-up time within the sleep period and the sink selects its beacon transmission time, $t_{\text{beacon}}^{\text{sink}}$ to a random time between $t_{\text{reg}}$ to $t_{\text{reg}}/2$. The subsequent beacon transmission times for sink will be as follows:

$$t_{\text{beacon}}^{\text{sink}}(\text{curr}) = t_{\text{beacon}}^{\text{sink}}(\text{prev}) + t_{\text{reg}}$$

A node having class 1 and class 2 data in the queue performs low power listening (LPL) during the sleep period until it gets any fixed beacon time from its downstream node. In this scheme, a receiver receives a maximum $N$ number of packets after sending the beacon, denoted as $N_{\text{max}}$, including retransmitted packets. To provision the packet transmission for loss intolerant traffic, we provide distinct beacon transmission time for the sibling nodes with the aim of reducing data packet loss by collision. Moreover, for real time traffic provisioning we intend to select the beacon transmission time of a node to be staggered as much as possible along with delivering the data packet within one regular interval. Let $t_{\text{beacon}}^{j}$ be the beacon transmission time of node $j$ and $N_{\text{child}}^{j}$ be the no. of child nodes of node $j$. Hence, the beacon transmission times of the child nodes are:

$$[t_{\text{beacon}}^{j} - t_{\text{max}} - 1],[t_{\text{beacon}}^{j} - t_{\text{max}} - 2], \ldots, [t_{\text{beacon}}^{j} - t_{\text{max}} - N_{\text{child}}^{j}]$$

Here $t_{\text{max}}$ is time to receive $N_{\text{max}}$ packets and $t_{\text{max}} = t_{\text{unique}} + t_{\text{retrans}}$, where $t_{\text{unique}}$ and $t_{\text{retrans}}$ are the time to receive unique and retransmitted packets respectively. During $t_{\text{retrans}}$, only class 1 and class 3 lost packets are retransmitted whereas class 1 traffic is given higher priority.

Node $j$ notifies the beacon times as slot numbers following the same order and assigns distinct slots randomly to different child nodes.

### III. Simulation

We perform simulation using ns-2 to evaluate the proposed MAC scheme. In the simulation, 50 nodes are randomly deployed in 100x100 m$^2$ sensor field. The transmission range is set as 30 m. The regular interval is set as 1 second and the listen period is fixed to 25 ms; whereas the period for SP, BP and DTP are 8, 7 and 10 ms respectively. The simulation is performed for 60 seconds and the average over 30 runs are taken. We compare a latency aware synchronous MAC, DMAC [2] with the proposed scheme.

![Figure 1: (a) End-to-End latency for different no of sources. (b) Delivery ratio varying no. of sources.](image)

Figure 1(a) shows the impact of end-to-end latency for different classes of traffic as traffic source increases. The class 1 and class 2 traffic shows lower latency than class 3 and class 4 with the proposed scheme. But DMAC achieves an average latency irrespective to traffic classes. As the reliability concerned, the loss intolerant traffic also shows higher reliability than loss tolerant traffic classes as load increases as shown in figure 1(b) and DMAC obtains moderate delivery ratio for all traffic.

### IV. Conclusion

We present a duty-cycle MAC scheme for wireless sensor networks which handles traffic according to their QoS requirements. The simulation shows that traffic with different classes achieved latency and reliability as per requirements.

### Reference

