2014 International Workshop on Electronics and Communications

WEC2014

Organized by
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Co-organized by
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Oct. 27th-28th, 2014, Chengdu, Sichuan, China

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Conference Information

Papers by Session

2014 International Workshop on Electronics and Communications

WEC 2014 Oral Session I

WEC 2014 Oral Session II

- A Nonvolatile FPGA Using MTJ-Based Logic-in-Memory Structure for Ultra Low-Power Reconfigurable Systems
  Daisuke Suzuki and Takahiro Hanyu
- Design of a Mobile-phone MIMO Antenna Based on Chassis Currents for LTE Band 13
  Xiang Zhang and Jin Pan
- Space-Time Block Coded Cooperative Amplify-and-Forward Relay With Multiple Receive Antennas in Unmanned Aircraft System (UAS)
  Chikara ENDO, Hiroyuki MIYAZAKI and Fumiyuki ADACHI
- Obstacle Classification Method Using Multi Feature Comparison Based on 2D LIDAR
  Moohyun Lee and Yongwan Park
- Experimental Study of Planar Waveguide for RFID System
  Toshio Dohi, Kuan-hua Chen ,Qiang Chen, Kunio Sawaya, Machiko Oouchida and Yoshiaki Hirano
- Design of a Time-Mode-Oriented Sensor Interface Using Pulse-Width-Modulated Signals
  Takayuki Konishi and Takahiro Hanyu
- Statistical probability-based multi-target positioning by radar receiver network
  Xiliang Wu, Xiaoling Zhang and Wenjun Wu
- The Impact of Channel Selection Algorithms on Transport Protocols in CRAHN
  Yousaf Bin Zikria, Summera Nosheen, and Sung Won Kim

WEC 2014 Oral Session III

WEC 2014 Oral Session IV

- Low Complexity Feature Extraction Using Haar-Wavelet Transformation for Embedded Speech Recognition
  Kiyoaki Matsui, Yuya Chiba, Takashi Nose and Akinori Ito
- Human Body Detection and Tracking by Using Combined Color and Depth Information
  Hyung-Seok Kim, Yong-Hwan Hyun and Kook-Yeol Yoo
- Tempo modification of music signal preserving attack-decay structure of sounds using sinusoidal model
  Tsukasa Nishino, Yuki Igarashi, Takashi Nose and Akinori Ito
- Passive TOA Localization Based on Single observer
  Yanbin Zou, Xiaoyun Zhang, Yulin Liu, Liangbin Chen and Qun Wan
- Rough Detection of Text in Scene Images by Finding Stroke Parts
  Tomo MIYAZAKI and Shinichiro OMACHI
- Weighted Sparsity Driven Autofocus method for SAR Image Formation
  Xiliang Wu, Xiaoling Zhang and Liwen Guo
- Electromagnetic Analysis of Noise Suppression by Multilayered Co-Zr-Nb Film Integrated on MSL
  Jingyan Ma, Yutaka Shimada, Sho Muroga, Yasushi Endo and Masahiro Yamaguchi
- Reliable Multicast Schemes in IEEE 802.11aa Standard
  Muhammad Khalil Afzal, Muhammad Touqeer Afzal, Byung-Seo Kim, and Sung Won Kim
- Algorithm analysis and system implementation of advanced face recognition under wireless networks
  Lingyun Lu, Xingang Liu, Xun Wang and Zhixin Shen

2014 International Workshop on Electronics and Communications Program Overview

Monday October 27th, 2014		
09:15-09:30	Registration (The Second Floor Lobby)	
09:30-10:05 Open Ceremony (C216, Chair: Prof. Jin Pan, UESTC, China)		
09:30-09:40	Welcome Speech: Prof. Jun Hu, School of EE, UESTC, China	
09:40-09:50	Speech from Korea representative: Prof. Ho-Youl Jung, Yeungnam University, Korea	
09:50-10:00	Speech from Japan representative : Prof. Fumiyuki Adachi, Tohoku University, Japan	
10:00-10:05	Technical Program Chair Speech: Dr. Xingang Liu, UESTC, China	
10:05-10:35	Keynote Speech I: Prof. Kai Kang, UESTC, China (C216)	
10:35-11:00	Group Photo & Coffee Break	
11:00-11:30	Keynote Speech II: Prof. Ho-Youl Jung, Yeungnam University, Korea (C216)	
11:30-12:00	Keynote Speech III: Prof. Akinori Ito, Tohoku University (C216)	
12:00-13:50	Lunch (FuRong Restaurant)	
13:50-15:50	WEC2014 Oral Session I (C204, Chair: Prof. Jinfeng Hu, UESTC)	WEC2014 Oral Session II (C218, Chair: Prof. Zongjie Cao, UESTC)
15:50-16:05	Coffee Break (The Second Floor Lobby)	
16:05-18:05	WEC2014 Oral Session III (C204, Chair: Prof. Jinfeng Hu, UESTC)	WEC2014 Oral Session IV (C218, Chair: Prof. Zongjie Cao, UESTC)
18:30-20:30	Banquet (HeKangJiaYun Restaurant)	

Tuesday October 28th, 2014	
09:30-12:00	Visiting the Old Campus of UESTC
12:00-13:30	Lunch (Hotel of UESTC)
14:30-15:45	Professors Meeting in New Campus (C218); Free Time Visiting for Students
15:45-17:45	Visiting the New Campus of UESTC
18:00-20:30	Dinner (FuRong Restaurant)

Reliable Multicast Schemes in IEEE 802.11aa Standard

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***Abstract*— Multicasting is a bandwidth efficient mechanism in group communication. However, multicast communication suffers because of lack of reliable and scalable mechanism. IEEE 802.11aa standard is a recent amendment to the IEEE 802.11 standard focus on multimedia streaming reliability in 802.11 networks. For reliable transmission, IEEE 802.11aa standard proposes a new mechanism named Groupcast with retries. Groupcast with retries defines two retransmission policies for group communication: Groupcast with retries unsolicited retry and Groupcast with retries block acknowledgement. In this paper, we comparatively evaluate the performance of reliable multicast schemes defined in 802.11aa.**

Keywords—802.11aa; Reliability; Multicast;

I. Introduction

The transmission of audio-video streams over wireless local area networks (WLANs) has become prevalent and greatly contributes to the Internet traffic [1]. Due to the increasing number of audio-video streams Cisco estimates predict that "by 2015, the world will reach 3 trillion Internet video minutes per month, which is 1 million Internet video minutes every second" [2]. Therefore, as a result, a number of quality of service (QoS) aware medium access control (MAC) protocols have been proposed during the last decade in the literature to support audio-video streaming applications. One of the first and most fundamental milestones was the IEEE 802.11e amendment [3]. IEEE 802.11e standard defined hybrid coordination function (HCF), which includes two coordination functions which are: enhanced distributed channel access (EDCA) and hybrid coordination function controlled channel access (HCCA). However, neither EDCA nor HCCA can provide absolute service guarantees [4].

Recently, IEEE 802.11aa standard introduced new amendments [5]. IEEE 802.11aa amendment defines the new mechanism target at significantly improving the performance of multimedia streams. (i) *Stream classification service (SCS)*, allows streams to be arbitrarily mapped to the primary and alternative queues. (ii) *Groupcast with retries (GCR)*, which provide reliable multicast service. (iii) *Overlapping basic service set (OBSS) management*, in order to limit the neighbor capture effect and extend admission control and scheduling policies. (iv) *Interworking with the IEEE 802.1Q stream reservation protocol (SRP)*, to provide end-to-end QoS guarantees by reserving network resources for specific traffic streams in bridged local area networks (LANs) [6]. (v) *Intra-access category (Intra-AC) prioritization*, to obtain a finger-grained prioritization between individual audio and video streams [1]. The focus of this paper is on reliable multicast scheme, GCR. The detailed overview of GCR scheme is provided in section II.

K. K-Szott *et al*. [4] provide the first description of the new QoS solution introduced in IEEE 802.11aa and IEEE 802.11ae standards. This tutorial helps the researcher and engineers to easily understand the new mechanism as well as become familiar with the area left open by the new amendments. However, they did not provide any evaluation on the amendments. There have been efforts to evaluate the mechanism defined in IEEE 802.11aa standard [7][8]. In [7], authors provide a qualitatively description of the new mechanism, and in [8], a numerical assessment based on simulation is presented. Banchs *et al.* [9] provide the analysis and evaluation of the IEEE 802.11aa multicast mechanism, in terms of throughput and reliability. However, they just consider the single source in the multicast group. According to their results, there is no "absolutely the best" reliable multicast scheme in IEEE 802.11aa standard. There is performance, complexity tradeoff. Santos *et al.* [10] evaluates the directed multicast service (DMS) and GCR services in terms of throughput and delay. However, higher throughput does not always mean better video quality as proven by Xiao *et al.* [11]. K. K-Szott *et al.* [12] present the first analytical saturation model of the intra-AC prioritization feature of the IEEE 802.11aa standard. Their results show that the new IEEE 802.11aa intra-AC prioritization feature provides a finer grained prioritization of voice and video streams, as compared to the currently EDCA inter-AC prioritization. In this paper, we describe the reliable multicast scheme of IEEE 802.11aa in detail. Additionally, we compare the GCR schemes of IEEE 802.11 standard in term of reliability.

The rest of the paper is organized as follows. Section II explains the GCR mechanism in detail. In Section III, we provide the performance evaluation in detail, and finally, Section IV concludes the paper.

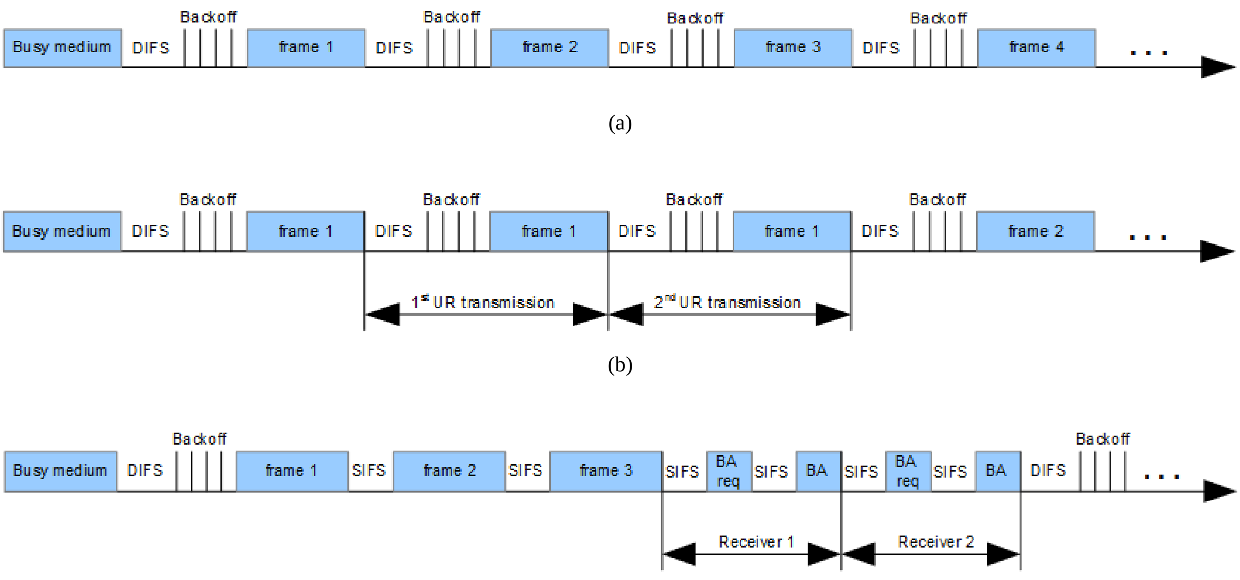

Fig. 1. Operation example of (a) Legacy 802.11 multicast (b) GCR Unsolicited Retry (c) Block ACK.

II. GroupCast with Retries Services

Multicast transmissions over IEEE 802.11 based standards still have inefficiencies such as the unreliability caused by the lack of ready-to-send (RTS)/clear-to-send (CTS) and acknowledgement (ACK) packets. Fig. 1a shows the multicast service with IEEE 802.11 standard. In order to provide a robust and reliable multicast audio/video streaming, IEEE 802.11aa standard specifies GCR enhancement. GCR defines two additional retransmission schemes: GCR unsolicited retry (GCR-UR), and GCR block ACK (GCR-BA).

A. GCR Unsolicited Retry

In GCR-UR mechanism, multicast frames are transmitted several times without waiting for any ACK packet after each transmission. The number of retry should be limited to a threshold fixed by the transmitter. Retry threshold depends on the application requirements. Although this mechanism improves the reliability by increasing the delivery probability, it leads to increasing the overhead when the number of retries is large, and becomes meaningless when the channel quality between transmitter and receivers is good. Fig. 1b represents an operational example of GCR-UR scheme.

B. GCR Block ACK

This mechanism is considered as an extension of the BA scheme defined in IEEE 802.11v and IEEE 802.11n standards. In this scheme, sender transmits a block ACK request (BAR) packet to all multicast members. The receiver station sends an ACK packet only when it is requested by a BAR packet. Therefore, this mechanism offers better reliability than other ACK policies. Fig. 1c shows an example scenario of the GCR-BA operation.

III. Performance Evaluation

In this section, we provide the performance evaluation of legacy 802.11 multicast, GCR-UR, and GCR-BA in term of reliability. The reliability is defined as the number of successfully received frames over the all transmitted frames. We consider the different number of retries (1, 2, and 3) for GCR-UR scheme. In legacy 802.11 multicast scheme, each frame is transmitted only once. Therefore, a multicast frame is successfully received by each multicast member when it does not collide and does not suffer from the channel error. In GCR-UR scheme, multicast frames transmitted several times without waiting for any ACK packet after each transmission. We assume that all stations experience the identical channel conditions, and they suffer from the same channel error probability.

Fig. 2 shows the transmission and the failure probability of legacy 802.11 multicast, GCR-UR and GCR-BA scheme as a function of the number of nodes. Failure can happen because of collisions and channel error. The failure probability of legacy 802.1 and GCR-UR is higher than that of GCR-BA because of the higher collision probability of IEEE legacy 802.11 and GCR-UR scheme. The collision probability in the wireless networks depends on the number of contending devices and the contention window.

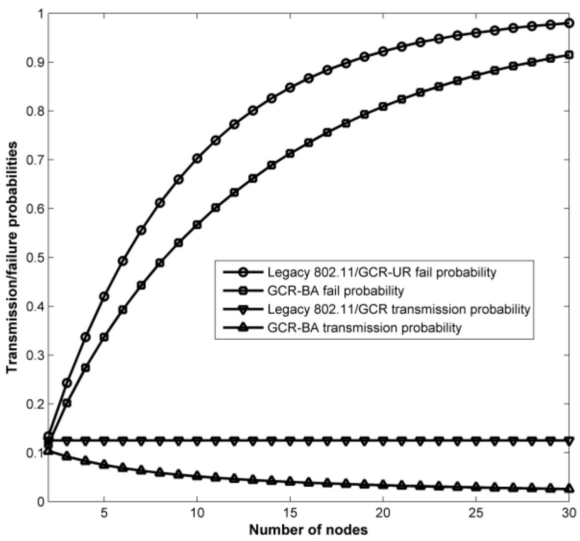

Fig. 2. Transmission and failure probability as a function of number of nodes.

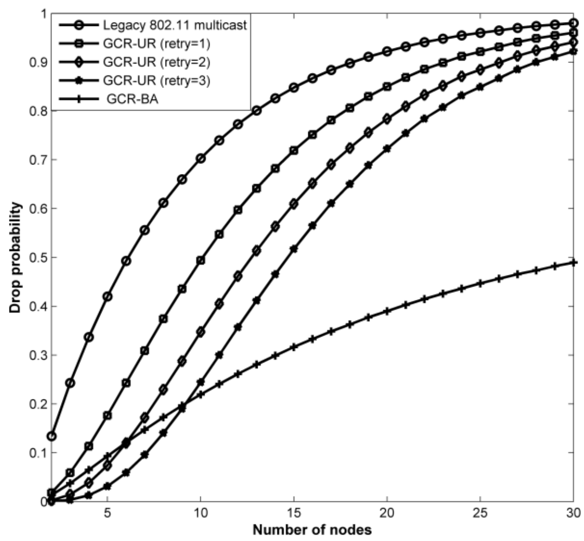

Fig. 3. Drop probability as a function of number of nodes.

If there is transmission failure, the transmitter increases the contention window size to reduce the collision probability. Since there is no ACK policy in IEEE legacy multicast and GCR-UR, each packet is transmitted using the minimum size of contention window. However, in the GCR-BA scheme size of contention window is doubled on each retransmission, up to the maximum retry limit, and hence reduce the failure probability. The maximum retry limit is considered as 7 in the GCR-BA.

Fig. 3 shows the drop probability of IEEE legacy 802.11, GCR-UR and GCR-BA scheme. The drop probability of legacy 802.11 is higher than others because there is no ACK packet of the failed frame. The drop probability of GCR-UR decreases when we increase the number of retries. GCR-UR with retries 2 and 3 shows the less drop probability when the number of nodes is less in the multicast group. However, on the higher number of nodes GCR-UR drop probabilities increase because of more collision in the network

Fig. 4 shows the reliability of different schemes as a function of channel error probability. The number of nodes is set to 10. GCR-BA shows higher reliability than others schemes. However, reliability increases in the GCR-UR when we increase the number of retries. Legacy 802.11 multicast shows the worse performance as compared to other schemes.

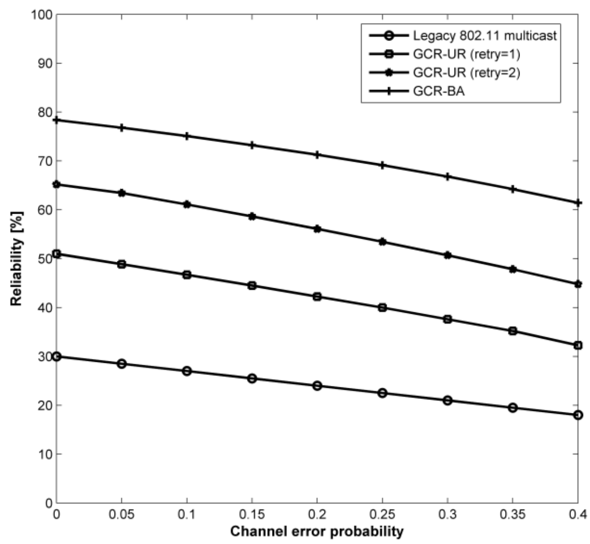

Fig. 4. Reliability vs. channel error probability (when number of nodes is 10).

IV. Conclusion

Multimedia transmission via multicast is one promising technology over wireless local area networks. Therefore, reliability is important in multimedia multicasting. To provide the reliability, recently, IEEE 802.11aa standard introduced new amendments. In this paper, we comparatively evaluate the performance of GCR-UR and GCR-BA schemes with IEEE 802.11 legacy multicast scheme in term of reliability. Results show that GCR-BA performs well in term of reliability. However, the reliability in the GCR-UR depends on the number of retries.

Acknowledgement

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