2014 International Workshop on Electronics and Communications

WEC2014

Organized by
University of Electronic Science and Technology of China

Co-organized by
Yeungnam University, South Korea; and Tohoku University, Japan

Oct. 27th-28th, 2014, Chengdu, Sichuan, China

Editor by: Xingang Liu, Kai Kang, Peicheng Wang

Conference Information

Papers by Session

Conference Information

2014 International Workshop on Electronics and Communications

---

- Program Overview
- Message from General Chairs
- Message from Technical Program Chair
- Organizing Committee
- Keynotes

⇦ Home ⇨

WEC 2014 Oral Session I

- Numerical Simulation of Scattering Characteristics of Mushroom Type Reflectarray Elements
  Hiroki Ito, Keisuke Konno and Qiang Chen
- An experiment of mutual interference between LIDAR scanners
  Gunzung Kim, Jeongsook Eom and Yongwan Park
- Design of Low Noise Amplifier for Bei-Dou Receiver
  Pin Li and Jin Pan
- Multi-User MIMO Using Vector Perturbation Precoding Scheme for Single-Carrier Block Transmission
  Shohei YOSHIOKA, Shinya KUMAGAI and Fumiyuki ADACHI
- Ground-based Back Projection for Millimeter-Wave Interferometric Synthetic Aperture Radar Imaging
  Liwen Guo, Shunjun Wei, Xiaoling Zhang and Jun Shi
- Complexity Reduced Near ML Block Signal Detection for Broadband Single-Carrier Transmission
  Katsuhiro Temma and Fumiyuki Adachi
- Solving Eigenvalue Problem of Rectangular Metallic Waveguide Filled with Blocking Mediums by Using An Approximate Analytical Method
  Xin Huang, Jin Pan and Renzun Lian
- Automatic Synthesis of Character Pattern Using Patch Transform
  Jian Wang, Hiroya Saito, Tomo Miyazaki, Yoshihiro Sugaya and Shinichiro Omachi
- Performance Evaluation of Multipath Routing Protocols for mobile adhoc network
  Abdullatif Marzouq Albalawi, Lee Ki Dong

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

- Interference-Aware Channel Segregation In A Correlated Shadowing Environment
  Ren Sugai, Martin T.H. Sirait, Katsuhiro Temma and Fumiyuki Adachi
- Image Similarity Distinction-based Positioning Method Using a Single Camera
  Jinseon Song, Soojung Hur and Yongwan Park
- Phase-Only Correlation Functions of Which Phase Spectrums are Quadratic-Phase CAZAC Sequences
  Kazuhiro FUKUI and Masayuki KAWAMATA
- High Quality with Low-Cost H.264/AVC Interframe Mode Decision Algorithm for Wireless Network
  Peicheng Wang, Yinbo Liu and Xingang Liu
- Study of Convergence Property of Adaptive Digital Filters for Colored Input Signals
  Yuki NOGUCHI, Shunsuke KOSHITA and Masayuki KAWAMATA
- Enhanced Indoor Positioning Method Using Combination WLAN and Geomagnetic
  Changhwan Choi, Soojung Hur and Yongwan Park
- SVD-based 3D Image Quality Assessment by Using Depth Information
  Lan Zhang, Xingang Liu and Chao Sun
- Random Access Control for Cognitive Radio Networks with Hybrid Spectrum Sensing Technique
  Muhammad Shafiq, Jin-Ghoo Choi, and Muhammad Khalil Afzal

Home

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

Home

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)

The Impact of Channel Selection Algorithms on Transport Protocols in CRAHN

Yousaf Bin Zikria*, Summera Nosheen**, Sung Won Kim*
* Department of Information and Communication Engineering, Yeungnam University, South Korea
** School of Engineering and Computer Science, Victoria University of Wellington, New Zealand
yousafbinzikria@ynu.ac.kr , summera.nosheen@ecs.vuw.ac.nz, swon@yu.ac.kr

***Abstract*— The cognitive radio adhoc network is designed to cater the spectrum scarcity by increasing the spectrum utilization. It allows unlicensed user to employ it when it is free. To order to maintain end-to-end reliability the transport protocol adjusts the source transmission rate by adapting to the congestion on the route. A number of new transport protocols were proposed for cognitive radio in the literature. This paper studies three transport protocols: TCP, TFRC and TFRC-CR for cognitive radio networks with respect to different channel selection policies. The sequential and random channel selection algorithms are used to analyze the overall performance of the transport protocols. Extensive set of simulations is carried out in NS-2. To evaluate the performance of these transport protocols we used average throughput and end-to-end delay as metrics. The empirical results highlight suggestive outcomes. The transport protocols with random channel selection policy perform better than the sequential channel selection policy.**

Keywords—TCP, TFRC, TFRC-CR, CRAHN, CW

I. INTRODUCTION

The increasing use of unlicensed band in the wireless medium has resulted in growing congestion and thus spectrum scarcity. The Federal communications Commission (FCC) pointed earlier to use the additional spectrum for unlicensed operations [1]. Latterly, the abandon frequency ranges ascribed to the analog to digital television transition for use by unlicensed operators [2]. This permit devices to sense channels and transmit opportunistically. These devices are enabled with cognitive radio (CR) capabilities. Therefore, it allows devices to sense the spectrum utilization, select the best available channel and share the available spectrum resource among other devices [3]. Although, The adaptivity of CR in ad hoc networks (CRAHNs) is not easy, with the challenges posed by the limited spectrum knowledge at the individual nodes and the decentralized operation [4].

The Cognitive radio ad hoc networks (CRAHNs) [4,5] are usually composed of two kinds of users: CR users and primary users (PUs). The PUs are the license users. However, CR user opportunistically accesses the licensed spectrum holes. The CRAHN facilitates the researchers to ample the wide range of parameters, such as power and spectrum, channel bandwidth and frequency, use custom-designed or existing spectrum selection and sharing policies and model accurately the activity of the PUs and CR users.

A significant number of studies are carried out on transport layer in wireless networks over the past decade. However, transport protocols for CR are just coming into the existence. The suitability of of TCP for CR networks, given is widespread use, has been explored in [3,6-9]. The TCP Friendly Rate control (TFRC) protocol [10], employs equation based congestion control in unicast traffic. Its focus on providing a stable throughput, as opposed to the sudden variations caused by the additive increase multiplicative decrease behavior of TCP. The TCP Friendly Rate Control for Cognitive Radio (TFRC-CR) [11], proposed the first equation-based transport protocol. It allows immediate changes in the transmission rate based on the spectrum-related changes in the network environment. Moreover, it does not assume any cross-layer feedback or input from intermediate nodes. The main features of TFRC-CR are as follows. According to the FCC regulations, the protocol is integrated with the spectrum dats bases. Therefore, completely eliminated any kind of feedback from the intermediate nodes or from lower layers. The proposed protocol polls at least once in every 60 seconds as specified in the FCC regulations. The TFRC-CR can distinguish between congestion and spectrum change. Thus, the transmission rate is never reprimanded. They modified the TFRC rate control equation by amending the loss event interval. As a consequence, it makes use of the bandwidth more efficiently with the help of higher and accurate sending rate. Hence, attained better throughput.

In CR networks, there is no assurance that a spectrum band will be vacant during the whole communication of CR user. If PU becomes active the CR user needs to find the next vacant channel or remain idle until PU finish its transmission. Therefore, the CR user performance solely dependent on the channel selection policy and algorithm. Moreover, in channel selection, the next vacant channel for communication should not interfere with the channel currently occupied by the PU. If the channel selection algorithm is suboptimal, it severely degrades the performance of the system. In this paper, we are evaluating the impact of different channel selection algorithm on the performance of the end-to-end protocol. According to the best of our knowledge this is the first study to see the impact on cross layer.

The rest of the paper is organized as follows. Section II presents the simulation environment. Section III reveals the simulation modeling and analysis in detail. Finally, section IV concludes the paper.

II. SIMULATION ENVIRONMENT

A. *Simulation Tool*

A substantial set of simulations is conducted in NS-2.33 [12]. We configure CRAHN in NS-2.33. The default simulation parameter values used are given below in Table I.

TABLE I. SIMULATION PARAMETERS

Radio propagation model	Two Ray Ground
Channel Type	Wireless Channel
Network Interface Type	Wireless Phy
Mac Type	802.11
Antenna Model	Omni Antenna
Routing Protocol	AODV
Transport Layer	TFRC-CR/TFRC/TCP
Number of Nodes	50
Queue Length	500
Cognitive Radio Model	CRAHN
Simulation Time	200 s

B. *Evaluation Metrics*

The evaluation parameters used are listed below.

i) Average Throughput

The total number of packets successfully received, divided by the total transmission time. The average throughput can be calculated by using the equation below.

$$Average\ Throughput = \frac{Number\ of\ Packets\ Received}{Simulation\ Time} \tag{1}$$

ii) Average End to End Delay

The average time taken by a data packet to arrive in the destination. We have calculated end-to-end delay as follows

$$D_A = T_{RP} - T_{SP} \tag{2}$$

Where

$D_A = Delay$

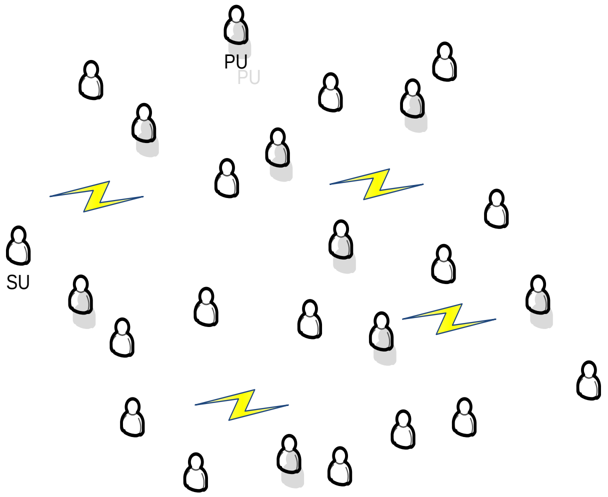
$T_{RP} = Time\ of\ received\ packet$

$T_{SP} = Time\ of\ Packet\ sent$

The average end-to-end delay is calculated by summing up all the delays divided by the number of packets received.

III. SIMULATION MODELING AND ANALYSIS

The network model presented in Fig 1. It contains 50 SUs and 20 PUs placed randomly. The PUs activity is independent and random over the course of simulation time. We conducted all the experiments on multihop CRAHN. In this way, there are one or more intermediate nodes along the path that receive and forward packets via wireless link. The CRAHN environment is based on eleven channels. All the channels have homogenous capacity. When the PU is sensed to be active on the current channel, the spectrum decision block check for spectrum policy and choose the next channel to be used by the CR users. In case of PU detection, the channel



Random Network Model of 20 PUs and 50 SUs

Fig. 1. Network Model

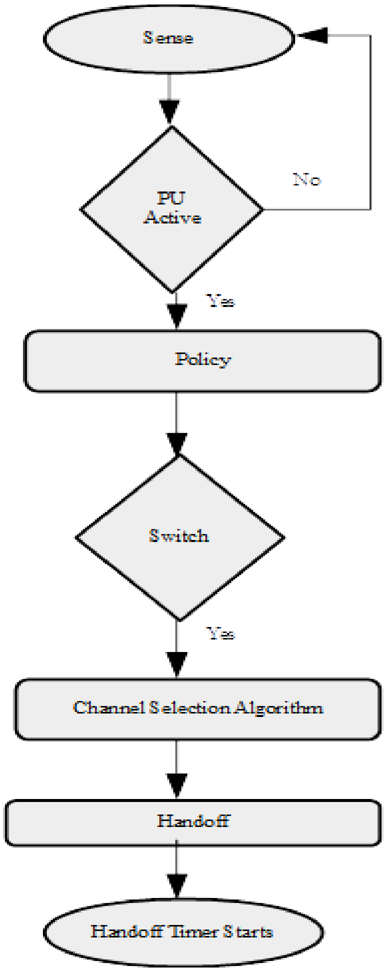


Fig. 2. Channel Selection flowchart

selection policy always looks for next vacant channel, i.e. always switch.

In this policy, the CR user immediately vacates the current channel and moves to the other available channel otherwise pause the transmission. In order to do the channel selection, we used two channel allocation algorithms namely random and sequential. In the random allocation scheme, the CR user chooses randomly among the available channels. In case of sequential scheme, the CR users visit all the available channels by round robin algorithm.

We are interested to see how the transport protocol reacts according to the channel selection policy. The Fig 2 shows the channel selection flowchart. When PU is sensed active, the CR user must vacate the current channel. Furthermore, it gets a new channel to switch according to the channel selection algorithm. The new channel is sensed for any PU activity. If the channel is free, the handoff process is initiated. During the handoff process, the CR user is not permitted to perform any communication.

The Fig 3 and Fig 4 depict the throughput of TFRC-CR, TFRC and TCP when selection policy is sequential and random respectively. It clearly shows that TCP performance is worse among the others. The self-clocking mechanism of TCP is highly susceptible to the observed round trip time (RTT). With the periodic interruptions caused by the PUs appearance, this mechanism by itself is unable to distinguish true congestion from PU induced spectrum changes. In addition, the dependence on ACK timing is aggravated in CR networks owing to the fact that, nodes pause their transmission when they are engaged in sensing or channel switching. This results in a varying RTT estimate and consequently make self clocking mechanism futile. Moreover, the additive increase/multiplicative-decrease (AIMD) algorithm, performs the rate control in TCP combines linear growth of the congestion window (CW) size. In this way, during the congestion avoidance phase an exponential reduction takes place. In the congestion avoidance phase, the CW is increased by one segment on each RTT. This conservative approach is scanty for CR networks since the spectrum opportunity is often lost before the CW has amplified to half the segments [3]. The TFRC also assumes that dropped packets occur due to the congestion only and consequently it reduces the sending rate at source. Moreover, in CR networks, the disparity in the sampling of TFRC can be wider as PU activity and spectrum availability changes and subsequently affect the sending rate. TFRC-CR high throughput rate at the high PU activity scenario is a result of slowing down the sending rate. Also, it avoids the excess and eventually lost packets that are sent in TCP and TFRC [11]. The empirical results shows, random selection policy performs better and consistent than the sequential one.

Table II illustrates the average delay with respect to the simulation time for the round robin and random selection policies. TFRC-CR shows better results than the TFRC and TCP. TCP performance is the execrable among all transport protocols. The TFRC-CR accomplishes well with random selection. The random channel selection algorithm is able to find the next vacant channel in lesser time. Therefore, attains better delay and throughput.

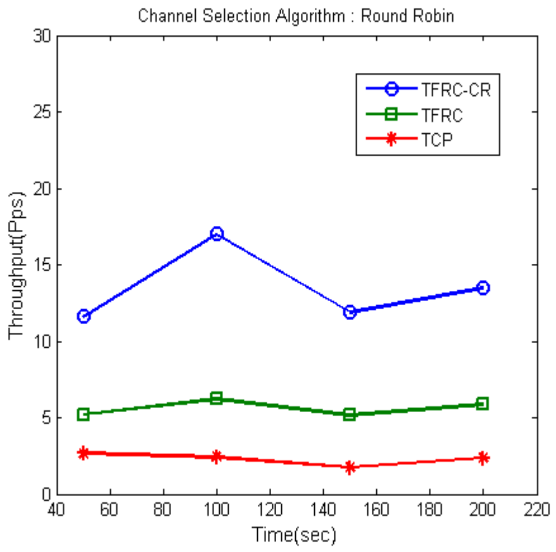


Fig. 3. Time vs Throughput

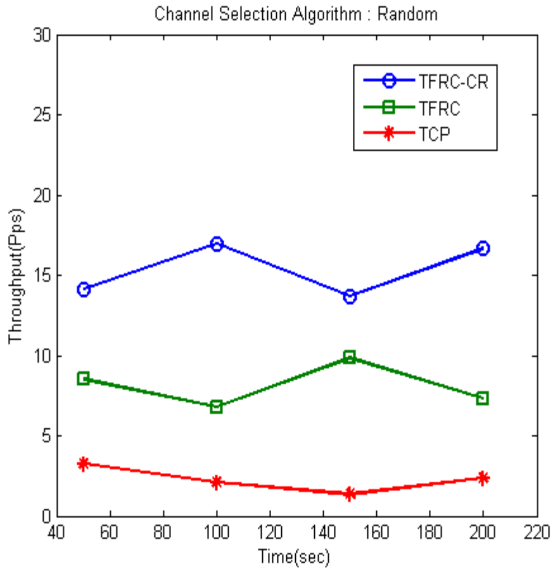


Fig. 4. Time vs Throughput

Table II. Time vs Delay

Channel Selection Policy	**Delay(ms)**			
Round Robin	*Time(sec)*	*TFRC-CR*	*TFRC*	*TCP*
	50	304.85	286.45	1036.58
	100	271.77	250.15	1035.51
	150	256.15	226.51	1011.67
	200	241.44	223.51	1036.45
Random	50	247.67	285.85	1136.53
	100	234.64	267.67	1013.02
	150	226.99	222.15	1041.46
	200	221.33	221.20	1021.06

IV. Conclusion

In this paper, we studied three transport protocols, namely, TCP, TFRC and TFRC-CR with different channel selection algorithms. We aimed to investigate the transport protocols in order to provide efficient utilization of available spectrum and to increase the overall performance of CR users without the interference of PU. It has been observed that the impact of the interruptions caused by the activity of the PU degrades the transport protocol and consequently reduced the transmission rate. The channel selection policy has a key role in finding the next vacant channel within the shortest time to maintain the overall performance of the CR users. We evaluated two simple channel selection policies, i.e. sequential and random policy. Simulation results depicted that the transport protocols with random channel selection policy perform better than the sequential channel selection policy algorithms. So, they achieved higher packets per second with lesser end-to-end delay.

The efficient channel selection policy and reliable transport protocols are not fully explored in CRAHN. In this context, it can be an open research challenge.

Acknowledgment

This research was supported by BK21 Plus Program (Creative Human Resource Development Team for ICT-based smart devices, 214C000066) funded by the Ministry of Education (MOE, Korea) and the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT & Future Planning (NRF2012R1A1B4000536).

References

[1] FCC, Spectrum policy task force report, ET Docket No. 02-135, November 2002.

[2] FCC, Spectrum policy task force report—in the matter of unlicensed operation in the TV broadcast bands: second report and order and memorandum opinion and order, ET Docket No. 08-260, November 2008.

[3] M. Di Felice, K.R. Chowdhury, W. Kim, A. Kassler, L. Bononi, End-to-end protocols for cognitive radio networks: an evaluation study, in: Elsevier Performance Evaluation, vol. 68 (9), September 2011.

[4] I. Akyildiz, W.Y. Lee, K.R. Chowdhury, CRAHNs: Cognitive Radio Ad HoC Networks, Ad Hoc Networks Journal 7 (5) (2009) 810–836.

[5] K.R. Chowdhury, M. Di Felice, Search: a routing protocol for mobile cognitive radio ad-hoc networks, Computer Communication Journal 32 (18) (2009) 1983–1997.

[6] A.O. Bicen, O.B. Akan, Reliability and congestion control in cognitive radio sensor networks, in: Elsevier Ad Hoc Networks, vol. 9 (7),September 2011.

[7] D. Sarkar, H. Narayan, Transport layer protocols for cognitive networks, in: Proc. of IEEE INFOCOM on Comp. Commun.Workshops, March 2010.

[8] H. Xiao, K.C. Chua, J.A. Malcolm, Y. Zhang, Theoretical analysis of TCP throughput in adhoc wireless networks, in: Proc. of IEEE GLOBECOM,December 2005.

[9] A.M.R. Slingerland, P. Pawelczak, R.V. Prasad, A. Lo, R. Hekmat, Performance of transport control protocol over dynamic spectrum access links, in: Proc. of IEEE DySPAN, April 2007.

[10] S. Floyd, M. Handley, J. Padhye, J. Widmer, Equation-based congestion control for unicast applications, in: Proc. of ACM SIGCOMM, August 2000.

[11] Abdulla K. Al-Ali, K.R. Chowdhury, TFRC-CR: An equation-based transport protocol for cognitive radio networks, in : : Elsevier Ad Hoc Networks, vol.11 (6), August 2013.

[12] http://www.isi.edu/nsnam/ns/