

**KOREAN SOCIETY FOR INTERNET INFORMATION**

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## **The 9<sup>th</sup> Asia Pacific International Conference on Information Science and Technology (APIC-IST 2014)**

**July 14-18, 2014, Himalaya Hotel, Kathmandu, Nepal**  
<http://www.apicist.org/2014>

# **Conference Program**

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**| Organized by |**  
**Korean Society for Internet Information (KSII)**  
**Korea Institute of Science and Technology Information (KISTI)**

<http://www.apicist.org>

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## A Message from Honorary Chair

I express my warm heart to all of attendants of the 8<sup>th</sup> Asia Pacific International Conference on Information Science and Technology (APIC-IST 2014) that will be held from July 14~18, 2014, at Himalaya Hotel Kathmandu, Nepal. I deeply appreciate all contributors for submitting papers, chairing sessions, and reviewing papers. We also feel grateful for the support we received from the Korea Institute of Science and Technology Information (KISTI).



Over the past 8 years, KSII (Korea Society for Internet Information) has increased its academic impact and influence in the area of computer engineering, internet technology, and information both worldwide and nationwide through this international conference and its SCIE-indexed journal the *KSII Transactions on Internet and Information Systems* (TIIS). In particular, the KSII TIIS journal is supported and funded by the National Research Foundation under the Ministry of Education, Science and Technology (MEST), the Korean Federation of Science and Technology Societies (KOFST), and the Korean government. Our KSII TIIS journal has been selected as an outstanding international journal by MEST, the Korean government since 2009.

A great number of outstanding papers have been submitted to the APIC-IST conference again this year. In addition, high-quality conference arrangements and program preparations have been achieved by the great efforts of the Conference Chair Prof. Junchul Chun (Kyonggi Univ.), Program Chairs In Kuk Song (Dankook Univ.) and Imran Ghani (Universiti Teknologi Malaysia), Steering Chairs Prof. Mingoo Kang (Hanshin Univ.), Kwanghoon Pio Kim (Kyonggi Univ.), Minho Jo (Korea Univ.) and JungKun Pae (Sookmyong Women's Univ.) and Workshop Chairs Dr. Hanmin Jung (KISTI) and Dr. Sunghyun Kim (NIA).

I also express my special thanks to the Keynote Speaker Chandra Bilash Bhutel who is the president of ITSN (Information Technology Society (IT-S), Nepal). KSII and ITSN will work together to expand the special relationship in the ICT & future Planning from the moment of APIC-IST 2014. In addition, my special thanks go to Advisory Board members, Program Committee members, Steering Committee members, and Workshop Committee members.

The APIC-IST 2014 aims at bringing together international researchers from Academia, Industry, and National Labs to exchange novel ideas, explore enabling technologies, discuss innovative designs, and share field trial experiences and lessons learned, in particular focusing on smart phone applications and services, mobile computing, network security, green computing, e-learning, medical/bio-informatics, data mining, artificial intelligence, S/W engineering, DB, and wireless communications.

I must thank all authors and speakers for their valuable research papers and effort to make the 9<sup>th</sup> APIC-IST 2014 a success! I also look forward to meeting you all again at ICONI 2014 held in Taiwan.

I wish you all a pleasant and prosperous time at the beautiful Jeju Island of Korea!

Dr. Bong Gyou Lee  
Yonsei University, Korea  
Honorary Chair of APIC-IST 2014

## *A Message from Conference Chair*

Welcome to the 9<sup>th</sup> Asia Pacific International Conference on Information Science and Technology (APIC-IST), which will be held on July 14-18, 2014, at Kathmandu, Nepal. APIC-IST is an annual conference organized by KSII providing an open forum for researchers, engineers, policy makers, and service providers in the Information Science and Technology.

In this year, we are glad to invite the prospective authors to submit papers / workshop / poster papers in the following areas: Smart Phone Applications and Service / Mobile Internet Computing, Wireless and Sensor Network, Security & Privacy in Internet, IoT (Internet of Things), Green (Energy-efficient) Computing & Smart Grid, Multimedia & Intelligent Systems, Database/Data Mining/ Mobile Object Database, Software Engineering & Architecture, Internet Business related Policy, Smart Learning, SNS(Social Network Services) and Communication.

As time goes on, annual APIC-IST conference becomes more qualified conference in which many honorable researchers participate to share their valuable research results. APIC-IST 2014 offers 1 invited talk, 10 sessions that present the latest results in various research fields of ICT (information Communication Technology). Moreover, Mr. Chandra Bilash Bhutel who is the president of ITSN (Information Technology Society, Nepal) will participate in the conference as a keynote speaker and speak us what challenges and opportunities most Nepali IT professionals and engineers face these days. This provides a valuable opportunity to develop strong relationship between KSII and ITSN in the future. I thank to Mr. Chandra Bilash Bhutel for his participation.

I must thank all the authors and speakers for the research papers on their precious achievements. Kathmandu, the capital and largest urban agglomerate of Nepal is known as a mystic place in the world. I hope all participants of APIC-IST take this opportunity to explore and encounter beautiful nature and traditional culture simultaneously while staying in Nepal.



**Dr. Junchul Chun**  
**Kyonggi University. Korea**  
**Conference Chair of APIC-IST 2014**

## *A Message from Program Co-Chairs*

It is a pleasure to welcome you to the 9th Asia Pacific International Conference on Information Science and Technology (APIC-IST 2014). The APIC-IST, hosted by Korean Society for Internet Information (KSII), is the premier conference in the Asia Pacific region. The hosting organization (KSII) is the largest Internet academic society in Korea. Over the past 9 years, APIC-IST has grown to be the major international conference in Information Science and Technology area. APIC-IST continues the endeavor of high-quality, broad international participation in all areas of Information Science and Technology.

The APIC-IST 2014 will be held at Kathmandu, Nepal on July 14-18. It aims to provide a high quality forum for researchers and practitioners to share research findings, practices, and ideas on key issues in Internet related technologies, services, and administrations. The APIC-IST 2014 Program Committee organizes as a set of 13 tracks, and welcomes presentations of completed research papers as well as research-in-progress papers, panel discussion, and posters covering those issues.

The successful organization of APIC-IST has required the talents, dedication and time of many volunteers from Malaysia and South Korea. Special gratitude and appreciation go to the various track chairs as they are primarily responsible for the content of the technical program. The Conference Chair, Professor Junchul Chun, has done an excellent job coordinating with the corresponding chairs and putting together the advanced program schedule. We would also like to thank the Publication Chair, Professor Seung Ryul Jeong for his endeavor to collaborate with a wide volume of researchers. Without their outstanding job, we would not have such an excellent conference site.

We hope that you will find the conference both pleasant and valuable, and also enjoy the architectural, cultural and natural beauty of Nepal. Kathmandu in Nepal is one of the most popular tourist destinations in South Asia and is well known for the highest point on the face of Earth, Mount Everest. We look forward to welcoming you at the APIC-IST 2014.



**Dr. Imran Ghani,**  
**Universiti Teknologi Malaysia (UTM)**  
**Program Co-Chair of APIC-IST 2014**



**Dr. In Kuk Song**  
**Dankook University**  
**Program Co-Chair of APIC-IST 2014**

## Keynote Speaker



### Mr. Chandra Bilash Bhurtel

- President of Information Technology Society Nepal (ITSN)
- Vice-Principal of College of Information Technology and Engineering (CITE)
- Member of ICT Education Sub-Committee under Computer Association of Nepal (CAN).

### **Title : Challenges for Engineers in Developing Countries**

Four Universities in Nepal are delivering IT Engineering Education and two new universities are on the move. In the context, as a developing country there are limitless possibilities and opportunities for engineers around the country. But the matter of accessibility towards education is limited to capital city and major cities. Here accessibility leads to Education, Resources, Infrastructures, Opportunities, Career... are limited to pin point.

The presentation also deals with nature of faculties available in the universities & colleges, in the side nature of students who takes education as a burden in their life. While, community people also takes some major education stream as a priority such of them are medical & nursing, architecture, civil engineers only as assets of education. Education like Information Technology, Computer Science, and Environmental Engineering are judged as low profile faculties where management and humanities disciplines are no value at all.

Internet bandwidth in Nepal is still low and cost of internet service is very high in compare to bandwidth and this internet penetration is still limited to major cities only. The new initiatives on CDMA (EVDO) service and 2G data service are now available to rural people but for ICT professional this is none of the thing. Opportunities are endless if ORIEC is de-centralized by Policy in Nepal. IT-S Nepal and some non-governing organizations are working for ICT enabled education throughout the countries and plays a vital role to policy level changes, which is enforcing good initiatives towards E-Governance also.

## Organizing Committee

### | Honorary Chair |

**Bong Gyou Lee**, Yonsei Univ., Korea

### | Conference Chair |

**Junchul Chun**, Kyonggi Univ., Korea

### | Program Chairs |

**Imran Ghani**, Universiti Teknologi Malaysia (UTM)

**In Kuk Song**, Dankook Univ., Korea

### | Publication Chair |

**Seung Ryul Jeong**, Kookmin Univ., Korea

### | Steering Chairs |

**Mingoo Kang**, Hanshin Univ., Korea

**Kwanghoon Pio Kim**, Kyonggi Univ., Korea

**Minho Jo**, Korea Univ., Korea

**Jung Kun Pae**, Sookmyong Women's Univ., Korea

### | Workshop Chairs |

**Hanmin Jung**, KISTI, Korea

**Sunghyun Kim**, NIA, Korea

### | Financial Chair |

**Jaehyon Kim**, Sungkyunkwan Univ., Korea

### | Program Committee |

**Ikyeun Ra**, Univ.,of Colorado at Denver, U.S.A.

**Myung-Mook Han**, Gachon Univ., Korea

**Frank Eljorde**, West Visayas State Univ.,, Philippines

**Jaewan Lee**, Kunsan National Univ., Korea

**Tuan Hung Dao**, Vietnam Education Publishing House, Vietnam

**Raymond C. Garcia**, Pluraldom Systems U.S.A.

**Ghanshyam Khanal**, ITSN, Nepal

**Sunil Threasa**, UniverSolution Inc., U.S.A.

## Conference Program

<b>July 14, 2014</b>	<b>Seminar 1</b>	<b>Seminar 2</b>
<b>15:00-20:00</b>	<b>Registration &amp; Greeting / VIP Reception</b>	
<b>July 15, 2014</b>	<b>Seminar 1</b>	<b>Seminar 2</b>
<b>08:30-09:50</b>	<b>Session 1</b>	<b>Session 2</b>
<b>10:00-11:20</b>	<b>Session 3</b>	<b>Session 4</b>
<b>11:30-12:20</b>	<b>Opening Ceremony / Keynote Speech</b>	
<b>12:20-13:50</b>	<b>Lunch</b>	
<b>14:00-15:20</b>	<b>Session 5</b>	<b>Session 6</b>
	<b>Poster Session 1 (Lobby)</b>	
<b>15:30-16:50</b>	<b>Session 7</b>	<b>Session 8</b>
	<b>Poster Session 2 (Lobby)</b>	
<b>17:00-17:50</b>	<b>Panel Discussion: Collaboration Between ITSN and KSII</b>	
<b>18:00-18:10</b>	<b>MOU Signing Ceremony</b>	
<b>18:10-18:30</b>	<b>Award Ceremony</b>	
<b>18:30-20:30</b>	<b>Banquet</b>	

## ***Conference Program***

<b>July 16, 2014</b>	<b>Seminar 1</b>
<b>10:00-12:00</b>	<b>Panel Session 1</b>
<b>12:00-13:30</b>	<b>Lunch</b>
<b>13:30-15:00</b>	<b>Discussion Session</b>

<b>July 17, 2014</b>	<b>Seminar 1</b>
<b>10:00-12:00</b>	<b>Panel Session 2</b>
<b>12:00-13:30</b>	<b>Lunch</b>
<b>13:30-15:00</b>	<b>ITSN Tour</b>

<b>July 18, 2014</b>	<b>Seminar 1</b>
<b>10:00-12:00</b>	<b>Ending Session</b>

## Conference Program

Tue, July 15, 2014

08:30-09:50	Session 1: Smart Phone Applications and Service / Mobile Internet Computing
	Session 2: Internet Business related Policy, Communication and Services & Green (Energy-efficient) Computing & Smart Grid
10:00-11:20	Session 3: SNS(Social Network services) and Communication
	Session 4: Wireless and Sensor Network
11:30-12:20	Opening Ceremony
	Keynote Speech "Challenges for Engineers in Developing Countries " Mr. Chandra Bilash Bhurtel, Information Technology Society Nepal (ITSN)
12:20-13:50	Lunch
14:00-15:20	Session 5: Wireless and Sensor Network & Security & Privacy in Internet
	Session 6: Multimedia/Image Processing/ HCI/ Intelligent Systems & IoT(Internet of Things) / Machine to Machine
	Poster Session 1 / Lobby
15:30-16:50	Session 7: Database/Data Mining/Big Data/Mobile Object Database & Smart Learning / Learning Contents Management Systems / e-Learning
	Session 8: Issues of ITC and S/W Convergence
	Poster Session 2 / Lobby

## Conference Program

### Tue. July 15, 2014

17:00-17:50	Panel Discussion: Collaboration Between ITSN and KSII
18:00-18:10	MOU Signing Ceremony
18:10-18:30	Award Ceremony
18:30-20:30	Banquet

### Wed. July 16, 2014

10:00-12:00	Panel Session 1
12:00-13:30	Lunch
13:30-15:00	Discussion Session

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## Conference Program

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Thu. July 17, 2014

10:00-12:00

Panel Session 2

12:00-13:30

Lunch

13:30-15:00

ITSN tour

Fri. July 18, 2014

10:00-12:00

Ending Session

## Conference Program

| 08:30-09:50, Tue, July 15, 2014 |

### Session 1: Smart Phone Applications and Service / Mobile Internet Computing

08:30-09:50, Tue, July 15, 2014

Chair: Prof. Mingoo Kang  
( Hanshin Univ., Korea)

1-1	A Implementation of Mobile Server Management System
	Hong-Jin Park (SangJi Univ., Korea)
1-2	A method to identify a receiver's address effectively for IP over Tactical Data Link
	Jung-Sik Lee, Seung-Bae Jee, Myung-Mook Han (Gachon Univ., Korea)
1-3	Implementation of Hand Gesture Recognition Based on Depth Camera
	Se-Ho Park, Tae-Gon Kim (KETI, Korea), Jun-Rim Choi (Kyungpook National Univ., Korea), Yong-Suk Park (KETI, Korea)
1-4	Design of Wideangle based small Endoscopic Lens Module with UWB Interface
	J.S. Lee, D.J.Kim (KISTI, Korea), M.G. Kang (Hanshin Univ., Korea), J.H. Kim (Sungkyunkwan Univ., Korea), H.J.Song (Wooam Co., Ltd, Korea)
1-5	Design and Implementation of Intelligent LED Dimming Control System Using Light Sensor in Smartphone
	Dong-Geon Lee (Kongju National Univ., Korea), Jun Hwang (Seoul Women's Univ., Korea), Jae-Hyun Lim(Kongju National Univ., Korea)
1-6	Design of Wide-angle Camera Module based Multimodal NUX
	Min-Goo Kang (Hanshin Univ., Korea), Se-Ho Park , Kyung-Taek Lee (KETI, Korea), In-Ki Kim (Innodigital Co. LTD, Korea), J.B Park (KT & C Co. LTD, Korea)

## Conference Program

| 08:30-09:50, Tue, July 15, 2014 |

**Session 2: Internet Business related Policy, Communication a Services & Smart Learning / Learning Contents Management Systems / e-Learning**

**08:30-09:50, Tue, July 15, 2014**

**Chair: Prof. Imran Ghani  
( UTM, Malaysia)**

2-1	Estimation of Sales in the Internet Industry in Korea GeunShik Han (Hanshin Univ., Korea)
2-2	What is difference between supporter and beneficiary of Creative Economy policy in Korea? Yong-ho Sim, Seo-kyun Kim, Sung-ik Huh (ETRI, Korea)
2-3	Measurement and Visualization of the Scientific Elephant Flow Data for e-science Applications Buseung Cho, Seunghae Kim (KISTI, Korea), Seong-Jin Ahn, Jin-Wook Chung (Sungkyunkwan Univ., Korea)
2-4	A Method to overcome GPS Error for the air platform in the military environment Jung-Sik Lee, Seung-Bae Jee (ADD, Korea), Myung-Mook Han (Gachon Univ., Korea)
2-5	How can Business Ventures Attain Sustainability? -System Dynamics Approach- Juho Song (ETRI, Korea), Ho Lee (Yonsei Univ., Korea), Seo-Kyun Kim (ETRI, Korea)
2-6	Workload Re-classification and Reputation-based Host Selection Towards Reliable and Energy Efficient Cloud Data Centers Frank Eljorde (West Visayas State Univ., Philippines), Jaewan Lee (Kunsan National Univ., Korea)

## Conference Program

| 10:00-11:20, Tue, July 15, 2014 |

### Session 3: SNS(Social Network services) and Communication

Chair: Prof. Jung Kun Pae  
(Sookmyong Women's Univ., Korea)

10:00-11:20, Tue, July 15, 2014

3-1	Privacy Protection and Facebook Use
	Namsu Park, Hyunjoo Lee (Konkuk Univ., Korea)
3-2	Emergence of Social Networked Journalism Model: A Case Study of Social News Site,"Wikitree"
	Jinah Seol (Korea National Open Univ., Korea)
3-3	Investigaion of Potential Roles of Perceived Credibility of Health Information from Traditional Media for Leading Health App Use among College Students
	Jaehee Cho(Chung-Ang Univ., Korea), H. Erin Lee(Hankuk Univ. of Foreign Studies, Korea), Margaret Quinlan (Univ.of North Carolina at Charlotte, USA)
3-4	Old media in the era of new media: an analysis of producer-audience social networks of community media in Seoul
	Young-Gil Chae (Hankuk Univ. of Foreign Studies, Korea)
3-5	Propagation Phenomena in Large Social Networks
	Meeyoung Cha (KAIST, Korea)
3-6	When Do People Post a Comment to a News Story on the Internet?
	Mina Lee (Sookmyung Women's Univ., Korea), Inhye Choi (NYPI, Korea), Seungchan Yang (Sookmyung Women's Univ., Korea)

## Conference Program

| 10:00-11:20, Tue, July 15, 2014 |

### Session 4: Wireless and Sensor Network

10:00-11:20, Tue, July 15, 2014

Chair: Prof. Jaewan Lee  
(Kunsan National Univ., Korea)

4-1	An Energy Analysis of Adaptive Congestion Control Scheme for Clustered Wireless Sensor Network Juniven Isin Sasi, Hyunho Yang (Kunsan National Univ., Korea)
4-2	Energy Efficiency depending on Control Packet Intervals in Sensor Systems Daeun Yu, Namgi Kim (Kyonggi Univ., Korea)
4-3	Secure Tree Construction for the Secure Hop-by-Hop Data Aggregation Protocol for Wireless Sensor Networks Triana Mugia Rahayu, SangGon Lee, HoonJae Lee (Dongseo Univ., Korea)
4-4	A Distributed Medium Access Control Protocol for Cognitive Radio Ad Hoc Networks Gyanendra Prasad Joshi, Sung Won Kim, Changsu Kim, Seung Yeob Nam (Yeungnam Univ., Korea)
4-5	Analysis of Packet Scheduling Algorithms for Real-Time Services in Wireless Mesh Networks Sung-Woong Jo, Jong-Moon Chung (Yonsei Univ., Korea)

## Conference Program

| 14:00-15:20, Tue, July 15, 2014 |

### Session 5: Wireless and Sensor Network & Security & Privacy in Internet

Chair: Prof. Minho Jo  
(Korea Univ., Korea)

14:00-15:20, Tue, July 15, 2014

5-1	An Effective Transmission Power Control for Wireless Body Sensor Systems Woosik Lee, Namgi Kim (Kyonggi Univ., Korea)
5-2	Design of Panorama ePTZ with Wideangle Lens and Sensors for Bus Security J.B. Park (KT&C Co. LTD, Korea) , O.S. Lee (Multipels Co. LTD, Korea), W.C. Song (Jeju National Univ., Korea), M.G. Kang, S.C. Hong (Hanshin Univ., Korea)
5-3	A Handover Management Scheme Based on User-Preferences and Network-Centric Approach Murad Khan, Gisu Park, Wooseong Cho, Gihyuk Seong, Kijun Han (Kyungpook National Univ., Korea)
5-4	Extended OAuth 2.0 Protocol for Secure Granting of User Access Cheol-Joo Chae, Kwang-Nam Choi, Kiseok Choi, Yong-Hee Yae, YongJu Shin (KISTI, Korea)
5-5	An Improved Laser Probing System for Fault Injection Attack Young Sil Lee, HoonJae Lee (Dongseo Univ., Korea), Doo-Ho Choi (ETRI, Korea)
5-6	A Study on Malware Containment Using PageRank in Dynamic Social Networks Jong-Hwan Kong , Myung-Mook Han (Gachon Univ., Korea)

## Conference Program

| 14:00-15:20, Tue, July 15, 2014 |

### Session 6: Multimedia/Image Processing/HCI/Intelligent Systems & IoT(Internet of Things) / Machine to Machine

14:00-15:20, Tue, July 15, 2014

Chair: Prof. Hae-Duck Jeong  
(Korean Bible Univ., Korea)

6-1	IoTs: Future Potential Domains
	Saeed Khorashadizadeh, Imran Ghani (UTM, Malaysia), Seung Ryul Jeong (Kookmin Univ., Korea)
6-2	A Composition Algorithm for Data Dependency based Abstract Ubiquitous Processes
	Hyun Ahn, Kwanghoon Pio Kim (Kyonggi Univ., Korea), Minjae Park (BISTel, Inc., Korea), Ilkyeun Ra (Univ. of Colorado Denver, USA)
6-3	Knowledge-Based Optical Music Score Recognition System on Mobile Device
	Trung Quy Nguyen, Dung Phan, In Seop Na, Soo Hyung Kim (Chonnam National Univ., Korea)
6-4	Video Transfer Method for Seamless Streaming Service
	Hyeonseok Oh, Namgi Kim (Kyonggi Univ., Korea)
6-5	Triangulation Based Skeletonization of Handwritten Characters using Average Moving of Polygonal Contours
	Dung Phan, In-Seop Na, Soo-Hyung Kim, A-Ran Oh (Chonnam National Univ., Korea)
6-6	An Efficient Method for Automatic Cell Counting from Microorganism Images on Mobile Environments
	Jaejoon Seo, Jinsung Lee(Kyonggi Univ., Korea), Sudan Prasad Uprety (Tribhuvan Univ., Nepal), Junchul Chun (Kyonggi Univ., Korea)

## Conference Program

| 14:00-15:20, Tue, July 15, 2014 |

Poster Session 1 14:00-15:20, Tue, July 15, 2014		Chair: Prof. Jongsuk Ruth Lee ( KISTI., Korea)
P-1	LED Communication based Multi-hop Multimedia Data Transmission System In Cheul Park, Le The Dung, Beongku An (Hongik Univ., korea)	
P-2	Impact on participation of country to commercialization in organic solar cell Young-duk Koo (KISTI, Korea)	
P-3	Deobfuscation of Virtualization-Obfuscated Executables Seung-Tae Ha, Myung-Mook Han (Gachon Univ., Korea)	
P-4	A Study on Dynamic Trust-based Anonymization Method in Social Network Environment SangWook Jeon , Myung-Mook Han (Gachon Univ., Korea)	
P-5	Distance-based K-means Clustering for Handling Large Data Jin Sung Park, Myung-Mook Han (Gachon Univ., Korea)	
P-6	Study on the Homegateway based HEMS Application with OneM2M Residential Use M.G. Kang (Hanshin Univ., Korea), H.S. Kim, S.H. Park , K.T. Lee (KETI, Korea), C.M. Kim (Kaonmedia Co. LTD, Korea), J.W.Seo (Namseoul Univ., Korea)	
P-7	A DVB-x2 Integrated Broadcast Gateway for All-in-One Broadcasting Services Yongje Woo, Mingoo Kang (Hanshin Univ., Korea), Chulmin Kim (Kaonmedia Co. LTD, Korea), Jeongwook Seo (Namseoul Univ., Korea)	
P-8	A Lego-type UHD (Ultra High Definition) Media Platform Suggestion for Next Generation Set-top Box Hyunsik Kim, Seongwan Koo (KETI, Korea), Jongsoo Seo (Yonsei Univ., Korea), Mingoo Kang (Hanshin Univ., korea), Jeongwook Seo (Namseoul Univ., Korea)	
P -9	Real Time 3D Hand Pose Estimation Using Kinect Wonggi Kim, Junchul Chun (Kyonggi Univ., Korea)	
P -10	Energy-Efficient Tree-Based Wireless Sensor Network Routing Scheme Nguyen Duy Tan, Nguyen Dinh Viet (Univ. of Engineering and Technology, VNU, Vietnam), Minho Jo (Korea Univ., korea)	
P -11	Interference Coordination Scheme using ABS in LTE-A Enterprise Femtocell Networks Yi-Kang Kim, SiO Seo, Seok-Ho Yoon, Choong-Ho Cho (Korea Univ., Korea)	

## Conference Program

| 15:30-16:50, Tue, July 15, 2014 |

### Poster Session 2

15:30-16:50, Tue, July 15, 2014

Chair: Prof. In Kuk Song  
( Dankook Univ., Korea)

P-12	A Study on the Link Server Development Using B-Tree Structure in the Big Data Environment
	Sungbum Park, Jong Sung Hwang, and Shin Ae Shin (NIA, Korea), Sangwon Lee (Wonkwang Univ., Korea)
P-13	Gov 3.0: Concept and Strategies for the Next e-Government
	Jongsung Hwang, Sunghyun Kim, Sungbum Park, Yeonwoo Lee, Shinae Shin (NIA, Korea), Tony Kim (Cisco Consulting services, Korea), Ho Lee (Yonsei Univ., Korea)
P-14	A Study on Exploring Weak Signals Using Informetrics in Big Data Environment
	Sungbum Park, Jong Sung Hwang, Yeonwoo Lee (NIA)
P-15	Big Data in Seoul Metropolitan City Night Bus Case
	Sunghyun Kim, Shinae Shin, Jong Sung Hwang, KyeongBin Song (NIA, Korea), ChangIk Song (KT, Korea), YoungWan Kim (Seoul City Government, Korea)
P-16	Finding Industries for Big Data Usage: an AHP Approach
	Sunghyun Kim, Shinae Shin (NIA, Korea), Sangwon Lee (Wonkwang Univ., Korea), Jongki Park (VTW, Korea)
P-17	Development of a Big Data Capability Assessment Model
	Kyung-shik Shin, Sang-mi Chai, Hyun-jung Park, Nam-ok Jo (Ewha Womans Univ., Korea), Shin-Ae Shin, Sung-hyun Kim (NIA, Korea)
P-18	Big Data as a Solution to Shrinking the Shadow Economy
	Myungki Nam (NIA, Korea), Hankyung Jun (NABO, Korea)
P-19	Discovering the Essence of Korean e-Government: From the Perspective of the UN e-Government Survey
	Sunghyun Kim, Jongsung Hwang (NIA, Korea), Ho Lee (Yonsei Univ., Korea)

## Conference Program

| 15:30-16:50, Tue, July 15, 2014 |

**Session 7: Database/Data Mining/Big Data/Mobile Object  
Database & Smart Learning / Learning Contents Management  
Systems / e-Learning**  
Chair: Prof. Jaehyun Kim  
( Sungkyunkwan Univ., Korea)  
15:30-16:50, Tue, July 15, 2014

7-1	Technology Keyword-based Hybrid Analysis Method for Future Technology based on Current Technology Information Yong-Ki Kim, Kwang-Nam Choi (KISTI, Korea)
7-2	The Feature Selection Method based on Genetic Algorithm for Improvement of Text Clustering Sung-Sam Hong, Jong-Hwan Kong, Myung-Mook Han (Gachon Univ., Korea)
7-3	A Collaborative Recommendation Approach for Personalized Learning Environment Seung Ryul Jeong (Kookmin Univ., Korea), Syed Mubarak Ali, Imran Ghani (UTM, Malaysia)
7-4	Bursting the Myths of the IT Productivity Paradox: A Big Data Perspective Jongsung Hwang, Sunghyun Kim (NIA, Korea), Ho Lee (Yonsei Univ., Korea)
7-5	Selection Analysis of Databases to Manage Big Data : Cordination Plan of Big Data and NoSQL JongSung Hwang, SungBum Park (NIA, Korea), SangWon Lee (WonKwang Univ., korea), YeonWoo Lee (NIA, Korea)
7-6	Social Media Text Opinion Mining Framework for Business Intelligence Yoosin Kim (Univ. of Texas at Arlington, USA), Seung Ryul Jeong (Kookmin Univ., Korea)

## Conference Program

| 15:30-16:50, Tue, July 15, 2014 |

### Session 8: Issues of ITC and S/W Convergence

Chair: Dr. Dongmin Seo  
(KISTI, Korea)

15:30-16:50, Tue, July 15, 2014

8-1	Building a Business Knowledge Base by a Supervised Learning and Rule-Based Method Sungho Shin, Dongmin Seo, Hanmin Jung, Sa-kwang Song (KISTI, Korea)
8-2	Comparative study on disambiguating acronyms in the scientific papers using the open knowledge base Do-Heon Jeong, Jangwon Gim, Hanmin Jung (KISTI, Korea), Michaela Geierhos, Frederik Bäumer (Univ.of Paderborn,Germany)
8-3	On a Big Data-based Analytics Service System Mikyong Lee, Hanmin Jung, Minhee Cho (KISTI, Korea)
8-4	Development on Web Content Extractor based on HTML Tag Similarity Dongmin Seo, Sungho Shin, Youngmin Kim, Hanmin Jung, Sa-kwang Song (KISTI, Korea)
8-5	Design of Symptom-Collection System Supporting Natural Language Typing Hyunchul Jang, Yongtaek Oh, Anna Kim (KIOM, Korea)
8-6	ICT in Education - An ITSN Perspective Ghanshyam Khanal (ITSN)

## Conference Program

| 17:00-17:50, Tue, July 15, 2014 |

### Panel Discussion: Collaboration Between ITSN and KSII

Chair: Prof. Seung Ryul Jeong  
(Kookmin Univ., Korea)

17:00-17:50, Tue, July 15, 2014

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Junchul Chun (Kyonggi Univ., Korea)  
Imran Ghani (UTM, Malaysia)  
In Kuk Song (Dankook Univ., Korea)  
Mingoo Kang (Hanshin Univ., Korea)  
Jaehyon Kim (Sungkyunkwan Univ., Korea)  
Chandra Bilah Bhurtel (ITSN, Nepal)  
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# A Distributed Medium Access Control Protocol for Cognitive Radio Ad Hoc Networks

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## Abstract

We propose a distributed medium access control protocol for cognitive radio networks to opportunistically utilize multiple channels. Under the proposed protocol, cognitive radio nodes forecast and rank channel availability by observing primary users' activities on the channels. The proposed approach protects primary users, mitigates channel access delay, and increases network performance. We simulate and compare the proposed protocol with the existing protocol. The results show that the proposed approach utilizes channels more efficiently.

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**Keywords:** opportunistic spectrum access, cognitive radio networks, medium access control, MAC protocol

## 1. Introduction

The electromagnetic spectrum is a key resource to enlarge the radio and broadcasting industry that helps develop other industries. Demand for spectrum is increasing daily due to the innovations of new technologies and businesses. Cognitive radio networks (CRNs) came up with an idea to use unutilized spectrum in the licensed bands. Cognitive radio (CR) may play a vital role in mitigating spectrum deficit issues.

Because CRNs use channels opportunistically, the medium access control (MAC) protocol is a key factor in making the CR approach successful. In addition to other responsibilities, the MAC protocol for CRNs has one more

responsibility—it has to protect incumbent license users, also called primary users (PUs).

This paper proposes a MAC protocol for cognitive radio networks that ranks channels based on the behavioral history of incumbent licensed users. One of the main problems in CRNs is how to rendezvous and then start communications without suffering from the multi-channel hidden node problem. The proposed protocol is a common control channel-based MAC protocol that does not suffer from the multi-channel hidden node problem. The protocol also deals with efficient spectrum utilization and well-known channel allocation problems, and protects licensed users with minimum, tolerable damage (or none at all).

The remainder of this paper is organized as follows. Section 2 reviews some of the related works. Section 3 describes the proposed distributed medium access control protocol for cognitive radio ad hoc networks. Section 4 discusses simulation results and performance evaluations. Section 5 gives conclusions.

## 2. Related Work

A number of protocols have been proposed in the literature to opportunistically access spectrum using cognitive radio [1-3]. The IEEE 802.22 working group [4] already standardized a MAC layer based on CR to reuse spectrum allocated to TV broadcast services. IEEE 802.22 specifies that the network should operate point-to-multipoint. The architecture of the 802.22 MAC layer is centralized and relies on the base station. Many locations where licensed spectrum bands are underutilized lack infrastructure. Therefore, a decentralized approach can be the solution to utilize those spectrum holes, because ad-hoc networks do not require a central infrastructure.

The distributed coordinated spectrum sharing (DCSS) MAC protocol for cognitive radio [5] is a dynamic channel allocation (DCA)-based protocol. Similar to DCA [6], in DCSS, request to send (RTS) and clear to send (CTS) are exchanged before communications. RTS/CTS messages include the available data channel list. The time slot mechanism in DCSS is used to detect incumbents. However, DCA negotiates for a data channel per packet. It fully relies on a common control channel (CCC), which may incur control channel starvation. In DCA-based protocols, the CCC can be a bottleneck when too much control information is sent over this channel. All nodes need to contend for access to the control channel, and the data channels remain underutilized [7]. The maximum number of channels that can be fully utilized using DCA-based protocols is around  $L_d/3L_c$ , where  $L_d$  is the data packet size and  $L_c$  is the control packet size.

A group-based DCA protocol was proposed by Zhang et al. [8]. This protocol divides the channels into several groups. Each group has one CCC and several data channels. Unlike traditional DCA, they exchange control

information over several channels simultaneously, so it mitigates the early CCC starvation problem.

A multichannel MAC protocol for cognitive radio (MMAC-CR) was proposed by Timmers et al. [9]. This is a single transceiver-based protocol. As in the 802.11 power-saving mode (PSM) standard [10], under the MMAC-CR protocol, time is divided into the ad hoc traffic indication message (ATIM) window and the data window (DW). In ATIM windows, control packets for channel negotiation and channel reservation are transferred, and in data windows, data packets are transferred. Similar to MMAC-CR, an energy-efficient cognitive radio MAC protocol for quality of service (QoS) provisioning [11] was proposed. This is also a single transceiver-based protocol. All these protocols waste channel bandwidth during channel negotiation time (i.e. the ATIM window). Nodes neither send nor receive data packets during this time. Hence, it wastes all data channels' bandwidth.

These protocols have to switch channels multiple times. There is no mechanism to detect the primary user's arrival in the channel after the channel negotiation period. These protocols can also suffer from the multi-channel hidden node problem.

We extended MMAC-CR with PU-behavior estimation and ranking of channels. Furthermore, the proposed protocol also utilizes the ATIM window for data communication opportunities that otherwise go to waste under MMAC-CR.

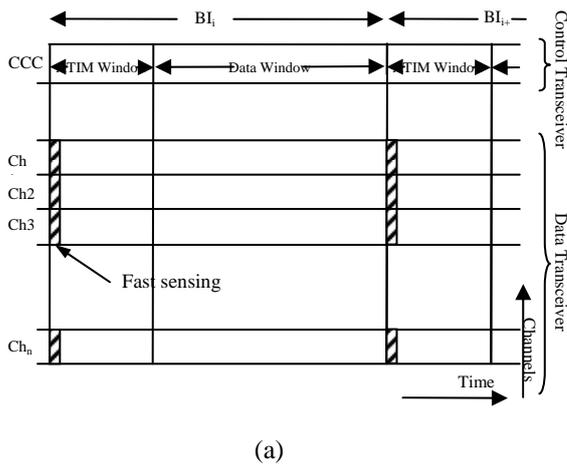
## 3. Proposed Protocol

We assume that each CR device is equipped with two transceivers. One is for the control channel and another for data channels. There are  $\{Ch/Chi, i=1,2,\dots, N\}$  non-overlapping licensed channels. These channels are conditionally and opportunistically accessible by secondary users (SU) and are called data channels.

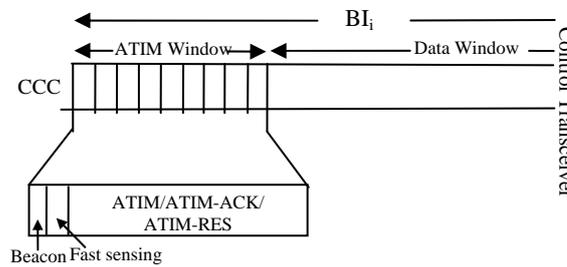
We further assume that a common control channel is available with all the required qualities for reliable communications at all times. The CCC is free from interference by the incumbents and is mainly used for control packet exchange. This channel is common to all SU

nodes in the network.

The SUs in the network synchronize and share channel sensing information with other SUs. Synchronization is similar to the 802.11 time synchronization function (TSF) [10]. Time is divided into beacon intervals, and each beacon interval (BI) is further divided into a channel negotiation window (or ATIM window) and a data communications window. Each SU maintains a table to record the status of the channels by sensing each channel and overhearing channel negotiation messages from the neighbors. There are two kinds of sensing: fast sensing and fine sensing. Fast sensing is done at the beginning of each ATIM window and in the middle of the BI, as shown in Fig. 1 (a).



(a)



(b)

**Fig. 1.** Structure of the proposed protocol. (a) BIs, ATIM windows, the data window and sensing periods. (b) ATIM window model.

Fast sensing takes a very short time and gives one of three results: (a) the channel is busy, (b) the channel is idle and (c) the status is uncertain. If there are no data to send or receive, the data transceiver starts fine sensing. This takes a long time and gives one of two results: (a) the channel is busy, (b) the channel is idle.

In the channel negotiation window, nodes negotiate for the channels by sending over the CCC a list of the idle data channels available for communications, as shown in Fig. 1(b).

Channel selection is carried out based on the history of incumbents' behavior on the channel over a period of time. Using the data recorded in the channel status table, SUs estimate the channels' status based on the multiplicative seasonal model for the next time slot. In the real world, availability of the channel is seasonal. For example, if we consider mobile phone bands as primary licensed spectrum, most of the channels are busy during business hours, particularly between 8:00 am to 10:00 am and 4:00 pm to 6:00 pm. Therefore, we used Winters' method [12, 13] to estimate the status of the channels. SUs start estimation only after a period of  $m$  seasons. This is because Winters' method requires initial values of the parameters  $\hat{a}_1(0), \hat{b}_2(0)$  and  $\hat{s}_1(0)$  for  $t=1, 2, 3, \dots, L$ , where,  $L$  is the length of the total season, that is,

$$L = \sum_1^L s_t, \hat{a}_1(t) \text{ is a permanent component,}$$

$$\hat{b}_2(t) \text{ is a trend component, and } \hat{s}_1(t) \text{ is a multiplicative seasonal factor.}$$

Let  $\bar{x}_j, j = 1, 2, 3, \dots, m$  be the average of the observations during the  $j^{\text{th}}$  session. The forecast for channel  $i$  at time  $t_i$  for a desired season  $\hat{c}_i(t_i)$  can be obtained with

$$\hat{c}_i(t_i) = \left[ \hat{a}_1(t_i) + \hat{b}_2(t_i) \right] \hat{s}_1(t_i) \quad (1)$$

Here,  $t_i = 0$  at the start of the first period. Permanent component  $\hat{a}_1(t_i)$ , and trend component  $\hat{b}_2(t_i)$  can be estimated as

$$\hat{b}_2(t_i) = \frac{\bar{x}_m - \bar{x}_1}{(m-1)L} \quad (2)$$

$$\hat{a}_1(t_i) = \bar{x}_1 - \frac{L}{2} \hat{b}_2(0) \quad (3)$$

$\hat{s}_1(\dots)$  are computed for each time period  $t=1, 2, \dots, mL$ , as the ratio of the actual observation to the average seasonally adjusted value for that season, further adjusted by the trend; that is,

$$\hat{s}(t) = \frac{x_t}{\bar{x}_i - \left[ \frac{(L+1)}{2} - j \right] \hat{b}_2(0)} \quad (4)$$

$t = 1, 2, 3, \dots, mL$

Eq. (4) produces  $m$  estimates of the seasonal factor for each period.

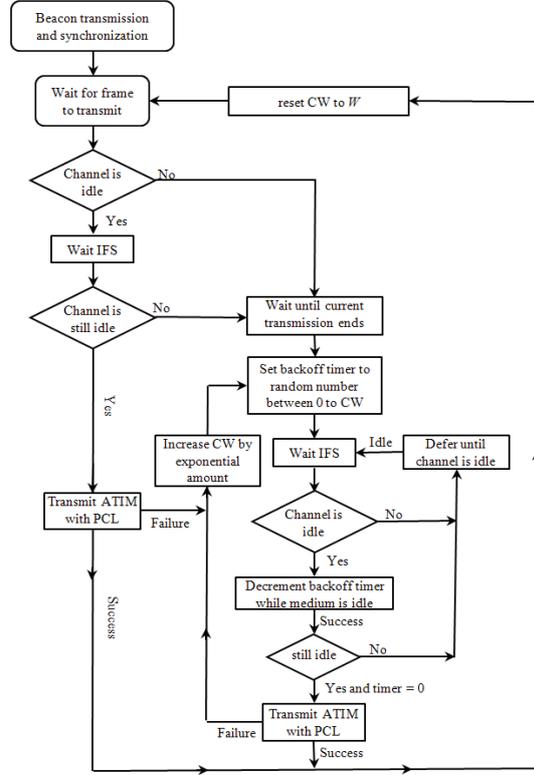
Based on these forecasts, SUs rank channels as - larger the forecasted idle period; the higher the ranking of the channel in the season. These channel rankings are used to prepare a preferred channel list (PCL).

When an SU receives a channel negotiation message along with a PCL, the SU sends back acknowledgement (ATIM-ACK) with a common data channel.

This common data channel is the highest ranked channel between sender and receiver nodes. Finally, the sender SU node sends a channel reservation message (ATIM-RES) to inform the receiver, including neighbors. A flowchart of the sending procedure of the ATIM packets with the PCL is shown in Fig. 2.

After successful channel negotiation, SUs exchange RTS/CTS before sending actual data packets to avoid the hidden terminal and exposed terminal problem. The SUs send data packets, as in the 802.11 distributed coordination function (DCF) [10].

In the middle of the BI, SUs pause their transmission and fast-sense the channel; if they sense the incumbent user's activity on the channel currently used by SUs, the SUs stop sending packets immediately and send an emergency control message in the CCC and handoff spectrum.



**Fig. 2.** Flowchart of the ATIM packets with the PCL sending procedure.

The control transceiver wakes up just before the fast sensing ends in the middle of data window to send the emergency control message and renegotiate for data channels. It enters the sleep state after the channel negotiation window. The data transceiver is turned off if the SU has no data to send or receive and no fine sensing to do.

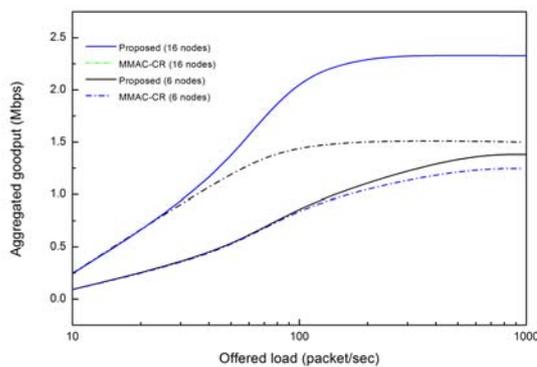
#### 4. Performance Evaluation

We simulated the proposed protocol using ns-2 [14] with a common control channel and six data channels of 2 Mbps. The transmission range of the nodes was approximately 250 m. The constant bit rate (CBR) traffic with the offered load varied from 10 packets per second to 1000 packets per second. The channel switching delay was 224 s. We considered the ON/OFF channel usage model. The BI was set to 100 ms and the ATIM window size was 1/4 of the data window size. We compared the aggregated goodput and average packet delay of the proposed protocol

against MMAC-CR with various node densities and offered loads.

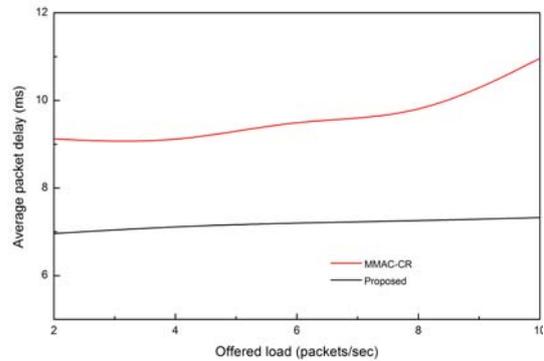
Fig. 3 shows the comparison of aggregated goodput of the proposed protocol with the offered loads varying from 10 packets per second to 1000 packets per second. We compared 6-node and 16-node scenarios.

They reached a saturation point at similar offered rates when there is only six nodes. However, MMAC-CR becomes saturated earlier, and goodput is much lower than our proposed protocol. This is because the proposed protocol selects a channel according to the PU's behavior in the channel. It senses the channel in the middle of the beacon interval and reconnects broken links if possible. It sends data just after channel negotiation and utilizes data channels even during the ATIM window, whereas MMAC-CR, which is a single transceiver-based protocol, cannot do the same. Furthermore, the proposed protocol selects a channel that is less prone to claim by the PUs. Therefore, it incurs less interference from the PUs, which helps increase goodput.



**Fig. 3.** Aggregated goodput at different offered loads with different node densities.

Fig. 4 shows the average packet delay in the three-channel six-node scenario. The proposed protocol has a shorter delay than MMAC-CR due to its strategy of not waiting to finish the ATIM window before transmitting data. The transceiver under MMAC-CR has to stay in the CCC for the entire ATIM period, even if there is no packet to send or receive. It also has to stay in the CCC for the entire ATIM period after negotiation for the channel.



**Fig. 4.** Average packet delay in the six-node scenario.

The proposed protocol starts data transmission just after successful channel negotiation. Also, channel ranking and selection strategies play a vital role in decreasing average packet delay.

## 5. Conclusions

In this paper, we present a distributed multi-channel MAC protocol for cognitive radio ad hoc networks. We compare the performance of the multi-channel MAC protocol with the existing protocol under various offered loads and node densities. MMAC-CR cannot utilize data channels during the ATIM window. It is difficult to observe emergency control messages and renegotiate for a data channel after the incumbent user claims the channel under MMAC-CR. In the proposed protocol, SUs can send and receive data packets even during ATIM windows and can reconnect broken links. Therefore, the proposed protocol efficiently utilizes white space. The simulation results show that the proposed protocol achieves better aggregated goodput and lower delay.

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