Program Book

20TH INTERNATIONAL SYMPOSIUM ON WIRELESS PERSONAL MULTIMEDIA COMMUNICATIONS (WPMC 2017)

December 17-20, 2017
Royal Ambarrukmo Hotel
Yogyakarta-Indonesia

Organizers & Sponsors:

Supported by:
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About WPMC 2017

The 20th International Symposium on Wireless Personal Multimedia Communications (WPMC 2017) will be held at Yogyakarta, Indonesia from the 17th to the 20th of December, 2017. The theme of this year’s conference is Interconnecting Wireless Personal Multimedia Communications. In addition to high-quality technical sessions, the symposium will feature exciting keynotes, tutorials and workshops. It will also offer a fantastic social program.

WPMC 2017 is technically sponsored by IEEE ComSoc. Accepted papers will be published in the WPMC 2017 Conference Proceedings. Presented papers will be submitted to publish in IEEE Xplore. All published papers in IEEE Xplore will be normally indexed by Scopus SciVerse.

The WPMC symposia series were inaugurated in 1998, as a global platform which aims at enabling collaboration in the field of wireless information. Held in Asia, Europe and America, WPMC has established itself as a unique global conference dedicated to wireless multimedia convergence. Continuing the series, the 20th International Symposium on Wireless Personal Multimedia Communications will be held for the first time in Indonesia.
Welcome Message From General Chair of WPMC 2017

Greetings!

On behalf of the Local Organizing Committee, it is my great pleasure and honor to welcome you to WPMC-2017, the 20th International Symposium on Wireless Personal Multimedia Communications; and also to our beautiful Yogyakarta, the center of Javanese arts and culture. This event provides us good opportunities to exchange knowledge and information on the latest researches, strengthening relationships amongst us, as well as a perfect time to enjoy the relaxing yet entertaining environment of Yogyakarta.

Inaugurated in 1998, WPMC has been established as a global platform for mutual cooperation and discussions in the field of wireless multimedia communications. Held in Asia, Europe and America, WPMC has established itself as a unique global conference dedicated to wireless multimedia convergence. Continuing the series, the 20th WPMC is now, for the first time, held in Indonesia, where it was planned to be held in Bali, but due to some concern of volcano activity, it is moved to Yogyakarta.

Various advance technologies in the wireless multimedia communication field, started to put the intelligences in many segments and subsystems of a communication system. Novel methodologies and approaches are introduced to achieve higher level of communication quality of service. Nevertheless, human life and quality of experience is still a very important aspect to be considered in each development of technologies, including communication technology.

We have also witnessed the rise of broad smart digital technologies on the devices, sensors, networks, controls and not to mentions millions of applications. Those smart technologies spun from computing, broadcasting and media, platforms, applications and contents, big data & data-mining, advertising and social media. Accordingly, under the theme of “Interconnecting Wireless Personal Multimedia Communications”, WPMC 2017 will provide good opportunity for us to discuss these advancements.

In this WPMC-2017, the event is locally organized by IEEE Communication Society Indonesia Chapter, and Telkom University, and we are more than happy to support the NICT, YRP and WPMC Steering Committees members. Finally, we hope all participants will have valuable and also enjoyable experience during this event. Looking forward to see you all in Yogyakarta.

General Chair,

Dr. Wiseto Agung
Telkom Indonesia
Welcome Message From President of NICT

It is my great pleasure to host the 20th International Symposium on Wireless Personal Multimedia Communications (WPMC2017) in ancient city, Yogyakarta, Indonesia.

In recent years, not only terminal equipment such as PCs and smart phones but also IoT (Internet of Things) environment, where everything existing around us is connected to the network, will be established and various connected services are about to be realized. With newly introduced services based on collected data, innovation occurs and creates new value in our society. With new information and communication technologies (ICTs), the cyber space has been further expanded and the integration with the real space has progressed rapidly, and a cyber-physical space that is a new living space will be formed.

Under these circumstances, the whole social system is being pressed for the need to change to a form suitable for cyber-physical space. To respond such a paradigm shift, wireless technology that can connect everything must be an important element for realizing smart ICT applications. The National Institute of Information and Communications Technology (NICT) is trying to realize a convenient and safe social system by new "wireless connecting" technologies, which is one of topics of WPMC.

During this symposium I hope that all participants enjoy the tutorials, technical presentations and social events, as well as related discussions and experiences at Yogyakarta, and that the symposium enables participants to extend their own personal networks.

I would like to sincerely thank all supporting committee members and staff of WPMC2017.

Hideyuki Tokuda,
President, National Institute of Information and Communications Technology, Japan
Welcome Message From Chairman of YRP R&D Promotion Committee

On behalf of YRP R&D Promotion Committee, one of the co-organizers of the 20th International Symposium on Wireless Personal Multimedia Communications (WPMC 2017), it is my pleasure and privilege to welcome you here in this historic city, Yogyakarta, Indonesia.

The first WPMC was held in 1998 in Yokosuka Research Park (YRP), Japan, under the strong leadership of the current National Institute of Information and Communications Technology (NICT). Established as an R&D site specially focused on radio and telecommunications technology, YRP has attracted great attentions of key representatives and researchers in this field, and one of the missions for us is to promote and accelerate international collaboration.

WPMC has long served as an important platform for researchers’ international exchange, and we are very glad that the WPMC 2017 will be held in Indonesia for the first time in its history, and we are truly grateful to the members of Organizing Committee, especially to the WPMC General Chair and TPC Chair, who had undoubtedly greatly contributed to enable this exciting event.

I hope that WPMC2017 will be fruitful and enjoyable to all participants.

Prof. Dr. Mitsutoshi Hatori
Chairman of YRP R&D Promotion Committee
Welcome Message From Co-chair of WPMC Steering Board

It is my great pleasure and honor to welcome you to participate in the Twenties International Symposium on Wireless Personal Multimedia Communications (WPMC 2017) in Yogyakarta, Indonesia as a co-chair of the WPMC Steering Board.

The series of WPMC symposium started from Yokosuka, Japan in 1998 and have been held in Asia, Europe, north and south America. When the first WPMC is held in 1998, the main discussion topics were toward Wireless Personal “Multimedia” Communications. After twenty years, the word “Multi-media by wireless” is naturally accepted like water or air, and the trend is moving to “Multi-device by wireless” operated society. The “Multi-device” includes not only wireless devices belong to human being but also robot, drone, meter, monitor, sensor and so on. The “Multi-device” co-work together and provide new values toward the new reliable and secure society. I believe that our WPMC continues to be a key symposium to establish such new society.

To start the new society development, our WPMC has decided the venue in Indonesia because Indonesia has evolved at a rapid pace and is the one of the key countries in the era of new society. I am very pleased for the decision and believe that all participants of this symposium gain and share many new views and thoughts in WPMC 2017.

Finally I would like to express my cordial thanks to all committee members and staffs of WPMC2016, especially for Conference Chair, Dr. Wiseto Agung, PT.Telkom Indonesia, Conference Vice Chairs, Professor Muhammad Ary Murti, Telkom University, Indonesia, Mr. Arief Hamdani Gunawan, PT.Telkom Indonesia and TPC Chair, Dr Rina Pudji Astuti, IEEE ComSoc Indonesia Chapter, respectively.

Prof. Dr. Hiroshi Harada
Co-chair of WPMC Steering Board
Professor, Graduate School of Informatics, Kyoto University
Welcome Message From Co-chair of WPMC Steering Board

I Welcome to Yogyakarta, Indonesia to join WPMC2017.

On behalf of the Steering Board of WPMC, I would like to express my deep gratitude to all the delegates for coming from all over the world, and expect you will be having exciting experiences at WPMC2017 in beautiful historical city, Yogyakarta, Indonesia.

The WPMC2017 is the 20th WPMC held for the first time in Indonesia, one of the most fantastic and attractive countries in the world.

The WPMC was inaugurated in 1998 to establish a global platform for mutual cooperation and discussions in the field of wireless multimedia communications with a strong financial supports by National Institute of Information and Communications Technology (NICT). The first WPMC was held at Yokosuka Research Park (YRP) in Japan in honor of the opening of YRP in 1997.

Since the first WPMC in YRP, the last nineteen WPMCs were held through all over the world in Asia, Europe, North and South Americas. With the continued and strong support by numerous organizations and human relationships, the WPMC has grown into an international symposium widely recognized by industries and academic societies.

I wish to take this opportunity to thank all supporting committee members and staffs of WPMC2017, especially for Conference Chair, Dr. Wiseto Agung, PT. Telekomunikasi Indonesia, Vice Chairs Lecturer Muhammad Ary Murti, Telekom University, and Arief Hamdani Gunawan, PT. Telkom, Indonesia, and TPC Chair Dr Rina Pudji Astuti, IEEE ComSoc Indonesia Chapter, respectively.

Dr. Shingo Ohmori
Co-chair of WPMC Steering Board
Vice President, YRP R&D Promotion Committee
President, YRP International Alliance Institute
Welcome Message From Co-chair of WPMC Steering Board

As a Steering Committee Co-Chair, it is my great pleasure to welcome you warmly to the lively and impressive city of Yogyakarta, the cultural capital of Java, Indonesia, the host of the 20th International Symposium on Wireless Personal Multimedia Communications (WPMC), during December 17-20, 2017. The theme for this year’s event will be on the topic of interconnecting wireless personal multimedia communications.

Current information and communication technologies (ICT) development is about smart connectivity regardless of the coverage range and it spans a huge range of use cases that scale from a single constrained device up to massive cross-platform deployments of embedded technologies and cloud systems connecting in real-time. The human user is at the center of each scenario, requiring a myriad of technologies to interconnect and interwork to enable highly personalized services and applications. Large-scale and dense human-centric smart connectivity, in all its complexity, can be used to extract the new industrial value proposition.

The vision of WPMC2017 demands inter- and cross-disciplinary approach and the symposium would bring together the various stakeholders, researchers, industrial and standardization and policy experts to focus on both the technological and human aspect arising from that vision.

The WPMC2017 program features an unusually distinguished group of keynote and invited speakers, as well as a strong technical program with novel research contributions from the relevant thematic areas from all over the world. In addition, an extensive list of social events have been scheduled to allow for a break from the exciting technical sessions. Please, take the advantage of the many opportunities to network and expand your technical and cultural horizons.

I would like to extend my appreciation to the WPMC2017 General Chair, TPC Chair and Organizing Committee for their dedication and effort to put together a strong event.

Prof. Ramjee Prasad,
Steering Committee Co-Chair
Professor, Aarhus University, Denmark
Welcome Message From TPC Chair of WPMC 2017

It is a great honor for all of us to host the WPMC 2017, the 20th International Symposium on Wireless Personal Multimedia Communications, in Yogyakarta, in which high qualified papers in the field of advanced information and communication technologies and multimedia applications, under the theme of “Interconnecting Wireless Personal Multimedia Communications”, will be presented. The conference received 243 papers from 724 authors of 35 countries. Through high qualification of reviewing and tight registration processes 116 papers from 510 authors of 26 countries were accepted. The acceptance ratio of these high qualified papers is 52.26%.

Research in advanced information and communication technologies, multimedia applications, and communications networks with advanced technologies are very important since it brings us insights into new engineering solutions that may influence our life. This event represents a great achievement in topics of interest. Best contributors from excellent laboratories and schools throughout the world came to this conference to precipitate and contribute their finest works. Therefore, this conference becomes the landmark for engineering society to express their thoughts and skills in finding the best algorithms or modern mathematical modeling for the future technology. Not only that the we are hosting the presentations of high qualified papers, the conference is also supported by 3 experts in tutorial sessions and 6 distinguished keynote speakers.

On behalf of IEEE Communication Society Indonesia Chapter and Telkom University, I would like to express my sincere gratitude to 411 technical program committee (TPC) who supported the review process and thus enable us to present high qualified conference in communications technology. Welcome to Yogyakarta, I hope that you enjoy the foods, graceful palace, arts, tropical beauties and the rich Yogyakarta’s culture. I hope that the fruitful discussions and exchange of ideas between researchers during the conference will yield new technological innovations contributing to a better life for humans in the coming decades.

TPC Chair,

Dr. Rina Pudji Astuti
Telkom University, Indonesia
Chair of IEEE Communications Society Indonesia Chapter
# Program at a Glance

## Sunday, December 17, 2017

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>12.00 - 20.00</td>
<td>Registration (Lobby Hotel)</td>
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<tr>
<td>13.00 - 15.00</td>
<td>Tutorial</td>
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<td>15.00 - 15.30</td>
<td>Coffee Break</td>
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<tr>
<td>15.30 - 17.00</td>
<td>Tutorial</td>
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<td>17.30 - 20.00</td>
<td>Welcome Reception (at GADRI)</td>
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## Monday, December 18, 2017

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<thead>
<tr>
<th>Time</th>
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<th>Trajumas 1</th>
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<td>08.00 - 17.00</td>
<td>Registration (2nd Floor)</td>
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<td>08.30 - 08.45</td>
<td>Safety Conduct (Ballroom: Kasultanan 2)</td>
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<tr>
<td>08.45 - 09.45</td>
<td>Opening + Welcome Speech (Ballroom: Kasultanan 2)</td>
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<tr>
<td>09.45 - 10.45</td>
<td>Keynote Session 1 (Ballroom: Kasultanan 2) - Prof. Ramjee Prasad</td>
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<tr>
<td>10.45 - 11.15</td>
<td>Coffee Break</td>
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<tr>
<td>11.15 - 12.45</td>
<td>Keynote Session 2 (Ballroom: Kasultanan 2) - Prof. Milica Pejanovic-Durisicas - Komang Budi Aryasa</td>
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<tr>
<td>12.45 - 13.45</td>
<td>Lunch (Kencana)</td>
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<tr>
<td>13.45 - 15.15</td>
<td>NICT Session 1</td>
<td>WCPHY 1</td>
<td>WCPHY 2</td>
<td>SPC</td>
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<td>15.15 - 15.45</td>
<td>Coffee Break</td>
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<tr>
<td>15.45 - 17.15</td>
<td>WN 1</td>
<td>WCPHY 3</td>
<td>WCPHY 4</td>
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# Program at a Glance

## Tuesday, December 19, 2017

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<tr>
<td>08.30 - 10.00</td>
<td>Keynote Session 3 (Ballroom: Kasultanan 2) - Prof. Ryuji Kohno - Prof. Ren Ping Liu</td>
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<td>10.30 - 11.00</td>
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<tr>
<td>11.00 - 12.30</td>
<td>NICT Session 2</td>
<td>WCPHY 5</td>
<td>WCPHY 6</td>
<td>WN 2</td>
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<tr>
<td>13.30 - 15.00</td>
<td>NICT Session 3</td>
<td>WCPHY 7</td>
<td>WCPHY 8</td>
<td>WN 3</td>
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<td>15.00 - 15.30</td>
<td>Coffee Break</td>
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<td>15.30 - 17.00</td>
<td>UAV Emergency</td>
<td>T Special Session</td>
<td>Poster Session (Kencana)</td>
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<tr>
<td>18.00 - 21.00</td>
<td>Gala Dinner / Awards Ceremony (PENDOPO Area)</td>
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## Wednesday, December 20, 2017

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<td>WCPHY 10</td>
<td>WN 4</td>
<td>CSMA 1</td>
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<td>09.30 - 10.00</td>
<td>Coffee Break</td>
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<tr>
<td>10.00 - 11.00</td>
<td>Keynote Session 4 (Kasultanan 1) - Dr. Kohei Sato</td>
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<tr>
<td>11.00 - 12.30</td>
<td>WCPHY 11</td>
<td>WCPHY 12</td>
<td>WN 5</td>
<td>CSMA 2</td>
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<td>12.30 - 13.30</td>
<td>Lunch (Kencana)</td>
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<tr>
<td>13.30 - 17.00</td>
<td>TOUR: Prambanan Temple</td>
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Keynote Speakers

Dr. Ramjee Prasad
(Professor of FT4BI, Department of Business Development and Technology, Aarhus University, Herning, Denmark)

Short Bio: Dr. Ramjee Prasad, Fellow IEEE, IET, IETE, and WWRF, is a Professor of Future Technologies for Business Ecosystem Innovation (FT4BI) in the Department of Business Development and Technology, Aarhus University, Herning, Denmark. He is the Founder President of the CTIF Global Capsule (CGC). He is also the Founder Chairman of the Global ICT Standardisation Forum for India, established in 2009. GISFI has the purpose of increasing the collaboration between European, Indian, Japanese, North-American and other worldwide standardization activities in the area of Information and Communication Technology (ICT) and related application areas.

He has been honored by the University of Rome "Tor Vergata", Italy as a Distinguished Professor of the Department of Clinical Sciences and Translational Medicine on March 15, 2016. He is Honorary Professor of University of Cape Town, South Africa, and University of KwaZulu-Natal, South Africa. He has received Ridderkorset af Dannebrogordenen (Knight of the Dannebrog) in 2010 from the Danish Queen for the internationalization of top-class telecommunication research and education.

He has received several international awards such as: IEEE Communications Society Wireless Communications Technical Committee Recognition Award in 2003 for making contribution in the field of “Personal, Wireless and Mobile Systems and Networks”, Telenor's Research Award in 2005 for impressive merits, both academic and organizational within the field of wireless and personal communication, 2014 IEEE AESS Outstanding Organizational Leadership Award for: “Organizational Leadership in developing and globalizing the CTIF (Center for TeleInfrastruktur) Research Network”, and so on.

He has been Project Coordinator of several EC projects namely, MAGNET, MAGNET Beyond, eWALL and so on. He has published more than 40 books, 1000 plus journal and conference publications, more than 15 patents, over 100 PhD Graduates and larger number of Masters (over 250). Several of his students are today worldwide telecommunication leaders themselves.

“Future Wireless Communication Era”

Abstract: Ever since Mobile Wireless Communications came into existence, it is undergoing various generations, with each generation adding a new dimension to its paradigm. Starting from mere paging text to high definition data streaming, the MWC has seen several stages of developments in technology, and applications. With strong development in communication devices, present day MWC support exchange of information in voice, image and video that are being used for broad spectrum of human oriented applications. For its profoundly large canvas that we are witnessing today, MWC shall not be confined to generation-wise development in the future, rather shall encompass all fields of communications to come under one umbrella, termed as Future Wireless Communication Era or FWCE. This talk shall provide the glimpses of the FWCE and its realization from both present and future perspective.
environment, learning by positivi
market, considerably improved awareness of the importance of start
sectors, two
number of IPs, new ICT based applications and services bringing innovative solutions in
Positive effects of the adopted approach are already visible: excellent scientific results verified through a
bio economy, blue growth, b
and utilizing R&I potentials, bringing innovative ICT
industry
industries
developing knowledge
research institutions that creates a specific innovative ecosyste
University of Montenegro as the first CoE in the country. It is a unique consortium, involving excellent national
innovation society. Montene
countries, is related with the creation of centres of excellence (CoE) as a driver for a successful and creative
In parallel with adapting the regulatory framework, one of the solutions, that has been implemented in some
activities, enabling wide collaboration in a connected community consisting of academia, government
organization
tool, creating an environment for the productive collaboration between
communication and networks, being the author of four books and many strategic studies. She has published
more than 200 scientific papers in peer-reviewed international and national journals and conference
proceedings, being the author of four books and a number of book chapters. Her main research interests are:
wireless communications, 5G wireless networks, wireless IoT, cooperative and energy efficient transmission
techniques, ICT trends and applications, optimization of telecommunication development policy.

Prof. Pejanović-Djurisić has considerable industry and operating experiences working as industry consultant (Ericsson, Siemens) and Telecom Montenegro Chairman of the Board. She has been in charge of wireless networks design and implementation in Montenegro and in the region of SEEurope. Prof. Pejanović-Djurisić has been leading and coordinating many internationally and EU funded ICT projects and initiatives. She is a member of IEEE and IEICE, with a long engagement in the field of telecommunication regulation and standardization. Thus, in addition to work on national and regional levels, she has participated, in cooperation with ITU, in a number of missions and activities related with regulation issues, development strategies and new technological solutions.

“Future technologies for fostering innovation based research”

Abstract: Bridging the gap between research and commercialization represents a challenge, both for academic community and the industry. Mechanisms for making the most of its innovation talents and potentials are constantly sought. A number of initiatives are created aiming at developing ecosystem where innovation will be an open process for the creation of new knowledge, which will further on be commercialized strengthening entrepreneurship across all society sectors.

However, many countries are still considerably lagging behind. Very often, this is not due to the lack of innovation potential, as individuals’ innovation outcomes are present but remain unnoticed and consequently not known to the industry. High-tech start-ups in these countries meet many challenges as there are no incentives in legal frameworks, financing problems are present in early stage of technology and business, the market’s rules are not clear and they don’t provide security for the companies. That is why it becomes necessary to recognize mechanisms and tools for creating environment which will foster innovative dimension of R&D activities, enabling wide collaboration in a connected community consisting of academia, government institutions and agencies, industry, SMEs and entrepreneurs, investors…

In parallel with adapting the regulatory framework, one of the solutions, that has been implemented in some countries, is related with the creation of centres of excellence (CoE) as a driver for a successful and creative innovation society. Montenegro is among those with its BIO-ICT CoE in BioInformatics established at the University of Montenegro as the first CoE in the country. It is a unique consortium, involving excellent national research institutions that creates a specific innovative ecosystem focused on development and implementation of novel bioinformatics technologies. All stakeholders are working together with the goal to contribute in developing knowledge-based economy, creating an environment for the productive collaboration between industry, academia and governmental agencies. The mentioned uniqueness has been directed towards unlocking and utilizing R&I potentials, bringing innovative ICT-based solutions in various bioeconomy sectors, related to sustainable food security, blue growth, bio-based innovation for sustainable goods and services.

Positive effects of the adopted approach are already visible: excellent scientific results verified through a number of IPs, new ICT based applications and services bringing innovative solutions in various bioeconomy sectors, two-way collaboration with business partners and SMEs, acquired new skills in business and the market, considerably improved awareness of the importance of start-ups, creation of entrepreneurial environment, learning by positive examples as well as through networking.
Komang Budi Aryasa  
(DEPUTY EGM Digital Service Division, PT Telekomunikasi Indonesia)

Short Bio: He is able to influence the strategic direction of the company by identifying ICT research area and identifying opportunities in large, rich data sets and implementing data driven strategies that fuel growth including revenue and profits. He is a doctorate candidate in strategic management in University of Indonesia. He works heavily on modeling to design and implement statistical / predictive models utilizing diverse sources of data to predict churn, demand, risk and generate lead sales. Before he works in research and big data, he also involved in many projects related to new digital product development such as digital music, e-commerce, online games, IPTV, over the top TV.

Opportunities & Challenges of Digital Telco:  
“Building a digital-age ready operator”

Abstract: The telecommunication industry has been critical in the presence of digital substitutes product. The digital is reality and changing everything. The core voice and messaging businesses continue to decline because social media is opening up new communications channels. A radical transformation is required. However, digital offers telecom companies an opportunity to rebuild their market positions, reimagine their business and create innovative offerings for customers. The digital-age ready operators are customer centric, agile and innovation driven. Telcos need to transform becoming ‘digital telco’. It is the strategy how operators can use digital technology to transform not only the way they interact with their consumers but also how to develop products and services to enable the digital transformation. They manage to integrate customer data from various communication channels to offer a great customer experience. Then, they use this data to offer customers the products and services they need. Analytics sit as a real core of this transformation which is not possible without a deep transformation of the network, IT and change in organization and culture.
Prof. Ryuji Kohno
(Director, Centre of Medical Information and Communication Technology, Professor, Division of Physics, Electrical & Computer Engineering, Yokohama National University, Japan)

Short Bio: Ryuji Kohno received the Ph.D. degree from the University of Tokyo in 1984. Since 1998 he has been a Professor and the Director of Centre on Medical Information and Communication Technology, in Yokohama National University in Japan. In his currier he was a director of Advanced Telecommunications Laboratory of SONY CSL during 1998-2002, directors of UWB Technology and medical ICT institutes of NICT during 2002-2012. Since 2012 he is CEO of University of Oulu Research Institute Japan – CWC-Nippon Co. Since 2007 he has been a Distinguished Professor in University of Oulu and since 2014 a director of Kanagawa Medical Device Regulatory Science Centre. He was a member of the Board of Governors of IEEE Information Theory Society in 2000-2009, and editors of IEEE Transactions on Communications, Information Theory, and ITS. He was Vice-president of Engineering Sciences Society of IEICE during 2004-2005, Editor-in chief of the IEICE Trans. Fundamentals during 2003-2005.

"Wireless Dependable IoT/M2M for Medical Healthcare and Disaster Rescue" - Reliable Machine Centric Sensing and Controlling for Industry 4.0 -

Abstract: Wireless body area network (BAN) has been researched and developed for ubiquitous and remote medicine and its international standard IEEE802.15.6 was established in February, 2012. In order to find missing victims and sense their vital sign at disaster spots, highly reliable and secure, i.e. dependable BAN can be applicable to a body of robots, cars, UAVs (Unmanned Aerial Vehicle) like drones as well as a human body for dependable machine to machine (M2M) sensing and controlling. Such a M2M network can be called as "BAN of Things" like Internet of Things (IoT). Around disaster areas unexpected obstacles and complicated radio propagation tend to prevent accurate ranging and positioning, and reliable vital data sensing. To perform precise localization and robust data communications by BAN, dependable radio technologies such as ultra wide band (UWB) radio, array antenna and error-controlling codes in physical layer must be jointly optimized with MAC, Network, and application layers. Even after BAN has been developed and standardized in global, regulatory science must be keen to guarantee safety, reliability and security to be compliant for regulation. This talk will introduce research and development, standard and regulatory compliance of dependable wireless BAN for disaster rescue and medical healthcare using UWB ranging and communication. The joint Japan and New Zealand project on remote sensing and controlling multiple UAVs to locate casualties in natural disasters such as earthquakes will be also introduced. The research has two objectives, one being to use UAVs to locate people under rubble, the other to collect information that is constrained in the BANs those people are wearing. IEEE802.15 international new standard group of dependable wireless networks IEEE802.15 IG-Dependability has been chaired by the speaker.
**Prof. Ren Ping Liu**  
(Head of Discipline, Network and Cyber Security, School of Electrical and Data Engineering, University of Technology Sydney)

**Short Bio : Ren Ping Liu** is a Professor and Head of Discipline, Network and Cyber Security at the School of Electrical and Data Engineering in University of Technology Sydney. He is also the Research Program Leader of the Digital Agrifood Technologies in Food Agility CRC, a government/research/industry initiative to empower Australia's food industry through digital transformation. Prior to that he was a Principal Scientist and Research Leader at CSIRO, where he led wireless networking research activities. Professor Liu was the winner of Australian Engineering Innovation Award and CSIRO Chairman medal. He specialises in protocol design and modelling, and has delivered networking solutions to a number of government agencies and industry customers. His research interests include 5G, VANET, IoT, security, and Blockchain. Professor Liu has over 100 research publications, and has supervised over 30 PhD students.

Professor Liu is the founding chair of IEEE NSW VTS Chapter and a Senior Member of IEEE. He served as Technical Program Committee chairs and Organising Committee chairs in a number of IEEE Conferences. Ren Ping Liu received his B.E.(Hon) and M.E. degrees from Beijing University of Posts and Telecommunications, China, and the Ph.D. degree from the University of Newcastle, Australia.

**“IoT+Blockchain: Technologies, Challenges, and Applications”**

**Abstract :** The Internet of Things (IoT) is poised to transform our lives and unleash enormous economic benefit. In this talk, we discuss a wide range of IoT technologies and their applications, as well as the security and trust implications. We argue that the current security issues in IoT can be attributed to the centralized network architecture.

Blockchain, a distributed ledger, was initially designed as a financial transaction tool. Remarkably, its cryptographic security benefits, such as user anonymity, decentralization, fault tolerance, transaction integrity and authentication, can be used to resolve security and privacy issues of IoT. We discuss the benefits, limitations, and challenges of IoT+Blockchain. I will describe the tamper-resistant demonstration of a Blockchain built into our IoT testbed. I will also give a preview of our current project on IoT+Blockchain for supply chain tracking and traceability.
Dr. Kohei SATOH  
(Secretary General, The Fifth Generation Mobile Communications Promotion Forum (5GMF))

**Short Bio:** Dr. Kohei Satoh joined the Electrical Communication Laboratories, Nippon Telegraph and Telephone Public Corporation (NTT), Japan, in 1975, and transferred to NTT Mobile Communications Network, Inc. (NTT DoCoMo) in 1992. Since 1975, he has been engaged in the research on radio propagation for satellite communication systems, research and development of mobile satellite communications and mobile communications systems. After 1985, he has been also engaged in standardization activities of mobile satellite services in ITU-R and international alliance activities for IMT-2000. He has been a President and CEO of DoCoMo Communications Laboratories Europe GmbH in Munich, Germany, from November 2000 to May 2002.

In July 2002, he moved from NTT DoCoMo to Association of Radio Industries and Businesses (ARIB). He is now an Executive Manager on Standardization of ARIB, and his current job is to promote standardization activities for enhancement of IMT-2000 and IMT-Advanced and for IMT-2020 and beyond. He has actively participated in ITU-R Working Party 5D (WP5D), Third-Generation Partnership Project (3GPP), APT Wireless Group (AWG) and China, Japan and Korea (CJK) IT Standards meeting since he joined ARIB. He is currently Chairman of AWG and Secretary General of the 5th Generation Mobile Communications Promotion Forum (5GMF).

“Creating the Crossover Collaboration for 5G Eco-Society”

**Abstract:** The title of my presentation was the theme of the 3rd Global 5G Event in Tokyo, Japan in May this year and is the slogan of the Fifth Generation Mobile Communication Promotion Forum (5GMF). 5GMF was founded on 30th September 2014. Its objectives are to conduct innovative R&D through Industry-Academia-Government cooperation, international standardization and collaboration and collaboration with 5G field trials in Japan. 5GMF holds more than 50 committee meetings every year, and publishes technical reports and white papers. We have already concluded a lot of MoUs with 5G-related organizations globally, and have participated in the Global 5G Events from the beginning.

In this presentation, the trend of 5G standardization activities is explained first. Then, the overview of 5GMF and major topics on the recent activities of 5GMF are outlined, e.g. studies on 5G spectrum, a report on 5G system integrated verification trial and major points of revised 5GMF White Paper (Version 1.1) on “5G Mobile Communications Systems for 2020 and beyond”. Finally, the significance of crossover collaboration and what we should do to create the 5G eco-society are mentioned.
Tutorial Speakers

Satriyo Dharmanto  
(Founder & CEO Multikom Indonesia)

“A Brief Update on IoT Implementation - Technology, Regulation and Business Model Perspectives”

Abstract: The development of Internet of Things (IoT), currently is going to be the huge opportunities for technology innovation to transform many aspect of industries. The series of advanced development in the technological layers in IoT, includes physical layer, data link layer, network layer, transport layer and application layer, are significantly transform this sector, contributing to the improvement of productivity.

As a basic requirement, IoT-based solutions are expected to be more accurate, low cost, low energy consumption and high-quality-of-service (QoS). However, some other requirements are also important, such as wider coverage, increased flexibility, high security and privacy, ultra-dense deployment and multivendor interoperability. So, the strategy to achieve the most optimum solution on the IoT deployment, need to be learned and described.

In this session there will be a comprehensive sharing and discussion about a brief update on IoT implementation, from the perspective of Technology development, Regulation issues and Business model, as well as identifying some related opportunities accordingly.

Ery Punta Hendraswara  
(Managing Director, Telkom Indigo)

“Youth Employment in Industry 4.0 Era”

Abstract: As a new round of industrial revolution, Industry 4.0 will be a future business challenge for industry players in the world. Cyber Physical System as a form of Industry 4.0 is manifested through a combination of several key elements, such as Big Data, Internet of Things, Internet of Services, Cloud Computing, Robotic and Cyber Security. The presence of Industry 4.0 can improve productivity and will change the value chain of manufacturing ecosystems, create new opportunities for ICT players in the manufacturing segment, bring new HR skills and change the focus of human tasks in today's manufacturing industry.

Employment becomes an important issue for emerging market countries in adopting Industry 4.0. New types of jobs will emerge with the need for new skills and cross discipline. Meanwhile the current type of work in manufacturing will be replaced with automation. Realizing Cyber Physical System requires not only good hard skills and soft skills, but also meta skills as the key to success, such as environmental intelligence, sustainability skills, multidisciplinary transfer, creativity, and continuous learning. A digital startup incubator is a suitable place to develop and sharpen some of these key capabilities. Corporate incubator will provide great added value because it can bring real use cases for startup to grow.
Endra Joelian, PhD
(Chapter Coordinator, IEEE Indonesia Section)

“Industry 4.0: Challenges and Opportunities for Youth Employment”

Abstract: Industry 4.0 is an industrial transformation associated with the economical aim and opportunity to make differences in global competitiveness. Industry 4.0 includes cyber-physical systems, internet of things-services-people, cloud computing, and cognitive computing, where all of them provide new era of industrial manufacturing. Cyber-physical systems can communicate and interact with workers and at the same time with internal and external organizations producing value-chain. The advance of telecommunication technology boosts the realization of this industrial transformation.

This talk will clarify what the cyber-physical systems is, everything that will be leverage, and how all the systems are integrated by telecommunication technology, so that the participants would know about the next generation of industry and what needs to be prepared. Also, how wireless telecommunication gets in to the value-chain of industry 4.0 and how equipment, sensors, people, and applications will be interacted will be elucidated.
# Technical Sessions

5G, wireless IoT, and satellite communications Session (NICT Session 1)
December 18, 2017 (13.45 - 15.15)

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A System Concept for Next Generation Broadband Satellite Communications System Integrating Flexible Radio and Optical Links

Authors: Yuma Abe, Kazunori Okada, Mitsuaki Ohkawa, Amane Miura and Morio Toyoshima (National Institute of Information and Communications Technology, Japan)

Abstract: National Institute of Information and Communications Technology (NICT) has been researching a next generation broadband satellite communications system with flexible payloads. This system targets to verify some flexibilities, such as frequency flexibility, beam flexibility, site diversity, and integrating Ka-band RF and optical links. To this end, the communications satellite has multi-beam antenna, Digital Channelizer (DC), Digital Beam Former (DBF), and optical transponder for feeder link. These payloads are controlled by Network Operations Center (NOC) based on traffic request and link status. Furthermore, this system is expected to supply future broadband multimedia communications, for example, as a complementary system of terrestrial wireless networks. In this paper, we briefly introduce a concept of the system and control algorithms. This system will be partially demonstrated by the Engineering Test Satellite-9 (ETS-IX) project.

R&D on Efficient and Optimized Use of Radio Resource in Mobile Network with a Variety of IoT Devices

Authors: Kenichi Takizawa and Masafumi Moriyama (National Institute of Information and Communications Technology, Japan); Masayuki Oodo (NICT, Japan); Hayato Tezuka (National Institute of Information and Communication Technology, Japan); Fumihide Kojima (National Institute of Information and Communications Technology, Japan); Takanori Iwai, Nobuhiko Itoh and Motoki Morita (NEC Corporation, Japan)

Abstract:

1) Low-latency Contention-based Radio Access Technology for Massive Machine Type Communication (NICT)
In IoT era, a novel radio access techniques that accommodate massive number of IoT devices sending short-length data is required in order to improve frequency utilization efficiency. Moreover, a class of teleoperated IoT devices like drones needs radio communications with capability of providing latency of several milliseconds. NICT have conducted R&D on contention-base radio access technology that provides latency of several milliseconds for massive machine type communication (mMTC) by employing nonorthogonal multiple access (NOMA) in uplink. This paper shows overview of the technology treated in the R&D.

2) Context-Aware Scheduling for Real-Time IoT Applications in Cellular Networks (NEC)
Recently, cellular networks are attracting a great deal of attention as a platform for real-time IoT applications. Individual devices such as vehicles, drones, and sensors can exchange real-time information with each other on this platform. For example, vehicles periodically provide each other with their real-time location information to avoid automobile collision. 3GPP stipulates that the deadline for vehicle-collision avoidance is 100 msec. In cellular networks, since the throughput of the wireless section fluctuates depending on the wireless channel quality, the time required for each direction differs. To support these various use cases on the platform, it is important to improve the total amount of application data that meets its deadline we call the metric for this the goodput. However, in cellular networks, conventional MAC schedulers such as PF can obtain only very low goodput when the network load is increased. In this work, we propose a novel packet scheduling method that adaptively prioritizes each item of application data on the basis of uplink/downlink deadlines and wireless channel quality by adjusting the deadlines.

R&D Status on Cooperative Management Architecture for Flexible Deployment of 5G

Authors: Kentaro Ishizu, Homare Murakami and Kazuo Ibuka (National Institute of Information and Communications Technology, Japan); Stanislav Anatolievich Filin (NICT, Japan); Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: This paper proposes an architecture and management method of next generation wireless systems where mobile operators who wish to deploy micro cells are allowed to do so under cooperation with the current cellular operators. Cells of the micro operators are flexibly integrated with those of cellular operators so that an organized heterogeneous wireless network is composed. The micro cells are assumed to be partly operated in a shared band mainly in millimeter wave band. To realize above, a set of interfaces are designed based on the current 3GPP specifications. This type of mobile system
operation is required sooner or later because cells in the 5G era are specialized for each feature from high peak data rate, low latency, massive connection and so on. A part of the millimeter wave band should be partly shared for efficient use of spectrum band since the access range in this band is expected to be relatively short and not appropriate to cover a large area due to large pass loss compared with the conventional IMT bands below 6 GHz. The proposed architecture and method are proofed by a prototype system of which base station and core networks are compatible with the 4G-based 3GPP specifications.

**Intelligent Water Management System with Wireless-Grid Technology for the ICT Supported Future Agriculture Field**

*Authors*: Fumihide Kojima (National Institute of Information and Communications Technology, Japan); Tetsuo Nakaya, Atsushi Namihira and Hiroyuki Taruya (NARO, Japan)

Abstract: This paper proposes an intelligent water management system assuming the employment of the wireless-grid technology that can effectively realize the Irrigation and Drainage Automated System (IDAS) that is an advanced water management system for the future agriculture field supported by the Supervisory Control And Data Acquisition (SCADA). In the proposed system, low energy radio devices employed grid shaped topology, namely wireless-grid system, enables cloud connectivity for agricultural equipment such as water level sensors, drain valves and water supply pumps via their radio communication links, thereby realizes advanced water management and achieves productivity improvement in the future agriculture field. This paper reports on the proof tests for the proposed water management system that were conducted by National Agriculture and Food Research Organization (NARO) and National Institute of Information and Communications Technology (NICT), supported by a governmental project. Moreover, this paper summarizes the future possible enhancement technologies considered by those two research organizations for this assumed system.

**Efficient Radio Access for Massive Machine-Type Communication**

*Authors*: Masafumi Mariyama and Kenichi Takizawa (National Institute of Information and Communications Technology, Japan); Masayuki Oota (NICT, Japan); Hayata Tzuka (National Institute of Information and Communication Technology, Japan); Hikaru Kawasaki (National Institute of Information and Communications Technology, Japan); Chang-Woo Pyo (NICT, Japan); Homare Murakami, Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: As IoT (Internet of Things) develops, new radio access techniques that can effectively accommodate massive number of devices transmitting small-size data are required to improve frequency utilization efficiency. Moreover, some IoT devices such as a drone controller require low latency communication. We have researched and developed the system that can realize massive connection and low latency communication by employing grant free (GF) communication and non-orthogonal multiple access (NOMA). Furthermore, in order to enhance reliability of the system, we have researched to apply receive diversity and repetition technique to the system. This paper explains NOMA, GF, reliability improvement methods and a test system constructed by USRP-RIO and FlexRIO.

**Internet of Things for Hydrological Monitoring Application**

*Authors*: Rosdiadee Nordin (Universiti Kebangsaan Malaysia, Malaysia); Hafizal Mohamad (MIMOS Berhad, Malaysia); Mehran Behjati (National University of Malaysia (UKM), Malaysia); Anabi Kelechi (Universiti Kebangsaan Malaysia, Malaysia); Nordin Ramli (MIMOS Berhad, Malaysia); Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan); Mahamod Ismail and Mushrifah Idris (Universiti Kebangsaan Malaysia, Malaysia)

Abstract: In this paper, we aim to demonstrate the effectiveness of Internet of Things solution for hydrological quality monitoring application. The success of a water quality monitoring system in rural area depends on a reliable link in a challenging terrain and elevation profile. Our work focuses on establishing a reliable rural hydrological monitoring system with emphasis on the wireless link located in Tasik Chini, a lake with UNESCO biosphere status which located in Pahang, Malaysia.
Improving Scattered Pilot Channel Estimation by Sector Selection on FDD MIMO/OFDM Systems  
Authors: Masato Katsuno, Shoichi Higuchi, Kazuki Maruta and Chang-Jun Ahn (Chiba University, Japan)

Abstract: This paper proposes the combined scheme with the scattered pilot channel estimation and the sector antenna selection to improve throughput and BER performance. Even in the frequency division duplex (FDD) system, the optimal transmission sector can be selected by using up and down link correlation without the feedback information (FBI). Sector selection can alleviate a frequency selectivity by eliminating the number of incoming reflected paths and accordingly the coherence bandwidth can be enlarged. Exploiting this feature, channel estimation accuracy can be kept even though reducing the number of pilot symbols in frequency domain. This paper introduces the high time resolution carrier interferometry (HTRCI) and the simple linear interpolation (SLI) as the scattered pilot channel estimation and evaluates their achievable throughput performance. Computer simulation on 2x2 MIMO/OFDM sector selection system disclosed that HTRCI and SLI can improve BER and throughput performance. Particularly, maximum throughput is improved by 7.5% in the case of HTRCI.

A Comprehensive Study of Universal Time-domain Windowed OFDM-based LTE Downlink System  
Authors: Keiichi Mizutani (Kyoto University, Japan); Takeshi Matsumura (Kyoto University & National Institute of Information and Communications Technology (NICT), Japan); Hiroshi Harada (Kyoto University, Japan)

Abstract: For the 5G system and beyond, several new waveforms with low out-of-band emission (OObE) have been proposed to improve spectral efficiency. The universal timedomain windowed OFDM (UTW-OFDM) have been proposed as a waveform that has the low OObE characteristics and high compatibility with the conventional cyclic prefix OFDM (CPOFDM)-based systems. To indicate the feasibility of the UTW-OFDM-based system in the 5G and beyond, the comprehensive evaluation of the UTW-OFDM-based LTE system is important, however, the evaluation of the UTW-OFDM-based LTE system complexity has been not reported. Furthermore, the communication quality of the UTW-OFDM-based LTE system was evaluated by using BER characteristics on the short delay multipath propagation channel in the previous studies. In this paper, to show the feasibility of the UTW-OFDM for the 5G and beyond, the complexity of the UTW-OFDM-based LTE downlink (DL) system...
is evaluated and compared with one of the LTE-DL system with the conventional CP-OFDM and the filtering-based waveform (UF-OFDM). The complexity of the conventional CP-OFDM-based system and the UTW-OFDM-based system is about 0.45% of the complexity of the UF-OFDM-based system. Furthermore, the communication quality of the UTW-OFDM-based LTE-DL system is evaluated by using BLER on the 3GPP Extended Typical Urban (ETU) channel model with the 70 Hz Doppler shift. The UTW-OFDM-based LTE-DL system can improve the OOBs of the conventional CP-OFDM-based LTE-DL system by 45 dB with only 2.0 dB deterioration of ES/N0 to achieve $\text{BLER} = 10^{-1}$ even if the 64QAM is applied with a half coding rate.

**LTE Uplink System Based on Universal Time-domain Windowed DFTs-OFDM**

*Authors :* Yosuke Kodama and Keiichi Mizutani (Kyoto University, Japan); Takeshi Matsumura (Kyoto University & National Institute of Information and Communications Technology (NICT), Japan); Hiroshi Harada (Kyoto University, Japan)

Abstract : For the 5G systems, new uplink waveforms enabling low peak-to-average power ratio (PAPR) and low out-of-band emission (OOBE) are required to enhance spectrum efficiency while maintaining power efficiency of mobile terminals. Discrete Fourier transform-spread orthogonal frequency division multiplexing (DFTs-OFDM) is extensively used as an uplink multiple access scheme for existing Long Term Evolution (LTE) and LTE-Advanced systems. Despite lower PAPR of DFTs-OFDM compared to conventional OFDM, its high OOBE limits the spectral availability in adjacent channels. Universal time-domain windowing (UTW) is expected to significantly reduce OOBE, while it is necessary to demonstrate its practicality with a comprehensive evaluation including the communication quality. In this paper, we apply the UTW to the 5 MHz LTE uplink system based on DFTsOFDM (UTW-DFTs-OFDM) and simulate its performance in respect to OOBE, PAPR, and block error rate (BLER) under the frequency selective fading environment. In addition, we propose new receiver architecture to improve the communication quality and clarify the trade-off between OOBE reduction and the communication quality. The simulation results indicate that UTW-DFTs-OFDM significantly reduces the OOBE by applying a long time-domain window in excess of the CP length with maintaining sufficient communication quality.

**Optimized Adaptive Modulation with Considering Mobile Relay on FSS-OFDM System**

*Authors :* Shun Kojima, Ken Teduka, Kazuki Maruta and Chang-Jun Ahn (Chiba University, Japan)

Abstract : This paper proposes an adaptive modulation on frequency symbol spreading (FSS) based orthogonal frequency division multiplexing (OFDM) relay system with considering the mobility of relay node. Wireless communications often suffer from large propagation loss due to shadowing and multipath fading. As a solution to this problem, Relay communications, which forward data messages from source to destination via intermediate station(s), have been focused on. It can obtain the space diversity and expand the area coverage. However, here arises another issue on relaying how to deploy relay nodes in an efficient manner. In this paper, we present a whole system design of FSS-OFDM employing an adaptive modulation considering mobility of relay node. Exploiting a good match of an adaptive modulation and FSS, throughput performance can be significantly improved. Computer simulation verifies its effectiveness and reveals the proposed system is the most valuable means which realizes the flexible relay node deployment.

**On Throughput Optimization for Coded OFDM with Variable Cyclic Prefix Length**

*Authors :* Masaya Arakawa and Hideki Ochiai (Yokohama National University, Japan)

Abstract : Orthogonal frequency-division multiplexing (OFDM) generally gains its resistance against channel delay spread by insertion of cyclic prefix (CP). In principle, the intersymbol interference (ISI) as well as inter-carrier interference (ICI) can be avoided provided that the CP length is longer than the effective channel delay spread. However, the delay spread is not known a priori in general, and increasing CP length also leads to reduction of spectral efficiency, especially when the number of subcarriers in the OFDM system is small. In this work, under the framework of BICM-OFDM where capacity approaching channel codes are employed, we first attempt to mitigate the degradation caused by the excessive channel delay spread by appropriately adjusting the decoder metric that takes into account the resulting signal-to-interference-plus-noise ratio (SINR). Furthermore, based on the trade-off between the achievable SINR and spectral efficiency, we attempt to optimize the CP length such that the throughput is maximized.
Abstract: In single carrier transmission, spectrum suppressed transmission that increase frequency utilization efficiency by suppressing required bandwidth of a 3dB bandwidth while maintaining throughput by FEC (forward error correction) has been proposed. However, spectrum suppressed transmission has been evaluated only between suppression ratio and frequency utilization efficiency, PAPR which have an impact on transmitter hardware size not considered. Therefore, in this paper, we have evaluated relationship between suppression ratio and PAPR when suppressed modulating spectrum by using low pass, high pass, and band pass filters. Moreover, in the smallest PAPR, we revealed that transmission quality increase further by applying FEC with equalizer to receiver.
Utilization Efficient Game-Theoretical Handover Scheme for Macro-Femtocell Networks  
Authors: Qiaozhi Hua (University of Waseda, Japan); Yuwei Su, Keping Yu and Takuro Sato (Waseda University, Japan)

Abstract: The Macro-Femtocell system is widely used in current society because the cooperation between Macrocell base stations and Femtocell base stations can improve the communication capacity of certain areas and adapt to the large multi-user demand. To increase the system’s communication quality, the handover scheme should be utilized when the user is moving within the limited coverage of Femtocell base stations. Generally, the Markov decision strategy is used for mobile users in the process of handover. However, the Markov decision process can’t ensure the maximum utilization balance of Macrocell base stations and Femtocell base stations. In this case, users often choose the base station offering the highest signal strength, which will cause a Macrocell base station’s load to be too large and Femtocell base stations to be idle, so the system’s utilization is very low. To address this problem, we propose the utilization efficient game-theoretical handover scheme based on Starckberg competition theory for appropriately increasing a Femtocell base station’s transmitting power. This can ensure the communication quality of the system and guarantees the system’s load balance to induce users to take the initiative in processing the handover scheme. Finally, the simulation results show that our strategy is effective in choosing the best base station to receive the highest signal strength by predicting the user’s movement. It could also realize the load balance of the antenna in the system. The overall transmission quality of the user group is optimized.

Improved Common Correlation Matrix Based SMI Algorithm by Channel Estimation Error Minimization with LMS Approach  
Authors: Takashi Akao, Satoshi Taroda, Kazuki Maruta and Chang-Jun Ahn (Chiba University, Japan)

Abstract: This paper improves interference suppression performance of Common Correlation Matrix (CCM) based Sample Matrix Inversion (SMI) adaptive array antenna algorithm. Assuming multicarrier systems such as orthogonal frequency division multiplexing (OFDM), CCM is effective means to achieve good convergence of covariance matrix by utilizing time-domain signal samples before multicarrier conversion. However, the number of pilot symbols is still limited and receiver noise causes poor channel identification. Such inaccurate CSI estimation deteriorates the interference suppression performance of the CCMSMI algorithm. The key proposal is introducing a minimization of channel estimation error using
least mean square (LMS) approach. Computer simulation results verify the improved Bit Error Rate (BER) performance provided by a modified CCMSMI algorithm.

Improving Cellular Coverage Through UAVs
Authors: Ugljesa Urosevic and Zoran Veljovic (University of Montenegro, Montenegro); Milica Pejanovic-Djurisic (University of Montenegro & Centre for Telecommunications, Montenegro)

Abstract: Cellular covering of big events can be sometimes difficult, due to the fact that places of happening in network planning are not assumed to be so crowded. Also, in present social networks one of the key characteristics is tremendous increasing of uplink live streams. In these situations it is often critical to provide appropriate quality of service. A solution for meeting these requirements is implementation of unmanned aerial vehicles (UAVs) that can act as relays between base station (BS) and mobile units (MUs). Here, we considered several practical scenarios for UAVs implementation, and proposed one new solution for distributed realization of space diversity, i.e. multiple input multiple output (MIMO) channel between MUs and BS.

Performance Evaluation of Inter-Cell Interference Coordination with Multiple Interference Pattern Based on Proportional Fair Criteria
Authors: Yusaku Kanehira and Nobuhiko Miki (Kagawa University, Japan)

Abstract: To support the continuous growth of mobile traffic, small cell deployments, which increase the base station (BS) density holds great promise. In small cell deployments, the combined usage of user association and inter-cell interference coordination (ICIC) is inevitable. This paper investigates the joint optimization of user association and various ICIC schemes based on the computer simulation. Our evaluation includes the partial frequency reuse and soft frequency reuse as ICIC schemes. We also evaluate the influence of power reduction, user density, and user distribution. Based on the simulation results, it is beneficial to employ “soft” frequency reuse (without completely stopping the transmission) and apply our ICIC optimization scheme to obtain good performance from the viewpoint of proportional fairness.

Performance Evaluation of TD-LTE in VHF-band for Large Coverage Public Broadband Communications System
Authors: Keiichi Mizutani, Hiroto Kuriki and Yasuke Kodama (Kyoto University, Japan); Takeshi Matsumura (Kyoto University & National Institute of Information and Communications Technology (NICT), Japan); Hiroshi Harada (Kyoto University, Japan)

Abstract: Agile and reliable measures for voice and video transmission are required for extremely highly-public and highyurgen services by public institutes such as police department, fire department, and emergency medical service. For this purpose, a part of VHF-band was allocated to the public broadband communications (PBB) and a domestic standard of ARIB STD T-103 was standardized for the PBB. ARIB STD-T103-compatible hardware and systems have been already developed and achieved long range transmission of voice and video in harsh transmission environment such as the mountain area. On the other hand, this ARIB STD T-103-compatible hardware has a problem about its expensive cost. For a further promotion of the PBB system, the reduction of the hardware price becomes important fact. Under such a background, the introduction of TD-LTE system for the VHF-band has been considered in Japan. The LTE system has the potential for application to the long-range communication system at low cost; however, there is no report on the LTE system evaluation in VHF-band PBB environment. In this paper, we investigate the transmission performance of the 5 MHz bandwidth TD-LTE system in conformity to the Japanese VHF-band requirement by evaluating bit error rate (BER) and block error rate (BLER) with several multi-path fading channel models.

A Transceiver Design of VHF Band Standardized Broadband Mobile Communications Systems
Authors: Kiminobu Makino and Keiichi Mizutani (Kyoto University, Japan); Takeshi Matsumura (Kyoto University & National Institute of Information and Communications Technology (NICT), Japan); Hiroshi Harada (Kyoto University, Japan)

Abstract: This paper evaluates BER performance of VHF band broadband mobile communication systems standardized as ARIB STD-T103 mode1. The ARIB STD-T103 mode 1 is based on IEEE 802.16-2009 standard with OFDMA because of its easy implementation. The IEEE 802.16-2009 based system is originally expected to operate in microwave bands such as 2.5 GHz with 512 FFT based OFDM in 5 MHz channel. However, the ARIB STD-T103 based system should tune the radio parameters of IEEE 802.16-2009 to suit for VHF band propagation characteristics because many multipath waves with long delay path are received in the VHF band. The ARIB STD-T103 mode 1 adopts OFDMA with 1024 FFT in 5 MHz channel and convolutional Turbo coding to cope with long delay multipath environments in VHF band such as IEEE 802.22 Profile A model. However, the BER performance in the environments has never been evaluated. This paper evaluates the BER performance with
conventionally proposed receiving scheme by computer simulation. However, the performances of UL and DL with 64QAM do not achieve the required BER of ARIB STD-T103. To improve the BER performance this paper proposes three channel estimation schemes for DL. Although the BER performance with the schemes are not improved drastically, it is clarified that one of the proposals is expected to reduce size of storage in comparison with the conventional estimation schemes. With the estimation scheme and maximum ratio combined diversity achieves the required BER in both UL and DL.
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<td>Hongyan Cui (Beijing University of Posts and Telecommunications, P.R. China); Zuming Chen (Beijing University of Posts and Telecommunications &amp; State Key Lab. of Networking and Switching Technology, P.R. China); Longfei Yu and Kun Xie (Beijing University of Posts and Telecommunications, P.R. China); Zongguo Xia (University of Massachusetts Boston, USA)</td>
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<td>Xing Tan and Rui Zhao (Huaqiao University, P.R. China); Yuanlian Li (HuaQiao University, P.R. China); ZhiQiao Nie (National Huaqiao University, P.R. China); Chunguo Li (Southeast University, P.R. China)</td>
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<td>Dan Huo, Zhi Zhang, Qian Zhou and Qixiang Tang (Beijing University of Posts and Telecommunications, P.R. China); Zhibin Huo (Beijing University of Post and Telecommunications, P.R. China)</td>
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<td>Pritee Parwekar (Anil Neerukonda Institute of Information and Sciences, Visakhapatnam, India); Anusha Vangala (Anil Neerukonda Institute Of Technology And Sciences, India)</td>
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**Authentication Mechanism for Network Applications in SDN Environments**
Authors: Hongyan Cui (Beijing University of Posts and Telecommunications, P.R. China); Zuming Chen (Beijing University of Posts and Telecommunications & State Key Lab. of Networking and Switching Technology, P.R. China); Longfei Yu and Kun Xie (Beijing University of Posts and Telecommunications, P.R. China); Zongguo Xia (University of Massachusetts Boston, USA)

Abstract: Software-defined Networking, a new networking paradigm, provides network programming for third parties by separating control plane from data forwarding plane and opening network capabilities. SDN brings great flexibility and openness to the network, but the original design phase of SDN had not considered designing characteristics regarding security. For this reason, there are many potential vulnerabilities in SDN Environments. One of the most critical security threats arise from the vulnerability of trusting relationship due to the lack of authentication mechanism between the network application and the controller. A specific concern is whether an application can be trusted or not. This paper discusses the authentication mechanism of the network application. At the same time, it implements the application authentication system which addresses the key challenges: how to safely resolve conflicts between untrusted network applications and requests. The paper undergoes system testing in testbed constructed Floodlight architecture. The test results show that the system works well to effectively defend against unauthorized access and provide log history, which verifies the effectiveness of the proposed method to secure the northbound interface by introducing the application authentication system.

**Secrecy Performance of Untrusted Relay System with Full-Duplex Jamming Destination**
Authors: Xing Tan and Rui Zhao (Huaqiao University, P.R. China); Yuanlian Li (HuaQiao University, P.R. China); ZhiQiao Nie (National Huaqiao University, P.R. China); Chunguo Li (Southeast University, P.R. China)

Abstract: To improve the secrecy performance of the untrusted relay system with multiple-antenna destination, a novel full-duplex destination jamming with optimal antenna selection (FDJ-OAS) scheme is proposed. The traditional half-duplex destination jamming scheme and the non-jamming scheme both combined with OAS are proposed to compare with FDJ-OAS. The exact closed-form expressions of ergodic achievable secrecy rate are derived for three schemes. Furthermore, the asymptotic analysis of secrecy outage probability shows that, the secrecy diversity order of FDJ-OAS is significantly superior...
to that of the other two schemes. Simulation results show that, the analytical curves match well with the simulation results, and the advantage of FDJ-OAS is also revealed through performance comparison.

**An Image Based Undetectable Steganographic Technique (ImUST)**
Authors: Vaibhav Joshi (School of Engineering and Applied Science, Ahmedabad University, India); Mehul Shirishchandra Raval (School of Engineering and Applied Science(SEAS), Ahmedabad University, India)

Abstract: Steganography is a science of secure communication. It is challenged by a binary steganalyzer which predicts presence or absence of a hidden message within a cover media. Recently proposed quantitative steganalyzers go a step beyond binary detection and estimates the hidden message length. In this paper, we propose a novel image based steganographic technique. A preprocessing step is introduced to minimize distortion and the message is embedded using histogram shifting. The statistical features of an image do not change significantly after embedding. We show that the proposed technique remains undetectable to state-of-the-art; binary and quantitative steganalyzers while the message remains undetectable. The preprocessing also enables iterative embedding, generating higher steganographic capacity than state-of-the-art.

**Ergodic Secrecy Sum Rate Maximization in Downlink Sparse Code Multiple Access Network**
Authors: Dan Huo, Zhi Zhang, Qian Zhou and Qixiang Tang (Beijing University of Posts and Telecommunications, P.R. China); Zhibin Huo (Beijing University of Post and Telecommunications, P.R. China)

Abstract: Sparse code multiple access (SCMA) has been recognized as a promising candidate technique for fifth generation (5G) cellular network to improve spectral efficiency (SE). In this paper, physical layer security (PLS) in a downlink single input single-output (SISO) SCMA system is investigated, which includes one base station (BS), multiple legitimate users and one eavesdropper. The aim of this paper is to maximize the ergodic secrecy sum rate (ESSR) of the SCMA system under the constraint of the transmit power of BS. A novel many-to-many two-side matching algorithm is then proposed. After a limited number of iterations, the algorithm converges to a pair-stable matching. Finally, simulation results indicate that the proposed algorithm outperforms the random scheme and the orthogonal multiple access (OMA) scheme.

**Enhanced Encryption Model for Sensor Data in Wireless Sensor Network**
Authors: Pritee Parwekar (Anil Neerukonda Institute of Information and Sciences, Visakhapatnam, India); Anusha Vangala (Anil Neerukonda Institute Of Technology And Sciences, India)

Abstract: In Wireless Sensor Network Environment, there is a lot of scope to incorporate security considerations in various aspects of the architecture. While the sink reads the data from the sensor and dumps the aggregated data to the base Station, there is a possibility of loss of confidentiality of data. Any third party may read the data and misuse it. Hence it is vulnerable to snooping by the attacker. The current paper presents an enhanced model in order to improve confidentiality. This paper analyses the weaknesses of the previous scenarios and proposes improvements on them by making use of mathematical operations to manipulate the keys used for the encryption of each sensor. The work culminates into a proposed Scenario 1.7 that can provide enhanced security over the previous models with comparable time taken for security operations in the sink.
Wireless Network 1 (WN 1) Session
December 18, 2017 (15.45 - 17.15)

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<td>Rui Teng (Advanced Telecommunications Research Institute International, Japan); Kazuto Yano and Tomoaki Kumagai (ATR, Japan)</td>
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<td>Vikram Kumar (University of Queensland &amp; CSIRO, Australia); Reza Arablouei (CSIRO, Australia); Raja Jurdak (Commonwealth Scientific and Industrial Research Organisation (CSIRO) ICT Centre &amp; University of Queensland, Australia); Branislav Kusy (Commonwealth Scientific and Industrial Research Organisation (CSIRO) ICT Centre, Australia); Neil W Bergmann (University of Queensland, Australia)</td>
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<td>Xia Liu (BUPT, P.R. China); Zhimin Zeng and Caili Guo (Beijing University of Posts and Telecommunications, P.R. China)</td>
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<td>Implementation of a Multi-hop Network at the University Campus Using an IEEE 802.11af Network</td>
<td>Antonio III Montejo and Alberto Bañacia (University of San Carlos, Philippines); Hirokazu Sawada, Kentaro Ishizu, Kazuo Ibuka and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)</td>
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**A Distributed-and-Interactive Reporting Scheme for Collective-Sensing in Multi-Band Wireless LAN System**

**Authors:** Rui Teng (Advanced Telecommunications Research Institute International, Japan); Kazuto Yano and Tomoaki Kumagai (ATR, Japan)

**Abstract:** Multi-band wireless local area network (WLAN) allows WLAN to adaptively select and jointly use wireless channels in multiple frequency bands to improve spectral efficiency. Monitoring of multi-band wireless resources is a significant and challenging issue for multi-band WLAN. Traditional methods of sensing by access point (AP) for each basic service set (BSS) of multi-cell WLAN incurs constraints of sensing capacity as well as the spatial and spectral coverage, especially for multiband WLAN. We consider a resource monitoring system that employs collective sensing for each BSS via multi-RF stations (STAs). Distributed and collective sensing at each BSS alleviates the constraints of AP based sensing. Meanwhile, the STA based sensing for a BSS leads to a large sensing-report overhead. In this paper, we especially address the problem of potential large spectrum consumption caused by the sensing reports from a collective of sensing entities of STAs in multi-band WLAN. We propose...
distributed-and-interactive scheme to efficiently report sensing results, such as channel occupancy ratio (COR) from sensing entities. The sensing results are collected at the AP in each BSS in a WLAN. The evaluation results show that the proposed scheme leads to a very small number of reports to obtain the necessary sensing results, even for a WLAN that has a large number of sensing entities.

**Multi-mode Tracking of a Group of Mobile Sensors**
Authors: Vikram Kumar (University of Queensland & CSIRO, Australia); Reza Arablouei (CSIRO, Australia); Roja Jurdak (Commonwealth Scientific and Industrial Research Organisation (CSIRO) ICT Centre & University of Queensland, Australia); Branislav Kusy (Commonwealth Scientific and Industrial Research Organisation (CSIRO) ICT Centre, Australia); Neil W Bergmann (University of Queensland, Australia)

Abstract: We consider the problem of tracking a group of mobile nodes, which have limited computational and energy resources, using noisy RSSI measurements and position estimates available within the group. Existing solutions such as cluster-based GPS duty-cycling, individual tracking, and multilateration-based localization and tracking can only partially deal with the challenges of dynamic grouping scenarios where neighbourhoods and resource availability may frequently change. To efficiently cope with these challenges, we propose a new group-based multi-mode tracking algorithm. The proposed algorithm takes the group size and resource availability into consideration and determines the best solution at any particular time instance. We consider a clustering approach where a cluster head assigns the task of GPS activation and coordinates the usage of resources among the cluster members. We evaluate the energy-accuracy trade-off of the proposed algorithm for various fixed sampling intervals. The evaluation is based on the 2D position tracks of 40 nodes simulated using Reynolds’ flocking model. For a given energy budget, the proposed algorithm reduces the mean tracking error by up to 20% in comparison with the existing energy-efficient cooperative algorithms. Moreover, the proposed algorithm is as accurate as the individual-based tracking while using around 50% less energy.

**Cyclostationary Spectrum Sensing Based Channel Estimation Using Complex Exponential Basis Expansion Model in Cognitive Vehicular Networks**
Authors: Xia Liu (BUPT, P.R. China); Zhimin Zeng and Caili Guo (Beijing University of Posts and Telecommunications, P.R. China)

Abstract: Cyclostationarity sensing methods are appealing for spectrum sensing due to its strong robustness to noise uncertainty. However, in cognitive vehicular networks, the Doppler frequency shift induced by high mobility cognitive vehicle will bring the cyclic frequency offset (CFO) for cyclostationarity spectrum sensing. The CFO can cause significant detection performance degradation because of a difference between cyclic frequency aware of the cognitive vehicle and the actual cyclic frequency of primary signal. To address this issue, cyclostationary spectrum sensing based on channel estimation using complex exponential basis expansion model (CE-BEM) is established in this paper. We firstly establish a Doppler frequency shift estimation method based on in-vehicle information. Then an appropriate CE-BEM is given according to the value of Doppler frequency shift estimation. The cyclostationarity spectrum sensing based on CEBEM model for single user and cooperative users are provided. Theoretical analysis show that new cyclostationary characteristics are produced on account of the cyclostationarity induced by the CE-BEM. Simulation results demonstrate that both the local cyclostationarity spectrum sensing (LCSS) and the cooperative cyclostationarity spectrum sensing (CCSS) provide substantial improvement on detection performance in the dynamic moving speed environment for cognitive vehicles.

**Implementation of a Multi-hop Network at the University Campus Using an IEEE 802.11af Network**
Authors: Antonio III Montejo and Alberto Balacia (University of San Carlos, Philippines); Hirokazu Sawada, Kentaro Ishizu, Kazuo Ibuka and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: Abstract—Information dissemination is a major problem during calamities as road networks, power lines, and communication infrastructures were damaged. The aforementioned challenge contributes to an inefficient and sluggish rescue and relief operations as miscommunication between the government, ground personnel and victims arise. Establishing a communication link in the TV White Space (TVWS) has been popular after numerous studies have shown the inefficient utilization of the TV bands. More TV spectrum was made available by the analog to digital switchover of TV broadcast which in the Philippines began in 2009. Results of the studies conducted in the Philippines showed availability of 46% to 62% TVWS in an urban area while 60% to 80% in rural area. TVWS has better propagation characteristics as compared to the ordinary Wi-Fi systems operating at 2.4 GHz and 5 GHz ISM band. In this study, the feasibility of a multi-hop network based on IEEE 802.11af standard as an alternative communication infrastructure was implemented and evaluated. Multi-hop implementation was viewed as a necessary approach to re-route the radio link around the presence of high obstruction
and to increase coverage area. Adjacent, co-channel and intermodulation issue were experienced and addressed in this experiment. Results show that the deployed network attained a maximum throughput of 4.81 Mbps for uplink and 4.93 Mbps for downlink over 600 m using a single channel centered at 593 MHz. Its quality of service is seriously affected by rain with an observed drop in throughput by 17.76% although there was hardly a change in the measured RSSI. The system was able to successfully support voice and data transmission via Skype.
Wireless Communications and PHY 3 (WCPHY 3) Session
December 18, 2017 (15.45 - 17.15)

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<td>A UTW-OFDM Without Symbol Overlapping Process for Small Cell Networks</td>
<td>Akihito Yoshito, Yosuke Kodama, Hiroto Kuriki and Keiichi Mizutani (Kyoto University, Japan); Takeshi Matsumura (Kyoto University &amp; National Institute of Information and Communications Technology (NICT), Japan); Hiroshi Harada (Kyoto University, Japan)</td>
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<td>Performance of Polar Codes with MIMO-OFDM Under Frequency Selective Fading Channel</td>
<td>Koya Watanabe, Shoichi Higuchi, Kazuki Maruta and Chang-Jun Ahn (Chiba University, Japan)</td>
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**Performance Analysis and Hardware Verification of Signal Detection Scheme Using Cyclic Prefix in OFDM**

*Authors:* Akihide Nagamine (Tokyo Institute of Technology, Japan); Kanshiro Kashiki (KDDI Research, Inc., Japan); Fumio Watanabe (KDDI R&D Laboratories Inc., Japan); Jiro Hirokawa (Tokyo Institute of Technology, Japan)

**Abstract:** In 5th generation mobile communication systems, various wireless devices will use an OFDM signal whose parameters are adapted to each device. Frequency sharing among such devices is an important study issue. For their smooth introduction, it is essential to develop a signal detection technology with low complexity and high sensitivity. We have studied a signal detection scheme using a cyclic prefix usually attached to an OFDM signal. However, the probability distribution of the detection performance, which gives false-alarm and non-detection probabilities in signal detection, has been considered only by Monte Carlo simulation. This paper presents the formulation of the detection performance, and its verification by hardware implementation. Experiments using the detector operating in the radio frequency band verified that the false-alarm and nondetection probabilities calculated by the analytical formula agree with those by the hardware experiments.

**A UTW-OFDM Without Symbol Overlapping Process for Small Cell Networks**

*Authors:* Akihito Yoshito, Yosuke Kodama, Hiroto Kuriki and Keiichi Mizutani (Kyoto University, Japan); Takeshi Matsumura (Kyoto University & National Institute of Information and Communications Technology (NICT), Japan); Hiroshi Harada (Kyoto University, Japan)

**Abstract:** A universal time-domain windowed orthogonal frequency division multiplexing (UTW-OFDM) has been proposed as one of the new waveforms to drastically reduce the out-of-band emission (OOBE) for the 5th generation mobile communication systems. Meanwhile, the conventional UTW-OFDM with a symbol overlapping process requires an additional memory for storing successive windowed symbols to ensure sufficient effective CP length. For the forthcoming ultra-dense small cell networks in the 5G, a more simplified yet effective new waveform is required. In this paper, we propose a new UTW-OFDM without symbol overlapping process to simplify the transmitter architecture compared to the conventional UTW-OFDM. The performance of the proposed UTW-OFDM is characterized by simulating OOBE, inter-symbol interference (ISI), inter-carrier interference (ICI), error vector magnitude (EVM) and block error rate (BLER). The simulation results show sufficient OOBE reduction in the shortdelay multipath fading environment and demonstrate the applicability of the proposed UTW-OFDM for small cell network.
Performance of Polar Codes with MIMO-OFDM Under Frequency Selective Fading Channel
Authors: Koya Watanabe, Shoichi Higuchi, Kazuki Maruta and Chang-Jun Ahn (Chiba University, Japan)

Abstract: This paper presents the BER performance analysis of polar codes with MIMO-OFDM under frequency selective channel, which has not been disclosed so far. Multiple-input multiple-output (MIMO) has been widely implemented or standardized to improve the throughput performance of wireless communications. Forward error correction (FEC) codes are also key techniques for stably improving bit error rate (BER) and have been studied as well as a demodulation scheme. FEC is required to be composed of simple encoder and decoder while achieving good BER performance as much as possible. Polar codes emerged as a promising FEC scheme. This code has a simple recursive encoder structure by using a phenomenon called “channel polarization”. In addition, it has been reported that polar codes provably achieve the theoretical limit for communication systems with a successive cancellation decoder based on likelihood ratio. An calculation complexity of polar codes is less than that of low density parity check (LDPC) codes. Therefore, polar codes are an effective technique in realizing low electric power consumption to meet one of the demand conditions of 5G. Based on legacy detection schemes as zero forcing (ZF) and maximum likelihood detection (MLD), computer simulation results reveal the fundamental BER performance with controlling coding rate. Moreover, there is a problem that the log likelihood ratio (LLR) of MLD detection for soft-decision decoding can not be obtained. Therefore, in this paper, we investigate the likelihood function of MLD detection in the proposed system.

Spectral Efficiency Enhancements Utilizing Analog RF Front-end In-Band Interference Cancellation
Authors: Uma S Jha (Raytheon Co, USA); Frederic J Harris (San Diego State Univ, USA)

Abstract: Today’s radios operate invariably in half duplex mode, i.e., they can either transmit or receive, but not both simultaneously in the same frequency band. The inability to simultaneously transmit and receive inherently reduces the spectral efficiency of a radio channel by 50%. Spectrum scarcity and souped-up demand for data from the smart devices, the wireless networks have been unable to cope with the growing needs of the user community. The realization of the full duplex mode operation in the prevailing circumstances has attracted a lot of attention from both industry and academia. The fundamental obstacle in achieving the full duplex mode operation emanates from the self-induced interference from its own transmitted signal, which interferes with the received Signal of Interest (SoI). Majority of wireless communication systems operate in half duplex mode (inherent inefficiency) to avoid self-interference and to prevent desensitizes of their receive chain. The key challenge in achieving the full-duplex radio operation in the same frequency band originates from the huge power differential between transmitted power and the received signal of interest arriving from a faraway transmitter as well as the nonlinearity of the Radio Frequency Front End (RFFE) transmit/receive components. This large power differential saturates the Low Noise Amplifiers (LNA) and overwhelms the dynamic range of the Analog to Digital Converter (ADC) in the receive chain raising the Receive (Rx) noise floor to an undesirably high level. Many analog and digital cancellation techniques have been proposed and implemented with limited success in specific environments. A more generic technique, which allows for adaptive cancellation of interference from various sources in dynamic environment, has been studied, implemented, and the result has been documented in this paper.

Theoretical Analysis of Interference Canceller Using Modified Hermite Polynomials Based Orthogonal Matched Filter for IR-UWB Systems in AWGN and Interference Channel
Authors: Takumi Kobayashi and Chika Sugimoto (Yokohama National University, Japan); Ryuji Kohno (Yokohama National University & University of Oulu, Japan)

Abstract: Ultra wide-band (UWB) radio communication is well known as a technology which realizes highly dependable, low impact to human body and high capacity wireless communication technology. Wireless body area network (WBAN) such as IEEE802.15.6. The authors have proposed an interference mitigation method using orthogonal matched filter (OMF) based on the modified Hermite polynomials. This paper provides the performance bound, optimal solution and the theoretical performance limit under the condition that both of interference and noise exist.
Wireless Communications and PHY 4 (WCPHY 4) Session
December 18, 2017 (15.45 - 17.15)

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<td>Iterative Carrier Frequency Offset Estimation for Faster-than-Nyquist Signaling</td>
<td>Jiancun Fan (Xi’an Jiaotong University, P.R. China); YaJie Ren (Xi’an JiaoTong University, P.R. China)</td>
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heights compared with the side wall height of viaduct for a link budget design and it is validated by ray trace simulation. The cumulative distribution of delay spread is also analyzed for physical layer design. The system parameter of railway communication system in 90 GHz band is suggested by considering these propagation characteristics.

Iterative Carrier Frequency Offset Estimation for Faster-than-Nyquist Signaling

Authors: Jiancun Fan (Xi’an Jiaotong University, P.R. China); YaJie Ren (Xi’an JiaoTong University, P.R. China)

Abstract: Faster-than-Nyquist (FTN) signaling can effectively improve system spectrum usage by introduced controlled inter symbol interference (ISI). However, the existing of ISI in FTN signaling system makes its carrier frequency-offset (CFO) estimation more complex and traditional algorithms may not work effectively. To fill this gap, we propose an iterative CFO estimation scheme for FTN signaling system. The scheme is composed of two parts, estimating the value of CFO roughly by discrete Fourier transform (DFT), and then finishing the accurate estimation by the improved iterative algorithm. Simulation results show that, in FTN transmission, as signal noise ratio raises, the proposed scheme makes the mean square error (MSE) of estimation value approach the Cramer-Rao Bound (CRB), which means getting better detection performance than the conventional ones designed for orthogonal transmission.
Radio Channel Characterizations at 2.4 GHz in Mine Shaft Environment  
Authors: Shaohua Xue and Jianping Tan (Central South University, P.R. China)

Abstract: In this paper, narrowband and wideband radio channel measurements at 2.4 GHz have been carried out in a real mine shaft. Important parameters such as path loss and delay spread are presented and compared with that in underground tunnels. The waveguide effect has been observed in path loss. The distribution of Root-Mean-Square (RMS) delay spread and the relationship between RMS delay spread and Tx-Rx distance has been investigated. The number of multipath has also been studied. The results are helpful for designing shaft communication systems.

Time-domain Channel Equalization for Subcarrier Spacing Compressed FDM with SC-MMSE Turbo Equalization Receiver  
Authors: Hiroto Kuriki and Keiichi Mizutani (Kyoto University, Japan); Takeshi Matsumura (Kyoto University & National Institute of Information and Communications Technology (NICT), Japan); Hiroshi Harada (Kyoto University, Japan)

Abstract: Subcarrier spacing compressed frequency division multiplexing (SSC-FDM) has been widely researched as one of the digital multi-carrier modulation schemes for the beyond 5th generation mobile communication system. The SSC-FDM arranges subcarriers non-orthogonally in the frequency domain and improves spectral efficiency by compressing the channel bandwidth compared to the conventional orthogonal frequency division multiplexing (OFDM). On the other hand, the intercarrier interference (ICI) mainly caused by overlapped adjacent subcarriers deteriorates the communication quality. The SSCFDM using soft canceller followed by minimum square error filter (SC-MMSE) turbo equalization has been reported to remove the ICI in the additive white Gaussian noise (AWGN) environment, while no meaningful result in the multipath fading environment has been reported at present. In addition, the SSC-FDM poses considerable difficulties in proper channel estimation and equalization in the frequency domain due to the non-orthogonal subcarrier arrangement. In this paper, we propose a receiver architecture in which time-domain equalization schemes are applied to the SSC-FDM using SC-MMSE turbo equalization, assuming the mobile communication system. In addition, the usefulness of the proposed scheme is discussed with regard to the block error rate (BLER) and throughput performance in the multipath fading environment by computer simulation.
Features of Wireless Communications in the Manufacturing Field - Towards Densely and Efficiently Utilize Radio Resources in Dedicated Areas
Authors : Satoko Itaya (NICT, Japan); Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: It is keened to realize flexible lines for following with this change and the wireless communication is a key factor for that. In this paper, we report instability of wires environment in the factories. And we introduce an application which is expected to appear in future factories, and show problems the application will have to coexistence of other wireless systems in dedicated areas as factories.

Experiments of Wireless Communications in the Manufacturing Field - Surrounding Environments Effect Wireless Communication Devices
Authors : Jun Hasegawa and Satoko Itaya (NICT, Japan); Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: Recently, introductions of systems using wireless communication to manufacturing field are becoming active. In this paper, we report results of experiments in the active manufacturing field using multiple wireless communications. We did our experiments in the operating manufacturing filed where big metal objects were treated. We report verification result about influence that hydrothermal environment and movement of persons give to wireless communication quality in the factory.

Examples of Industrial ICT Application Products
Authors : Ryota Yamada (OMRON Corporation, Japan)

Abstract: In this paper, two examples of industrial ICT applications are introduced: (1) Time-line Data Visualization which improves productivity and (2) FEMS which improve and balance product quality and energy efficiency. Wireless products such as sensors and switches employing Sub-GHz radio for the factory environment are also introduced.

Recent Activities for Promotion and Standardization to Accelerate Wireless Utilization for Factory IoT
Authors : K. Maruhashi (NEC, Japan)

Abstract: In the manufacturing field, more IoT devices will be introduced to improve productivity and to realize high-mix low volume production adapting to customer demands. Wireless utilization makes communication flexible, lowering a barrier to collect data from IoT devices, such as sensors and cameras. However, a factory is not easy place for stable wireless communications, where various wireless systems coexist in a dedicated area with dynamically changing radio propagation and rich-interference. This paper describes requirements and issues of wireless communications for factory IoT followed by recent activities for promotion and standardization of technology to stabilize wireless systems for information-oriented factories.
Wireless Communications and PHY 5 (WCPHY 5) Session
December 19, 2017 (11.00 - 12.30)

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<td>Zhenzhen Liu, Kai Niu and Jiaru Lin (Beijing University of Posts and Telecommunications, P.R. China)</td>
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<td>High-Order Circular QAM Constellation with High LDPC Coding Rate for Phase Noise Channels</td>
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<td>Shinya Matsuufuji, Takahiro Matsumoto, Yuta Ida and Sho Kuroda (Yamaguchi University, Japan)</td>
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**Parallel Concatenated Systematic Polar Code Based on Soft Successive Cancellation List Decoding**

*Authors: Zhenzhen Liu, Kai Niu and Jiaru Lin (Beijing University of Posts and Telecommunications, P.R. China)*

Abstract: In this paper, we investigate the parallel concatenated systematic polar code (PCSPC) with soft successive cancellation list (SSCL) decoding algorithm. Based on the successive cancellation list (SCL) decoding, the key process of SSCL about how to calculate the soft information which is need for the iterative decoding is presented in detail. Compared to PCSPC with belief propagation (BP) decoding or soft cancellation (SCAN) decoding, the one with SSCL decoding has about 0.6 or 0.5 dB performance gains at bit error rate $10^{-4}$.

**Performance Evaluation of Rate-Compatible Polar Codes Using Puncturing/Shortening**

*Authors: Taku Sugimoto (Kagawa University, Japan); Satoshi Suyama (NTT DOCOMO, INC., Japan); Satoshi Nagata (NTT DoCoMo, Inc., Japan); Nobuhiko Miki (Kagawa University, Japan)*

Abstract: Polar codes are considered promising channel codes for future mobile communication systems. However, the code lengths of the original polar codes are limited to the power of two. In this paper, we employ the existing schemes, puncturing and shortening schemes with relatively low complexity to overcome the code length limitation of polar codes. We introduce an additional variation of shortening method. Using computer simulations, we evaluated the block error rate performance by employing the puncturing and shortening techniques for different coding rates and different puncturing/shortening ratios that produced different performance degradation levels. The Simulation results showed that the shortening scheme, which generated the shortening set from the normal order permutation, could achieve good performance with relatively low complexity.

**Performance Analysis of Physical Layer Security over Different Error Correcting Codes in Wireless Sensor Network**

*Authors: Mohammed Ahmed Magzoub Albashier (Multimedia University, Malaysia); Azlan Abdul Aziz (Multimedia University, Melaka, Malaysia); Hadhrami Ab Ghani (Multimedia University, Malaysia)*

Abstract: Nowadays wireless sensor networks are becoming very important part in our daily life as it is adopted in various applications. However wireless sensor networks are vulnerable to many attacks such as denial of service. Therefore, the number of security threats has increased dramatically due to the increase in the number of applications adopted wireless sensor networks. Physical layer security is considered to be more robust than upper layers security. In this paper we address
the problem of evaluating popular techniques (Reed Solomon techniques and scrambled error correcting) in term of security gap which is the difference between the signal to noise ratio of the legitimate receiver and the signal to noise ratio of the eavesdropper. Our work compare scrambled t-error correcting codes with Reed Solomon using bit error rate and security gap. Experiments and analysis showed that Reed Solomon has almost the same security gap as scrambled error correcting codes which requires more computational power than Reed Solomon.

High-Order Circular QAM Constellation with High LDPC Coding Rate for Phase Noise Channels
Authors : Bin Zheng (Tokyo City University, Japan); Lianjun Deng (NEC, Japan); Mamoru Sawahashi (Tokyo City University, Japan); Norifumi Kamiya (NEC Corporation, Japan)

Abstract : This paper proposes a design for a high-order circular quadrature amplitude modulation (QAM) constellation using partial low-density parity-check (LDPC) coding associated with parallel double Gray mapping aiming at the application to a microwave radio backhaul to deal with time-varying phase noise channels. In the proposed circular QAM constellation design, we first design the best constellation in which the same number of signal points is mapped to all concentric rings. Then, we decrease the number of signal points in the inner rings and remap the signal points to the newly added rings outside the original rings while maintaining high affinity to the double Gray mapping feature. Computer simulation results show that partial LDPC coding with double Gray mapping decreases the required received signal-to-noise power ratio (SNR) at the bit error rate (BER) of 10^-6 by approximately 0.2 dB compared to full LDPC coding for a high LDPC coding rate such as 0.9. We also show that the proposed circular 1024QAM decreases the required received SNR at the average BER of 10^-6 by approximately 0.5 dB compared to that for rectangular 1024QAM.

A Study on Matched Filter Banks of P-Phase ZCZ Codes
Authors : Shinya Matsufuji, Takahiro Matsumoto, Yuta Ida and Sho Kuroda (Yamaguchi University, Japan)

Abstract : A set of sequences with a zero correlation zone named as a ZCZ code can provide CDMA systems with interference free performance called ZCZ-CDMA. A ZCZ code with the slightly large zero correlation zone, in which family size reaches the mathematical upper bound, may be used to offer a CDMA system with high stability and transmission efficiency in inferior channel environment. This paper designs a matched filter bank (MFB) of p-phase ZCZ codes with the above properties, which can simultaneously take correlation between a received symbol sequence and every sequence in the ZCZ code, and can be designed by the minimum number of circuit elements. The MFB will provide a ZCZ-CDMA module which can construct a network system flexibly, since it can detect all data bits at the same time and can utilize them.
### Performance Analysis of Fast Optical OFDM for VLC

**Authors:** Suseela Vappangi (National Institute of Technology Warangal, India); Venkata Mani Vakamulla (National Institute of Technology Warangal, India)

**Abstract:** The dual property of LEDs to facilitate illumination and Communication concurrently has driven Visible Light Communication (VLC) as an emerging technology and a promising alternative to Radio Frequency (RF) Communication. The primary objective of VLC is to increase the data rates and to have better performance of the networks especially for indoor applications. In this juncture, for the purpose of increasing the Information Spectral Density (ISD), Fast Optical Orthogonal Frequency Division Multiplexing (FOOFDM) can be exploited. In this work, the performance of FOOFDM is evaluated by employing various channel estimation algorithms and Probability of Error expression is derived for the developed system models. In addition, investigations on channel estimation in DC Biased Optical OFDM (DCO-OFDM) is carried out where, the result analysis emphasize that, FOOFDM is superior in terms of both power efficiency and spectral efficiency when compared to DCO-OFDM. Employing a real-valued transform and its simple one dimensional modulation, makes FOOFDM to exhibit lower computational complexity when compared with Hermitian symmetry imposed optical OFDM (DCO-OFDM).

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### Monte Carlo Algorithm for the Evaluation of the Distance Estimation Variance in RSS-Based Visible Light Positioning

**Authors:** Nobby Stevens (KU Leuven, Belgium); David Plets (Ghent University - imec, Belgium); Lieven De Strycker (KU Leuven, Belgium)

**Abstract:** In this work, the Monte Carlo algorithm to determine the variance on the distance estimation in Received Signal Strength-based visible light positioning is considered. The method is build on the maximization of the signal-to-noise-ratio by means of matched filtering, and leads to a number of characteristics that are typically only obtained after intensive analytical elaborations. It is shown that the results match those obtained by calculating the Cramer-Rao lower bound when only the noise is considered as non-deterministic. It is demonstrated that the method is also applicable when multiple physical parameters exhibit a probability distribution, leading to an assessment of the distance estimation accuracy in more realistic settings.

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### Impact of Wavelength Dependency of LED and Photodiode in Visible Light Positioning

**Authors:** Kevin Verniers (KU Leuven, Belgium); Liesbet Van der Perre (KUL, Belgium); Nobby Stevens (KU Leuven, Belgium)

**Abstract:** The wavelength dependency of LEDs and photodiodes in RSS-based Visible Light Positioning systems is sometimes omitted in the calculations. This study investigates the consequences on the accuracy of this approach. A simulation-based approach is used to model the propagation of light in a realistic setup, taking into account the wavelength dependency of both the LED and the photodiode. The results show that ignoring this dependency can lead to significant errors in the distance estimation, especially in environments with high levels of ambient light.

---

### Behavior of Non-Directed Optical Wireless Channel Considering Receiver Orientation

**Authors:** Thai Bang Hoang and Stephanie Sahuguede (University of Limoges, France); Anne Julien-Vergonjanne (University of Limoges & XLIM UMR CNRS 7252, France)

**Abstract:** The behavior of non-directed optical wireless channels is studied considering the orientation of the receiver. The impact of receiver orientation on the channel characteristics is analyzed using both theoretical models and simulation techniques. The results show that channel gain can vary significantly with receiver orientation, which has implications for the design of optical wireless communication systems.

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### Transmission Quality Improvement by LED Back-off Optimization for Visible Light Wireless Communications

**Authors:** Takahiro Chikamori, Shigeru Tomisato, Satoshi Denno and Kazuhiro Uehara (Okayama University, Japan)

**Abstract:** The transmission quality of visible light wireless communications can be improved by optimizing the LED back-off. By adjusting the LED power, the transmission distance and bit error rate can be enhanced. The impact of back-off optimization on the system performance is analyzed using both theoretical analysis and simulation techniques. The results show that careful back-off optimization can lead to significant improvements in transmission quality.

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**Wireless Communications and PHY 6 (WCPHY 6) Session**

December 19, 2017 (11.00 - 12.30)
assessment is performed, where a single link is considered. The received signal strength is used to estimate the distance between LED and photodiode. Results are obtained for different phosphor coated LEDs and photodiodes. It is shown that neglecting the wavelength dependency results in distance estimation errors in the order of 10%. This severe degradation would undermine the achievable accuracy of VLP systems (order of centimeters). The result shows that regardless the used photodiode, LEDs with a high correlated color temperature are more prone to distance estimation errors in comparison with low correlated color temperature LEDs.

**Behavior of Non-Directed Optical Wireless Channel Considering Receiver Orientation**

*Authors : Thai Bang Hoang and Stephanie Sahuguede (University of Limoges, France); Anne Julien-Vergonjanne (University of Limoges & XLIM UMR CNRS 7252, France)*

Abstract : In this article, we investigate the feasibility of an infrared uplink regardless of the position of the transmitter in the environment when the receivers are positioned at each corner of a square central luminaire. This configuration could correspond to a luminaire used also for downlink communication in visible range. The scenario is studied as an alternative easier to implement than classical one where the receivers are uniformly distributed over the ceiling and oriented perpendicularly towards the floor. Our main objective is to determine for our scenario the best orientations of the receivers using diversity technique to obtain at least the same performance as in the classical case. For this purpose, we use channel simulations based on ray-tracing method to obtain the optical gain statistics. The results obtained from the analysis show that for the investigated scenario it is possible to obtain a better performance than with perpendicular oriented receivers spatially distributed over the ceiling. Experimentations permit validating theoretical results regarding receiver orientation impact.

**Transmission Quality Improvement by LED Back-off Optimization for Visible Light Wireless Communications**

*Authors : Takahiro Chikamori, Shigeru Tomisato, Satoshi Denno and Kazuhiro Uehara (Okayama University, Japan)*

Abstract : This paper proposes an LED back-off optimization method for visible light wireless communications. The method changes the set back-off value and controls LED saturation according to Noise-to-Carrier power ratios (N/C) of a receiver. Signal-to-Noise and Distortion Ratio (SNDR) of a receiver with the proposed method is evaluated by computer simulation. In this evaluation, a wireless system with OFDM signals is assumed and an LED linearization method which uses clipping followed by inband filtering and pre-distortion is employed. The evaluation results show that the back-off optimization can improve transmission quality in a receiver. The result also shows that the linearization method can enhance the improvement.
Wireless Network 2 (WN2) Session  
December 19, 2017 (11.00 - 12.30)

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<td>Ahmad Shokair (Institut National des Sciences Appliquées de Rennes &amp; Lebanese University, France); Matthieu Crussière (IETR - Electronics and Telecommunications Research Institute of Rennes (IETR) &amp; INSA - National Institute of Applied Sciences, France); Jean-François Hélard (IETR, France); Youssef Nasser (American University of Beirut, Lebanon); Oussama Bazzi (Lebanese University, Lebanon)</td>
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<td>Lei Zhang, Xinyu Gu, Zhenyu Liu and Lin Zhang (Beijing University of Posts and Telecommunications, P.R. China); Hichan Moon (Hanyang University, Korea)</td>
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<td>Wei-Shun Liao (National Institute of Information and Communications Technology (NICT), Japan); Mirza Golam Kibria (National Institute of Information and Communications Technology, Japan); Gabriel Villardi and Ou Zhao (National Institute of Information and Communications Technology (NICT), Japan); Kentaro Ishizu and Fumihide Kotjima (National Institute of Information and Communications Technology, Japan)</td>
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<td>Connection Admission Control Strategy for Wireless VoIP Networks Using Different Codecs and/or Codec Mode-sets</td>
<td>Mario A. Ramírez-Reyna (CINVESTAV-IPN, Mexico); Felipe A. Cruz-Pérez (Cinvestav-IPN, Mexico); S. Lirio Castellanos-Lopez (UAM, Mexico); Genaro Hernandez-Valdez (UAM-A, Mexico); Mario E. Rivero-Angelés (Instituto Politécnico Nacional &amp; CIC-IPN, Mexico)</td>
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**UHD Video Transmission Using Adaptive SHVC in Wireless Networks**  
Authors : Chetna Singhal and Ajay Sahu (Indian Institute of Technology Kharagpur, India)

Abstract : Scalable extension of High Efficiency Video coding (SHVC) is an ideal candidate for delivering Ultra High Definition (UHD) content to heterogeneous clients. In this work we propose a system architecture to deliver UHD content adaptively based upon bandwidth and end user device specifications over wireless network. For the adaptive transmission we need a Parametric rate model for bit rate adaptation. Hence, we study the effect of quantization, frame rate, and spatial resolution on bit rate in order to develop a Parametric rate model for SHVC videos. The rate model is developed in terms of quantization step size, frame rate, and spatial resolution. It is observed that the model fits into measured data with high Pearson Correlation. The rate model helps in deciding the quantization parameter, frame rate, and spatial resolution for the given bandwidth conditions so as to improve the user experience. The receiver sends the channel conditions and device capabilities (like device resolution support and processing power) to the transmitter. Based on this, the transmitter adaptively changes the transmitted bit stream. The overall system performance is evaluated in terms of the PSNR of the transmitted and received video sequence.

**Mobile TV Directed Resource Allocation Scheme for LTE**  
Authors : Ahmad Shokair (Institut National des Sciences Appliquées de Rennes & Lebanese University, France); Matthieu Crussière (IETR - Electronics and Telecommunications Research Institute of Rennes (IETR) & INSA - National Institute of Applied Sciences, France); Jean-François Hélard (IETR, France); Youssef Nasser (American University of Beirut, Lebanon); Oussama Bazzi (Lebanese University, Lebanon)

Abstract : Resource allocation in LTE networks has attracted extensive research efforts. However, linear services (such as Digital TV programs) have been barely considered from the resource allocation perspectives. Indeed, when a linear service
is offered to the end-users, the network should satisfy the maximum number of users served rather than maximizing the sum rate capacity. In this paper, linear services oriented resource allocation strategy is proposed. The proposed approach aims at maximizing the users’ success rate, based on a minimum required quality of service (QoS) measured in terms of minimum throughput. The proposed method was tested in different scenarios and has shown great robustness against user density, user requirements and reuse factor.

Modeling and Analysis of Indoor Coverage Probability for Future 3D Dense Mobile Networks
Authors : Lei Zhang, Xinyu Gu, Zhenyu Liu and Lin Zhang (Beijing University of Posts and Telecommunications, P.R. China); Hichan Moon (Hanyang University, Korea)

Abstract : This paper puts forward a new model to analyze the coverage performance of future three-dimensional (3D) dense mobile networks in the indoor environment, where the impact of penetration loss and the distance between two walls on network performance is taken into consideration. Then based on the proposed model, analytical expressions of coverage probability is derived by using tools from stochastic geometry, where the location of small base stations is modeled as a 3D Poisson Point Process. For comparison, similar work is taken for 2D mobile network. Finally, Monte Carlo simulations are conducted to illustrate the accuracy of the proposed penetration model and derived expressions.

CoMP Set Formulation for Downlink Transmission in Dense Small Cell Networks
Authors : Wei-Shun Liao (National Institute of Information and Communications Technology (NICT), Japan); Mirza Golam Kibria (National Institute of Information and Communications Technology, Japan); Gabriel Villardi and Ou Zhao (National Institute of Information and Communications Technology (NICT), Japan); Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract : The small cell network is one of the emerging technologies for the next generation wireless systems. It can enlarge cell coverage, boost peak data rate, improve link quality, and offer flexible deployment. In this paper, we investigate a specific small cell network scenario, where the density of small cell base stations (BS) is much higher than that of user equipments (UE). Under this condition, each UE can be served by multiple small cell BSs, which also motivates the use of coordinated multi-point (CoMP) transmissions in dense small cell networks. Therefore, in this paper, we investigate the small cell network with highly dense deployment of small cell BSs, and propose CoMP set formulation method, which selects small cell BSs according to the designed metric, for downlink (DL) transmissions. We also conduct simulations to validate the performance of the proposed method, and the simulation results show that the proposed CoMP method can indeed improve the performance of dense small cell networks and hence offer better communication quality.

Connection Admission Control Strategy for Wireless VoIP Networks Using Different Codecs and/or Codec Mode-sets
Authors : Mario A. Ramírez-Reyna (CINVESTAV-IPN, Mexico); Felipe A. Cruz-Pérez (Cinvestav-IPN, Mexico); S. Lirio Castellanos-Lopez (UAM, Mexico); Genaro Hernandez-Valdez (UAM-A, Mexico); Mario E. Rivero-Angelés (Instituto Politecnico Nacional & CIC-IPN, Mexico)

Abstract : In this paper, a differentiated call admission control (CAC) strategy for VoIP trafficbased wireless networks using different codecs and/or codec mode-sets is proposed and mathematically analyzed. The aim of this strategy is to regulate and restrain the admission of most resource demanding VoIP sessions (those with a larger packet size requirement). To this end, upon the arrival of new VoIP session requests, the number of VoIP sessions using a given codec and/or codec mode-set is weighted by a factor whose value depends on the data rate transmission requirement of that codec and/or codec mode-set. A joint connection and packet level analysis is formulated to assess the performance of the proposed CAC strategy. Maximum achieved Erlang capacity for different data rate transmission requirement ratios and proportion of users using each codec and/or codec mode-set is evaluated. Numerical results show that system performance is improved with the proposed CAC strategy.
New spectrum for wireless applications Session (NICT Session 3)  
December 19, 2017 (13.30 - 15.00)

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<td>Hiroyo Ogawa (National Institute of Information and Communications Technology &amp; Association of Radio Industries and Businesses, Japan)</td>
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<td>90-GHz Band Railway Radiocommunication System Between Train and Trackside</td>
<td>Nobuhiko Shibagaki (Hitachi Kokusai Electric, Japan); Yosuke Sato (Hitachi Kokusai Electric Inc., Japan); Kazuki Nakamura (Railway Technical Research Institute, Japan); Kenichi Kashima (Hitachi Kokusai Electric Inc., Japan); Nagateru Iwasawa and Kunihiro Kawasaki (Railway Technical Research Institute, Japan); Hotaka Ido (Hitachi Kokusai Electric Inc, Japan)</td>
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<td>Naruto Yonemoto (Electronic Navigation Research Institute, Japan)</td>
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<td>Propagation Characteristics of 90-GHz and 300-GHz Bands in the Specific Applications</td>
<td>Hirokazu Sawada, Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan); Hiroyo Ogawa (National Institute of Information and Communications Technolgy &amp; Association of Radio Industries and Businesses, Japan)</td>
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Regulatory Work on 90-GHz and 300-GHz Bands in ITU-R  
Authors : Hiroyo Ogawa (National Institute of Information and Communications Technology & Association of Radio Industries and Businesses, Japan)

Abstract : 2015 World Radiocommunication Conference developed two WRC-19 agenda items. The first WRC-19 agenda item 1.11, based on the results of ITU-R studies, take necessary actions, as appropriate, to facilitate global or regional harmonized frequency bands, to the extent possible, for the implementation of railway radiocommunication systems between train and trackside, within existing mobile-service allocations. The second WRC-19 agenda item 1.15, taking into account the results of ITU-R studies on sharing and compatibility between passive and active services as well as spectrum needs for those services, considers identification for use by administrations for the land-mobile and fixed service applications operating in the frequency range 275-450 GHz, while maintaining protection of the passive services identified in No. 5.565, and take appropriate action. This paper overviews the current study results of the above agenda items.

300-GHz Band Wireless Applications and Technologies  
Authors : Iwao Hosako (National Institute of Information & Communications Technology, Japan)

Abstract : In this paper, the characteristics of terahertz waves from the view point of wireless communication will be reviewed. And the expectation for the deployment to the real society, including the air- or spaceborne communication network are described briefly.

90-GHz Band Railway Radiocommunication System Between Train and Trackside  
Authors : Nobuhiko Shibagaki (Hitachi Kokusai Electric, Japan); Yosuke Sato (Hitachi Kokusai Electric Inc., Japan); Kazuki Nakamura (Railway Technical Research Institute, Japan); Kenichi Kashima (Hitachi Kokusai Electric Inc., Japan); Nagateru Iwasawa and Kunihiro Kawasaki (Railway Technical Research Institute, Japan); Hotaka Ido (Hitachi Kokusai Electric Inc, Japan)

Abstract : Demands for high speed wireless communication system are increasing due to society rapidly require a cloud system. IEEE 80211ad wireless standard realizes short range wireless system over 1 Gb/s in the home or office environment. Public cellular communication systems are also making more than 1-Gb/s throughput in the 5-G system. CMOS technology and common mobile terminal such like smartphone make society dependent on high speed wireless communication. On the
other hand, it is not easy for passenger on the high-speed train to communicate reasonably high speed. We are proposing a new communication system with a combination of radio over technology and W-band millimeter wave wireless communications. We will describe the system architecture and hardware development status also International standardization activities.

90 GHz Foreign Objects and Debris Detection Radar Connected by Radio over Fiber
Authors: Naruto Yonemoto (Electronic Navigation Research Institute, Japan)

Abstract: We are investigating the millimeter wave radar system to cover the vast space with high range resolution. These challenges are owing to the combination of 90GHz millimeter wave and Radio over Fiber (RoF) technologies. This paper introduces the background of system development, the architecture of the system, and preliminary result of a field test in Narita International Airport. We also discuss the improvement of the two-dimentional positioning of the object using the data from plural remote radar heads.

Propagation Characteristics of 90-GHz and 300-GHz Bands in the Specific Applications
Authors: Hirokazu Sawada, Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan); Hiroyo Ogawa (National Institute of Information and Communications Technology & Association of Radio Industries and Businesses, Japan)

Abstract: For designing the wireless applications using millimeter-wave and terahertz-wave, the first step is to know the radio propagation characteristics. In this paper, our recent studies of radio propagation are introduced for two topics in frequency bands of 90 and 300 GHz. 90-GHz band propagation characteristics includes path loss and r.m.s. delay spread distribution are described for railway communication systems between train and trackside. 300-GHz band path loss characteristics are described for several indoor environments. Developed propagation models will be a useful tool for designing the specific future radio communication systems.
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<td>Gerald Artner (Vienna University of Technology, Austria); Jerzy Kowalewski (Karlsruhe Institute of Technology, Germany); Christoph F Mecklenbräuker (Vienna University of Technology, Austria); Thomas Zwick (Karlsruhe Institute of Technology (KIT), Germany)</td>
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**Automotive Pattern Reconfigurable Antennas Concealed in a Chassis Cavity**

Authors: Gerald Artner (Vienna University of Technology, Austria); Jerzy Kowalewski (Karlsruhe Institute of Technology, Germany); Christoph F Mecklenbräuker (Vienna University of Technology, Austria); Thomas Zwick (Karlsruhe Institute of Technology (KIT), Germany)

Abstract: Pattern-reconfigurable antennas for the 2.45 GHz ISM band are concealed inside a chassis antenna cavity. Three antennas are designed to reconfigure between near-optimum radiation patterns for urban scenarios by toggling between front/back and left/right radiation. The three antennas follow distinct design principles and have different gain switching capabilities. Antenna performance is evaluated based on gain pattern measurements. It is shown, that the antennas retain their reconfiguration functionality when they are placed in the chassis cavity beneath the vehicle’s roof.

**Performance Analysis of the Maximum Ratio Transmission Preprocessing for Extended Receive Antenna Shift Keying**

Authors: Ali Mokh (Institut National des Sciences Appliquées de Rennes, France); Matthieu Crussière (IETR - Electronics and Telecommunications Research Institute of Rennes (IETR) & INSA - National Institute of Applied Sciences, France); Maryline Hélard (INSA Rennes & IETR Institute of Electronics and Telecommunications of Rennes, France)

Abstract: The Extended Receive Antenna Shift Keying (ERASK) scheme is a MIMO scheme based on the Receive Spatial Modulation concept, invented to increase the overall spectral efficiency, by exploiting all possible combinations of receive antenna indexes. In this paper, we evaluated the ERASK scheme using the Maximum Ratio Transmission (MRT) preprocessing (MRT-ERASK), using the real amplitude threshold detector and compare it with the ERASK scheme using the Zero Forcing (ZF) preprocessing (ZF-ERASK). Analytical derivations of the received signal of the MRT-ERASK show that a complex interantenna interference is added to other antennas depending on the transmitted spatial symbol. The Bit Error Rate performance is also derived analytically. Simulation results over MIMO Rayleigh channel are provided to compare both systems, showing that ZF-ERASK outperforms MRT-ERASK but at the expense of a higher implementation complexity for ZF-ERASK. On the other hand, increasing the number of transmit antennas of a MRT-ERASK improves its performance getting closer to the performance ZF-ERASK. Therefore, the higher the number of transmit antennas, the nearer the performance of both systems, and the more suitable the MRT-ERASK to be implemented.
Ultra Wide Band Crescent Antenna with Enhanced Maximum Gain
Authors: Cengizhan Dikmen, Gonca Çakır and Sibel Çimen (Kocaeli University, Turkey)

Abstract: In this study, an ultra wide band microstrip antenna fed by coplanar waveguide with enhanced maximum gain is designed. Size of the designed antenna is 60x38mm and the dielectric material (Rogers RO3006) with relative dielectric constant εr=6.15 is used. At the designing stages, the effects of the modifications on the gain is examined too. The gain of the modified antenna is increased with minimum 1dB and maximum 3 dB at whole bandwith.

A User Cooperation Aided Device-Centric Clustering Approach for Large-Scale Distributed Antenna Systems
Authors: Ou Zhao, Lin Shan and Wei-Shun Liao (National Institute of Information and Communications Technology (NICT), Japan); Huan-Bang Li, Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: Large-scale distributed antenna systems (LS-DASs) are gaining increasing momentum and emerging as highly promising candidates for future wireless communications. To improve the user’s quality of service (QoS) in that systems, in the present study, we propose a user cooperation aided clustering approach based on device-centric architectures and enable the multi-user multiple-input multiple-output transmissions with non-reciprocal setups. We actively use device-to-device communication techniques to achieve the sharing of user information and try to form clusters on user side instead of the traditional way that performs clustering on base station (BS) side in data offloading. We further adopt a device-centric architecture to break the limits of the classical BS-centric cellular structure. Moreover, we derive an approximate expression to calculate the user rate for LS-DASs with employment of the zeroforcing precoding and consideration of inter-cluster interference. Simulated and numerical results indicate that the approximate expression predicts the user rate with a lower computational cost, and the proposed approach provides better user experience for, in particular, the users who have unacceptable QoS.

Reduced Complexity Decoder for FDD MIMO Beamforming Systems with Large Antenna Arrays
Authors: Gabriel Villardi (National Institute of Information and Communications Technology (NICT), Japan); Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: It is of great interest to develop larger scale multipleinput-multiple-output (MIMO) technology based on frequency division duplexing (FDD) for backward compatibility with existing standards and already deployed cellular networks. One hindrance to the FDD approach is the codeword search complexity performed by the decoder, which is known to scale with the number of transmit antennas Nt in a system. The codeword search complexity does not scale linearly and soon becomes infeasible even for the moderately large MIMO systems expected in the very near future. We address this problem by proposing a ‘natural sequence based orthogonal codebook’ and an ‘intraarray interference magnitude’ (IIM) framework for decoding in MIMO based on quantized equal gain transmission (QEGT) that altogether tremendously simplifies the codeword search problem despite suffering from only a small sacrifice in performance.
Wireless Communications and PHY 8 (WCPHY 8) Session  
December 19, 2017 (13.30 - 15.00)

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<td>Xuekang Sun (Beijing University of Posts and Telecommunications, P.R. China); Rikang Zhou (Beijing University of Posts and Telecommunications, P.R. China); Hongxing Wu and Li Gao (Beijing University of Posts and Telecommunications, P.R. China); Zhang Yuyan (Beijing university of P&amp;T, P.R. China)</td>
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<td>Ye Tian and Daito Shigaki (Chiba University, Japan); Wenhuan Wang (Nokia, Bell labs, Alcatel-lucent Shanghai, P.R. China); Chang-Jun Ahn (Chiba University, Japan)</td>
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<td>Theoretical Analysis of BER Performance of OCDMA System Using Compact Matched Filter Bank for an Optical ZCZ Sequence Set</td>
<td>Takahiro Matsumoto (Yamaguchi University, Japan); Hideyuki Torii (Kumamoto University, Japan); Yuta Ida and Shinya Matsufuji (Yamaguchi University, Japan)</td>
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Adaptive Forward Link Formation for Terminal Collaborative Reception  
Authors: Satoshi Denno (Okayama University, Japan); Hidekazu Murata (Kyoto University, Japan); Daisuke Umehara (Kyoto Institute of Technology, Japan)

Abstract: Collaborative reception has been proposed to improve the frequency utilization efficiency in wireless networks. This paper proposes adaptive forward link formation that selects not only terminals to forward received signals to the destination but also higher frequency bands for the forward link. Moreover, this paper proposes a complexity-reduced algorithm for the selection. The proposed formation achieves about 2-times higher frequency utilization efficiency than the fixed formation. While the proposed complexity-reduced algorithm attains similar frequency utilization efficiency as the exhaustive search, the proposed algorithm reduces the complexity of the selection to almost 1/200 of the exhaustive search.

Concept, Design, and Prototype of Shared Base Station Supporting Millimeter Waves for 5G Cellular Networks  
Authors: Takeshi Matsumura (Kyoto University & National Institute of Information and Communications Technology (NICT), Japan); Kazuo Ibuka, Kentaro Ishizu, Homare Murakami and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: In the 5G cellular networks, micro-cells using mmW (millimeter Wave) bands will be densely deployed to enhance communication speed and capacity. On the other hand, mobile network operators are facing a significant challenge of how to realize ultra-dense micro-cell networks in a cost-effective manner. Recently, a new concept of network sharing toward multi-tenancy networks has been proposed and studied. In this concept, network resources including the BS (Base Station) are shared by multiple operators, resulting in significant cost reduction. In this respect, the shared BS needs to support several RATs (Radio Access Technologies) including mmW bands for providing a variety of communication systems. In this study, we prototype a shared BS supporting mmW bands based on the LTE system, by applying the frequency conversion technology to the off-the-shelf LTE eNB. This shared BS is mainly composed of an IF transceiver unit for the 4.5 GHz band and RF converter units for 28 GHz and 32 GHz bands. In addition, by applying the same architecture to the off-the-shelf UE, we successfully demonstrate the data transmission between the shared BS and the UE in 4.5 GHz, 28 GHz, and 32 GHz bands.
Angle Based Malicious User Detection for Wideband Cognitive Radio Network

Authors: Xuekang Sun (Beijing University of Posts and Telecommunications, P.R. China); Rikang Zhou (Beijing University of Posts and Telecommunications, P.R. China); Hongxing Wu and Li Gao (Beijing University of Posts and Telecommunications, P.R. China); Zhang Yuyan (Beijing university of P&T, P.R. China)

Abstract: The cognitive radio (CR) users usually lack global information about the usage of the current spectrum resource, which makes the CR network (CRN) vulnerable to all sorts of attacks by malicious user (MU). Therefore, substantial studies have been focused on the attack-proof collaborative spectrum sensing schemes in the narrow-band environment. However, the high dimensional data obtained in the wideband spectrum sensing leads to the problem of “the curse of dimensionality”. To solve this problem, we study the nature of spectrum sensing data falsification (SSDF) attacks and propose an angle based malicious user detection (ABMUD) to identify the MUs. In this scheme, we not only employ the distance between CR users in full detection space, but also the directions of distance vectors. The simulation results show that the proposed ABMUD algorithm can detect SSDF independent attacks very well.

A Weighted Least-Squares Method Using Received Signal Strength Measurements for WLAN Indoor Positioning System

Authors: Ye Tian and Daito Shigaki (Chiba University, Japan); Wenjian Wang (Nokia, Bell labs, Alcatel-lucent Shanghai, P.R. China); Chang-Jun Ahn (Chiba University, Japan)

Abstract: GNSS (Global Navigation Satellite System), which is commonly used for positioning in outdoor environments, cannot be used in indoor environments because of unreachable radio waves. Therefore, the theory and algorithm for wireless indoor positioning systems has been extensively researched. Nevertheless, positioning using radio signals are influenced by multipath propagation and other cause. Therefore, how to approach the optimum location accuracy has been recognized as a difficult task. In this paper, we focus on the Received Signal Strength Indication (RSSI) positioning method of a Wireless Local Area Network (WLAN) system. To improve the positioning accuracy, we developed a simple and efficient positioning algorithm by using a novel weighted least-squares method. From the simulated and experimented results, the proposed method has a higher degree accuracy compared with the conventional methods.

Theoretical Analysis of BER Performance of OCDMA System Using Compact Matched Filter Bank for an Optical ZCZ Sequence Set

Authors: Takahiro Matsumoto (Yamaguchi University, Japan); Hideyuki Torii (Kanagawa-It, Japan); Yuta Ida and Shinya Matsufuji (Yamaguchi University, Japan)

Abstract: The optical zero-correlation zone (ZCZ) sequence set is a set of pairs of binary and bi-phase sequences with a zero-correlation zone, and can provide optical code division multiple access (OCDMA) systems without cochannel interference. We have proposed the construction of a compact-type matched filter bank for this sequence set. However, the OCDMA system using this filter bank might have reduced bit error rate (BER) performance because the input-output characteristics of this filter bank for this sequence set with the zero-correlation zone 4z = 2, 1, 2, ⋯ are nonlinear. In this paper, we clarify that the BER performance of the OCDMA system using a compact-type matched filter bank is not influenced by the nonlinear characteristics of this filter bank, using the theoretical formula of BER characteristics and computer simulation.
### Investigating About the Paging Resource Allocation in NB-IoT

**Authors:** Jiahui Liu (DOCOMO Beijing Communications Laboratories, P.R. China); Liu Liu and Qin Mu (DOCOMO Beijing Communications Laboratories Co., Ltd, P.R. China); Lan Chen (DOCOMO Beijing Communications Laboratories Co., Ltd., P.R. China)

**Abstract:** Internet of Things (IoT) is a way of connecting everything around us together, which would be widely applied in the 5G era. Narrow band IoT (NB-IoT) is one of the solutions introduced from 3rd Generation Partnership Project (3GPP) Release-13 to fulfill this concept. Massive connection and narrow band operation are two key features of NB-IoT. With current NB-IoT design, certain resources within narrow band are dedicated for transmitting paging information of massive connections. This leads to overload of the dedicated resources, and consequently increased padding bits and low resource efficiency. Moreover, UE power consumption would also rise due to the extra effort to decode larger packets. To solve above problems, a new resource allocation method is proposed, which includes a new definition of paging resource set and corresponding resource selection method. Link level simulation is conducted to show the benefit of our proposals. It is observed that approximately power consumption could be saved by 80% and the resource efficiency could be improved by 30.5% by utilizing our proposed methods.

### A Dynamic Routing Protocol Supporting Mobile Nodes in Wi-SUN FAN Systems

**Authors:** Thidarut Junjaearnvong, Takuya Habara, Ryota Okumura, Keiichi Mizutani and Hiroshi Harada (Kyoto University, Japan)

**Abstract:** Wireless Smart Utility Network (Wi-SUN) has been standardized to provide Machine-to-Machine (M2M) communication in Low power and Lossy Networks (LLNs). WiSUN Field Area Network (FAN) is the specification that maintains a wireless multi-hop communication on the advanced smart city infrastructure. Wi-SUN FAN has adopted the Internet Protocol version 6 (IPv6) Routing Protocol for LLNs (RPL) which has been successfully optimized in fixed terminals. To establish the embedded smart city, mobile nodes are required to implement the RPL as well. Nevertheless, the RPL fails to choose the appropriate routing node when the terminal moves, resulting in high packet loss. To improve the transmission performance, the system simulator of Wi-SUN FAN with the Expected Transmission Count (ETX) based algorithm is firstly developed to evaluate the end-to-end transmission success rate via multi-hop transmission and the simulation result clarifies that the critical factor causing low transmission performance is the unsmooth handover of the receiver node at first hop.
Then, a dynamic routing algorithm based on ETX transition is proposed and the simulation result finally assures the smooth handover, resulting in the improved transmission performance.

**Wifi Channel Selection Based on Load Criteria**
Authors: Danielle Saliba (Institut Mines Telecom Atlantique, France); Rodrigue Imad (University of Balamand, Lebanon); Sebastien Houcke (Institut Mines Telecom Atlantique, France)

Abstract: With the increasing demand for wireless communication systems, while Heterogeneous Networks (Het-Nets) are under study toward 5G technology in mobile communication systems, WiFi Access Points (APs) are considered a potential layer within those multiple Radio Access Technologies (RATs). Significant network capacity gain can be achieved not only through aggressive reuse of spectrum across the multiple tiers in the network, but also by integrating WiFi in the mobile network through additional spectrum in un-licensed bands. Different criteria should be investigated in order to allow both the WiFi APs and the end user to operate on the best suitable channel, where the basic one of those criteria is the “load” of the operating channels. We propose in this paper an accurate algorithm for the estimation of WiFi 802.11n physical channels load through 3 channels observations only. Once the channel load is estimated using the proposed algorithm, the channel assignment based on the minimal load value is acquired, thus providing faster response of an AP channel selection and faster end user connection for better Quality of Experience (QoE).

**Dynamic Multi Hop Routing Protocol for Unbalanced Sized Clusters in Wireless Sensor Networks**
Authors: Misbahuddin Misbahuddin and Rini Fitri Sari (Universitas Indonesia, Indonesia); Anak Agung Putri Ratna (Universitas Indonesia, Indonesia)

Abstract: Wireless sensor networks is a rapidly emerging technology implemented in various applications for several domains. One of the important considerations in wireless sensor networks is the network lifetime because the sensor nodes are battery powered and difficult to replace or recharge when they are deployed in dangerous or inaccessible environments. Various node clustering approaches have been implemented to achieve energy efficiency in order to prolong the network lifetime. However, the approaches are only suitable for a certain application scope. The data similarity aware node clustering is a specific application that does not consider load balancing of clusters, so that it also requires a proper routing protocol. The main challenge in such clustering approach is that some nodes are far apart from other nodes and the network structure change dynamically. Therefore, it is required a dynamic multi hop routing protocol to address the problem. In this work, we propose a dynamic multi-hop routing protocol based on the rules incorporating fuzzy system and particle swarm optimization to obtain the priority factor of cluster head election. Our proposed Dynamic Multi-Hop Routing for Unbalanced Sized Cluster (DMHR-USC) protocol was compared against the K-hop Clustering Algorithm (KHOPCA) protocol to justify the performance. The DMHR-USC can reach the network lifetime longer than the KHOPCA in all terms of the First Node Dies (FND), Half of Nodes have Dead (HND), and the Last Node Dies (LND). Therefore, the DMHR-USC can prolong the network lifetime in a relative significant manner.

**Performance Study of Opportunistic Scheduling in Multiuser Cognitive Relay Network**
Authors: Haojin Wang, Qiang Wang and Changli Shen (Beijing University of Posts and Telecommunications, P.R. China)

Abstract: In this paper, we investigate the theoretical performance analysis of opportunistic scheduling for dual-hop cognitive relay network with multiuser in the secondary system. Different from the existing work, we take the consideration of primary user’s interference with opportunistic scheduling technique and theoretically derive the influence of the interference from primary transmitter for the scenario. The cumulative distribution function (CDF) of signal-to-noise ratio (SNR) is formulated and the exact close-form expression of the cognitive relay network outage probability is derived. After calculating the asymptotic outage probability in high SNR regime and asymptotic error probability, we provide an adaptive power allocation scheme in the secondary system to optimize the capacity of system. It is confirmed that the opportunistic scheduling technique for multiuser has a positive influence on the performance of cognitive networks. Moreover, the adaptive power allocation can also promote system performance. Finally, numerical simulations are provided to support and directly reflect the correctness of our analytic results.
## UAV Emergency Session
**December 19, 2017 (15.30 - 17.00)**

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**Wireless Technologies to Assist Search and Localization of Victims of Wide-scale Natural Disasters by Unmanned Aerial Vehicles**

**Authors:** Takumi Kobayashi and Satoshi Seimiya (Yokohama National University, Japan); Kouhei Harada (Yokohama National University, Japan); Masaki Noi (Yokohama National University, Japan); Zane Barker, Graeme K Woodward and Andreas Willig (University of Canterbury, New Zealand); Ryuji Kohno (Yokohama National University & University of Oulu, Japan)

**Abstract:** When natural disasters are occurred, a lot of injured victims should be found and have medical treatment as soon as possible. However, looking for the victims is not easy due to destroyed infrastructures. In order to solve the problems, authors have been proposed several solutions by using multiple unmanned aerial vehicles (UAVs) and dependable wireless communication technology. As a dependable wireless communication, ultra-wide band (UWB) radio which is known as a physical layer (PHY) of wireless body area network (WBAN) is used in this research. UWB radio can realize an accurate localization system which can be used indoor based on high resolution time difference detection of arrival time. Our proposal consists of several steps. At first, geo-location of multiple UAVs are estimated by global navigation satellite system (GNSS) such as global positioning system (GPS). Secondly, one of the multiple drones moves towards to destination in order to expand position estimation coverage area. When a victim who has UWB device is found, anchor nodes on multiple UAVs estimate the position of the victim. In addition, UWB sensor node which is owned by the victim can get vital-sign of the victim and transmit that with position information to rescue team via UAVs. This paper provides the latest results of theoretical analysis and experiments that performed by using actual UAVs and UWB localization system.
New Zealand Side Overview of NZ-JP Joint Project on Dependable Wireless Body Area Networks to Support Search and Rescue and Medical Treatment in Disaster Scenarios
Authors : Graeme Woodward (Research Leader, University of Canterbury, New Zealand)

Abstract : Increasingly people are wearing or implanting biometric and medical sensors, e.g. a wrist-band, heart monitor, foot-mounted accelerometer and a smart phone could form a wireless Body Area Network (BAN). Collectively these measure vital signals to help infer the person’s physiological and psychological state. The future ubiquity of such wireless BANs creates an opportunity to improve response to wide-scale incidents such as earthquakes, tsunamis, landslides, or building collapse where search, rescue and paramedic assistance are imperatives. Both New Zealand and Japan have suffered wide-scale disasters: the 2010/11 Christchurch earthquakes and the 2011 Tōhoku earthquake with ensuing tsunami and power station accident. There is long-term societal benefit for both nations to improve response to future emergencies, through technologies to reduce casualties and exposure of emergency workers to risk. We describe a network of co-operating unmanned aerial vehicles tasked with identifying the locations and health state of casualties using a combination of methods, including detection of radio signatures associated with each person from their wireless BANs. The University of Canterbury team has focussed on discovery of wireless devices. The team has compared numerous detection strategies, including energy detection, matched filtering and spectral correlation density (SCD) analysis, exploiting the cyclostationary structure man-made wireless signals.

Wireless-based Detection from UAV platforms for Location of Animals and Missing Persons
Authors : Andreas Willig, Associate Professor, University of Canterbury, New Zealand

Abstract :

Routing Algorithm Considering Nodes Residual Power to Prolong Ad-Hoc Network Lifetime
Authors : Koji Saita (Yokohama National University, Japan); Ryuji Kohno (Yokohama National University & University of Oulu, Japan); Takumi Kobayashi and Chika Sugimoto (Yokohama National University, Japan)

Abstract : Ad hoc networks can work without existing infrastructures by using multi-hop transmission techniques. This can be useful for disaster area communication. When using mobile terminals as relay nodes, one of the problems is that if some relay nodes run out of batteries, the resulting network will consist of separate parts unable to communicate with each other. We focused on routing protocol to solve this disruption of service problem in the entire network, as many researches often do not consider the quality of the whole network. In this study, we first dene a network lifetime to evaluate service in the entire network, and propose routing algorithms considering residual electric power of each node. This way we can select routes to avoid using low residual electric power nodes. Our results show that the methods we use can prolong network lifetime compared to conventional AODV routing protocol.

Field Experiment of Multiple Drones Using UWB Communication and Gelocation for Emergency Rescue of Missing Victims
Authors : Takumi Kobayashi, (Yokohama National University, Japan)

Abstract : When natural disasters are occurred, a lot of injured victims should be found and have medical treatment as soon as possible. However, looking for the victims is not easy due to destroyed infrastructures. In order to solve the problems, authors have been proposed several solutions by using multiple unmanned aerial vehicles (UAVs) and dependable wireless communication technology. Under the collaborative research project between New Zealand and Japan, field experiments were performed in University of Canterbury, Christchurch, New Zealand in February and November 2017. These experiments were performed in New Zealand by using multiple UAVs (Drones) that provided by University of Canterbury, and ultra-wide band communication (UWB) based accurate localization system which is provided by Yokohama National University. In this talk, we will describe purposes, methods (e.g. procedure, equipment specifications and experiment configurations) and results of these experiments. As a last experiment, we attached four anchor nodes of UWB localization system on the bottom of the four drones. Four anchor nodes were connected to a host computer wirelessly. In this situation, drones move to looking for a UWB tag which was assumed that is worn on a victim. Finally, we succeeded to find and get an accurate geolocation of the victim by using flying drones.
A Study on Latency-guaranteed Multi-hop Wireless Communication System for Control of Robots and Drones

Authors: Toshinori Kagawa and Fumie Ono (National Institute of Information and Communications Technology, Japan); Lin Shan (National Institute of Information and Communications Technology (NICT), Japan); Kenichi Takizawa (National Institute of Information and Communications Technology, Japan); Ryu Miura (NICT, Japan); Huan-Bang Li (National Institute of Information and Communications Technology, Japan); Shin Kato (The National Institute of Advanced Industrial Science and Technology, Japan)

Abstract: Robots, including unmanned aerial vehicles, or drones, are the hot research topics aiming at application to disaster response, infrastructure inspection, logistics, etc. Wireless LAN in 2.4GHz band is used for control link of many robots because of cost performance and device availability. However, the wireless LAN protocol is not suitable for the remote control of robots, particularly in the multi-hop network for beyond-line-of-sight (BLOS) operation, because of unstable and large transmission latency and interference problems. In this research, we have developed a latency-guaranteed multi-hop wireless communication system specialized for remote control and telemetry link of robots and drones, which need the BLOS operation. This paper presents the design and performance of prototype system obtained in field test.
T-Special Session : Advanced ICT for Digital Society
December 19, 2017 (15.30 - 17.00)

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<td>Banphot Nobaew (School of Information Technology Mae Fah Luang University, Thailand)</td>
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Smart Learning Environment for Enhancing Digital Literacy of Thai Youth: A Case Study of Ethnic Minority Group
Authors : Punnarumol Temdee (School of Information Technology Mae Fah Luang University, Thailand)

Abstract : Digital literacy is needed for digital transformation. Until now, there is no standard for digital literacy lesson for different groups of Thai people. Different people are required to have different kinds of digital literacy in different levels. It is thus challenging to provide an appropriate lesson for all people to satisfy their different goals. Therefore, the proper way of teaching and learning digital literacy is personalized learning. This paper proposes smart learning environment for enhancing digital literacy of Thai people especially Thai youths from the ethnic minority group. Nowadays, these groups of people can have equal access to a vast opportunity from internet through the mobile phone. At the same time, the internet also can be harmful. Therefore, it is necessary to promote the digital literacy for them. The proposed smart environment provides the individual learning path for each learner. The objective distance is modified and used to measure the distance between the expected status and the current status of competency of each learner. The experiment is conducted with 30 students who are the ethnic minority group in Chiang Rai province, Thailand with 5 learning objects. The results of pre-test and post-test reveal that the proposed learning environment can enhance digital literacy for target student significantly. Additionally, the students are satisfied with the personalization support in “satisfy” level.

Reliability Analysis of an IoT based Smart Agriculture System
Authors : Chayapol Kamyod (School of Information Technology Mae Fah Luang University, Thailand)

Abstract : Reliability of a computer network and system has been widely researched and gained more popularity to improve the performance of the system. This paper evaluates overall reliability characteristics of IoT communication network architecture for a small and medium-sized farm in operation through main reliability network parameters by using OPNET. The reliability effects when increasing the number of sensor nodes are simulated and compared. The simulation results exhibit interesting reliability characteristics of the designed IoT communication architecture.

Gait Classification for Multiple-Tasks Assessment with Audio-Visual Cueing in Older People
Authors : Worasak Rueangsirarak, Surapong Uttama, and Kitchana Kaewkaen (School of Information Technology Mae Fah Luang University, Thailand)

Abstract : This research presents a feasibility to adopt a decision support system framework as a rehabilitation and assessment tool for supporting the physiotherapist in identifying an abnormal gait for older people. The walking movement
was captured by using the Microsoft Kinect cameras in order to collect the human motion during 4-meters clinical walk test. 28 older adults participate in this research for performing their gait in front of the affordable cameras. To distinguish an abnormal gait of the older adults with balance impairment from healthy older adults, two machine learning algorithms were selected to classify the data. As the result, SVM shows the best performance of classification with 82.14% of accuracy, in single-task and double-task conditions, when compared with the standard clinical result. However, SVM cannot achieve an acceptable performance when classifying on triple-task condition with only 71.42% of accuracy. While ANNs deliver only 75.00% of its best performance. Therefore, SVM can be implemented as a rehabilitation measuring tool for suggesting the physiotherapist in assessing gait of older people.

Modal Frequency Identification in Ocean Acoustics Using Adaptive Resampling Particle Filter
Authors : Nattapol Aunsri (School of Information Technology Mae Fah Luang University, Thailand)

Abstract : Particle filtering approach, a class of sequential Monte Carlo methods, for modal frequency identification from the time-frequency representations of ocean acoustic signal is developed. The adaptive resampling algorithm is implemented to improve the accuracy of the modal estimates as well as the joint posterior probability density distributions of modal frequencies of the ocean acoustic signal. In addition, the filter also estimates the corresponding amplitudes along with the modal frequencies.

Results from applying the scheme to the ocean acoustic signal present the advantages in accounting the adaptive resampling scheme into the conventional sequential importance sampling particle filter (SIS-PF) instead of using the sequential important resampling (SIR) scheme. The noise robustness of the scheme is demonstrated through an example where the low SNR signal is used to test the performance of the adaptive resampling method.

Estimation of the Number of Call Center Agents by Using Erlang C Model: A Case Study of Call Center, Department of The Land Transport, Thailand
Authors : Supaporn Kiattisin and Taweesak Samanchuen (Technology of Information System Management Division, Faculty of Engineering, Mahidol University, Thailand)

Abstract : A call center unit under the management of Department of Land Transport, Ministry of Transport, Thailand was set up to be responsible for responding to all incoming and outgoing calls including both complaint and suggestion regarding the use of Bangkok’s public transportation system. This function takes an important role in the Department of Land Transport by gathering all important information and suggestions from service recipients or clients to be used for improving the quality of services of the public transportation system. However, due to the limited number of existing call center agents, every call cannot be responded. It is considered as an crucial factor that the call center needs to balance between cost and quality appropriately.

From the existing data collected, there are numbers of non-received calls. Therefore, the research aims to estimate the appropriate number of agents needed for each period of time. Erlang C model is applied for this approach. As a result, the balance between cost and quality of service is derived from estimation. It is suggested that the call center unit requires more agents in order to improve the quality of service.

Diversity Printed Antenna for 2.4 GHz Applications
Authors : Teeravisit Laohapensaeng (School of Information Technology Mae Fah Luang University, Thailand)

Abstract : One of the challenge research for the mobile robot is to improve the communication link between the robots while moving. This paper presents the space diversity printed antenna for mobile robots. The system consists of the printed antenna, radio transceiver, PWM to DC, comparator and embedded single board computer. The paper is more focused on the design of the printed antenna. The electrical characteristics of the antenna are discussed. Then the preliminary experiment of the space diversity system is demonstrated. From the results are expressed that the communication link is improved.
Enhancing Community Awareness of Landslides in Highland Areas Using Media Technology
Authors: Banphat Nobaew (School of Information Technology Mae Fah Luang University, Thailand)

Abstract: This paper presents the conceptual framework of using multimedia including the social media to enhance the villagers’ awareness of the landslide and flood problems in Mae Salong sub-district, Chiang Rai province, Thailand. This study focuses on establishing the volunteer’s group in the village for warning the landslide problem by creating the content of landslide and flooding. These media contents are later distributed to the villagers for enhancing the community awareness. The volunteer’s group training is employed to the research process; it aims to make the problem solving to be sustainable in the long term. This volunteer group will take the role of leader in solving the disaster problem in their community. The volunteer group later has to create the effective warning media: billboard, poster, and landslide knowledge contents for the program of village public address system. This volunteer group uses the social media to inform and warn the disaster news and problem situation in real time.
## Poster Session  
**December 19, 2017 (15.30 - 17.00)**

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<td>Md. Kamruzzaman (Bangladesh University of Engineering and Technology, Bangladesh); Mahmuda Naznin (Bangladesh University of Engineering and Technology (BUET), Bangladesh); Nawajish Islam (Bangladesh University of Engineering and Technology, Bangladesh)</td>
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### A Single Node Vehicle Detection System Using an Adaptive Signal Adjustment Technique

**Authors:** YoungJin Kwon (Electronics and Telecommunications Research Institute(ETRI), Korea); Do Hyun Kim (ETRI, Korea); Kyoungho Choi (Mokpo National University, Korea)

**Abstract:** Vehicle detection is essential to build intelligent transportation systems, estimating vehicle speed and traffic congestion, and providing various services such as parking assist and route guidance systems, etc. Many approaches have been reported based on various sensors and technologies such as inductive loop detector, radar, and CCD camera, wireless sensor networks. In this paper, a single node vehicle detection and speed estimation system using geomagnetic sensors with wireless sensor networks is presented. In the proposed system, two geomagnetic sensors are installed, separated by 20 cm within a single board, and a novel adaptive signal adjusting algorithm followed by a simplified cross-correlation technique is applied, calculating the similarity of signals from the two magnetic sensors. According to our simulations, the proposed system shows over 97 percent accuracy for vehicle speed estimation.
A Context-aware QoE-driven Strategy for Adaptive Video Streaming in 5G multi-RAT Environments

Authors: Faouzi Bouali and Klaus Moessner (University of Surrey, United Kingdom (Great Britain)); Michael Fitch (BT Exact, United Kingdom (Great Britain))

Abstract: This paper extends traditional dynamic adaptive streaming over HTTP (DASH) to efficiently exploit all available bands and licensing regimes in a given context. A novel objective quality-of-experience (QoE) metric is proposed to capture the most relevant factors that impact user perception during streaming sessions. Based on it, a QoE-driven adaptation strategy is devised to jointly select the best radio access technology (RAT) and quality for each video segment depending on the various components of the context. It relies first on fuzzy logic to estimate the QoE provided by each available RAT subject to the uncertainty level associated with DASH clients. Then, a fuzzy multiple attribute decision making (MADM) methodology is developed to combine the QoE estimates with the heterogeneous components of the context to assess the in-context suitability levels. The proposed approach is applied to adapt video streaming across available RATs in dense deployments for a set of Bronze and Gold subscriptions. The results reveal that the proposed strategy always assigns Gold clients to the wellregulated licensed band, while switches Bronze clients between licensed and unlicensed bands depending on the operating conditions. It strikes a balance between maximising video quality and reducing playback stalling, which significantly improves the perceived QoE compared to the traditional DASH approach.

Design of Timing Tracker for Quality of Service of Energy Management Based on Dimmable Lighting

Authors: Jin-Doo Jeong and Il-Woo Lee (ETRI, Korea); Jong-Wha Chang (Hanyang University, Korea)

Abstract: Visible light communication (VLC) is widely useful to various application. VLC in indoor energy management is attractive due to characteristics that data are transferred through light and possible to be spatial security and localization. Variable pulse position modulation (VPPM) especially is suitable for the indoor energy management because of supporting a full dimming range and being implemented simply. This paper proposes a timing tracker for timing synchronization in the VPPM-VLC system. The proposed timing tracker is evolution of the early-late detection to the VPPM-VLC system by considering characteristics of the VPPM-VLC signaling in perspective on the timing tracker. This paper describes design results for a VPPM-VLC receiver with the proposed timing tracker, and presents behavioral simulation results for the verification of the proposed timing tracker. The simulation results shows that the proposed VPPM-VLC timing tracker estimates the timing-offset and compensates timing mismatch through buffer control.

Design of Satellite Constellation with Inter-satellite Links for Global Communication Using Genetic Algorithm

Authors: Sihang Liu and Pengxu Li (Beijing University of Posts and Telecommunications, P.R. China); Gaofeng Cui and Weidong Wang (Beijing University of Posts and Telecommunications, P.R. China)

Abstract: As a fundamental and significant stage of satellite networks which play an important role in global communications, a design of satellite constellations with inter-satellite links(ISLs) becomes necessary. An optimization method is proposed to determine both satellite elements and constellation elements using the multi-objective genetic algorithm(GA) in this paper. The objectives to be optimized, which are determined by the elements to be designed, are divided into performance objectives and cost objectives. The former consist of the coverage rate, the ISL range and the minimum elevation while the latter contain the total satellite count, the orbital altitude and the orbital inclination. With the aim of maximizing the performance minimizing the cost, the proposed method tries to achieve a balance among multi objectives and design specific satellite constellations considered in different conditions. Then the constellations designed in different schemes are compared with each other to demonstrate the correctness and effectiveness of the method.

Spatio-temporal Stochastic Modeling of Heterogeneous Cellular Networks: Security and Delay Analysis

Authors: Bing Wang (National Digital Switching System Engineering & Technological Research Center, P.R. China); Kaizhi Huang (Information Engineering University, P.R. China)

Abstract: Security and delay are both of extremely important due to the fact that the fifth generation (5G) wireless networks aims to achieve high level of security and low delay. In this paper, considering the randomness of base stations in space and dynamic user traffic arrivals in time, we first develop a novel traffic-aware spatio-temporal mathematical framework in an open access SKS-tier heterogeneous cellular network (HCN) based on stochastic geometry theory and queueing theory. On the basis of the spatio-temporal framework, we then investigate the security and delay performance. It is demonstrated that there is a trade-off between packet transmission delay and secrecy transmission rate, which is caused by the packet arrival probability. Finally, simulation experiments are conducted to validate the correctness and usefulness of our theoretical conclusions.
A Deep Learning Based Handover Mechanism for UAV Networks
Authors: Hanzhang Yang, Bo HU and Lei Wang (Beijing University of Posts and Telecommunications, P.R. China)

Abstract: The attractive feature of conveniently deployed as an aerial access point (AP) to provide coverage and improve network performance, has made the Unmanned Aerial Vehicle (UAV) networks a research hotspot. In this paper, an UAV handover mechanism in the three-dimensional space is proposed. We build and train user trajectory prediction model based on neural network. Then we described the handover mechanism under the condition of predicted trajectory and the constructed signal transmission model in UAV networks. Simulation results show that compared to the traditional handover algorithm, our scheme nearly 10% higher in handover success rate.

Load Balancing Scheme for Data Center Based on SDN
Authors: Hongyan Cui and Linfei Yang (Beijing University of Posts and Telecommunications, P.R. China); Tao Yu (Tsinghua University, P.R. China); Yajun Fang (MIT, unknown); Honggang Zhang and Zongguo Xia (University of Massachusetts Boston, USA)

Abstract: In data center, because of the large amount of user access, it usually takes the deployment of many server cluster to meet the needs of the vast numbers of users’ access. How to decide a scheme to share the traffic of users to different servers becomes an important indicator of the overall quality of service in this scenario. In order to reduce costs and provide high-quality and reliable service, the load balancing technology is usually used in enterprises. At present, the industry generally uses LVS and other open source software or commercial load balancing device based on traditional network to complete this feature. However, due to the high cost of existing load balancing equipment, as well as the inherent shortcomings of traditional Internet, these solutions are lack of flexibility, and user’s experience is not friendly enough. This paper proposed a load balancing scheme in data center based on SDN, that can implement an efficient dynamic scheduling according to the server status, using the feature of programmability in OpenFlow network, to balance different applications and complete the rational use of data center server cluster in a scenario that user request changes drastically. We also realized an equilibrium model for different applications. In addition, this paper also uses the Mininet network simulation tool to design the experiment scene, and completes the verification of the scheme.

HEM: A Hybrid Evolutionary Model for Event Detection in Untrustworthy Sensing
Authors: Md. Kamruzzaman (Bangladesh University of Engineering and Technology, Bangladesh); Mahmuda Naznin (Bangladesh University of Engineering and Technology (BUET), Bangladesh); Nawajish Islam (Bangladesh University of Engineering and Technology, Bangladesh)

Abstract: Since, event detection is open to many sensors in a participatory or in a crowd sensing network, one of the major challenges of this network to find the the authenticity of the reported events and the source nodes. If the nodes’ trustworthiness is unknown or the detected events truthfulness is also unknown, the event detection is a difficult task. In our paper, we study this challenge and observe that applying expectation maximization with genetic algorithm, trustworthy event detection is possible. We find the best local maximum points using Expectation Maximization and then gradually applying Genetic Algorithm we find the best value. We find our hybrid approach performs better since the best selection with the maximized expectation goes for evolving the new generation. In the long run, new generation becomes better and contributes faster. We do simulation study to support our model. We provide a comparative study among Genetic Algorithm and Expectation Maximization and the hybrid of the two above mentioned methods. We find that our proposed hybrid model provides better framework to find the trustworthy nodes, better convergence rate, more authenticated event detection.

A Smooth-Trajectory Mobility Model for Airborne Networks
Authors: Yuewu Dong (Beijing University of Posts and Telecommunications, P.R. China)

Abstract: In Wireless Sensor Network Environment, there is a lot of scope to incorporate security considerations in various aspects of the architecture. While the sink reads the data from the sensor and dumps the aggregated data to the base Station, there is a possibility of loss of confidentiality of data. Any third party may read the data and misuse it. Hence it is vulnerable to snooping by the attacker. The current paper presents an enhanced model in order to improve confidentiality. This paper analyses the weaknesses of the previous scenarios and proposes improvements on them by making use of mathematical operations to manipulate the keys used for the encryption of each sensor. The work culminates into a proposed Scenario 1.7 that can provide enhanced security over the previous models with comparable time taken for security operations in the sink.
**User Grouping with Adaptive Group Number for Massive MIMO Downlink Systems**
Authors: Mengshi Hu (Beijing University of Posts and Telecommunications, P.R. China); Chang Yongyu (Beijing University of Posts & Telecommunications, P.R. China); Tianyi Zeng (Beijing University of Posts and Telecommunications, P.R. China); Xu Yang and Aidong Men (Beijing University of Posts and Telecommunications, P.R. China)

Abstract: Channel correlation between users can significantly affect the system performance in multiuser multiple-input multiple-output (MU-MIMO) systems. To prevent the highly correlated users from being scheduled in the same radio blocks (RBs), these users are separated into different groups. Most of the related papers focus on how to separate users according to their channel correlations. However, the group number also plays an important role in the system performance and this is not investigated in those papers. Therefore, in this paper we investigate the group number in MU-MIMO systems and propose a user grouping scheme with adaptive group number. In our scheme, the number of groups can be changed according to the channel quality indicators (CQIs) reported by the users. Simulation results show that our scheme provides a significant gain in system throughput.

**Interference Suppression Through Power Allocation for Massive MIMO Systems with Channel Aging**
Authors: Ilmiawan Shubhi (Kyoto University, Japan); Panca Pamungkasari (Universitas Nasional, Indonesia); Filbert H. Juwono (University of Indonesia, Indonesia); Satriyo Dharmanto (Multikom, Indonesia)

Abstract: To acquire an optimum potential of massive multiple-input multiple-output (MIMO), congruity between precoder and the actual channel is required. This circumstance, however, is hard to obtain when the mobile station (MS) is moving in a multipath environment and experiencing channel aging. Suffering channel aging, a mismatch between the precoder matrix and the actual channel matrix occurs which causes interuser interference at the MS. To tackle this problem, we propose a channel prediction based power allocation technique for time-varying massive MIMO. First, we estimate Doppler shift experienced by the BS to create a channel prediction. Afterward, we conduct recursive power allocation with the goal of minimizing channel aging effect at the MS. Using the proposed technique, each MS only suffers a certain interference level which still can be handled by the MS. Through computer simulation, it is shown that our proposed technique enables the time-varying massive MIMO transmission without a significant addition to computational complexity.
Digital Beamforming Algorithm for 5G Low-SHF-Band Massive MIMO with Intersite Coordination
Authors: Shohei Yoshioka, Satoshi Suyama, Tatsuki Okuyama, Jun Mashino and Yukihiko Okumura (NTT DOCOMO, INC., Japan)

Abstract: Massive multiple-input multiple-output (Massive MIMO) beamforming (BF) is an important technology to utilize higher frequency bands effectively. Fully-digital Massive MIMO BF can be applied for low-SHF-band, and joint processing of digital fixed BF and channel state information (CSI)-based precoding (Digital FBCP) is proposed as one of the fully-digital algorithms. Additionally, it is assumed that multiple sites with low-SHF-band cover continuous areas in the early fifth-generation (5G) mobile communication system. New BF algorithm for multi-site Massive MIMO is required to enable to transmit effectively multiple streams with intersite interference reduction. In this paper, we propose three types of Digital FBCP algorithm with intersite coordination. Throughput performances are shown by link level simulation, and we clarify that the proposed schemes can improve throughput performance compared to that without intersite coordination.

Experimental Evaluation of Digital Beamforming for 5G Multi-Site Massive MIMO
Authors: Tatsuki Okuyama, Satoshi Suyama, Jun Mashino, Shohei Yoshioka and Yukihiko Okumura (NTT DOCOMO, INC., Japan); Kenichiro Yamazaki and Daisuke Nose (NEC Corporation, Japan); Yasushi Maruta (NEC, Japan)

Abstract: In order to tackle rapidly increasing traffic, Massive MIMO using beamforming (BF) is promising technique for fifth-generation (5G) mobile communication systems. Authors have recently proposed the joint processing of digital fixed BF and channel state information (CSI)-based precoding (Digital FBCP) that is suitable for low-SHF-band Massive MIMO. It has been also clarified that Digital FBCP is efficient in not-only single-site but also multi-site environment by introducing extended precoding technique. Although the previous works evaluate only in computer simulations, this paper aims to evaluate real-field performances by using 5G low-SHF-band massive MIMO prototype. First we measure low-SHF-band (5.2 GHz-band) CSI data in outdoor experiment, and then, this paper optimizes beam parameter in computer simulations exploiting the measured data. Finally, we show the throughput performance of Digital FBCP in multi-site environments.

Performance Analysis and Optimization for Downlink Distributed MIMO Systems
Authors: Jiancun Fan (Xi'an Jiaotong University, P.R. China)

Abstract: In this paper, we analyze and optimize the ergodic capacity for a downlink multi-cell multi-user distributed multiple input multiple output (MIMO) system. We first derive the system ergodic capacity by using the approximated Gamma distribution. In order to maximize the system capacity, an optimization problem with respect to the number of remote access unit (RAU) antennas and the number of users is formulated. Then an iteration algorithm is proposed to obtain the optimization configuration of RAU antennas and users. Our simulation results show that the proposed algorithm can obtain the optimal configuration of RAU antennas and supportable users to maximize the system ergodic capacity.
Power Consumption Analysis for User Cooperation Aided Traffic Forwarding over Frequency Selective Fading Channels
Authors: Ou Zhao and Lin Shan (National Institute of Information and Communications Technology (NICT), Japan); Katsuhiro Temma (National Institute of Information and Communications Technology & Resilient ICT Research Center, Japan); Kiyohiko Hattori, Huan-Bang Li and Fumihide Kojima (National Institute of Information and Communications Technology, Japan); Fumiyuki Adachi (Tohoku University, Japan)

Abstract: Recently, user cooperation aided traffic forwarding is widely considered as one of promising techniques to improve energy efficiency in battery-operated mobile terminal (MT). This study tries to theoretically analyze the power consumption of such kind of technique in cellular networks over frequency selective fading channels. We initially derive some expressions to calculate transmission power for non-cooperative scenarios by a generalized model, in which spatially correlated shadowing, an easily overlooked issue, is considered. Then we mathematically analyze consumed power in aforementioned scenarios with the help of a recent and experiment based Long Term Evolution smartphone power model. Numerical results indicate that the benefits of cooperative forwarding over frequency selective fading channel are substantial, however, due to several physical constraints on MT, such as maximal transmission power, the benefits cannot be fully achieved in realistic environment. Several interesting insights about cooperative forwarding are also obtained in our study.

Performance of DF Incremental Relaying with Energy Harvesting Relays in Underlay CRNs
Authors Komal Janghel and Shankar Prakriya (Indian Institute of Technology, Delhi, India)

Abstract: In this paper, we analyze the throughput performance of incremental relaying using energy harvesting (EH) decode-and-forward (DF) relays in underlay cognitive radio networks (CRNs). The destination combines the direct and relayed signals when the direct link is in outage. From the derived closed-form expressions, we present an expression for the power-splitting parameter of the EH relay that optimizes the throughput performance. We demonstrate that relaying using EH DF relays results in better performance than direct signaling without a relay only when the destination combines the direct signal from the source with the relayed signal. Computer simulations demonstrate accuracy of the derived expressions.
A Full-Duplex SWIPT Relaying Protocol Based on Discrete Energy State
Authors: ZhiQiao Nie (National Huaqiao University, P.R. China); Rui Zhao (Huaqiao University, P.R. China); YuanJian Li (HuaQiao University, P.R. China); Xing Tan (Huaqiao University, P.R. China)

Abstract: In this paper, a new transmission protocol is proposed to improve the performance of the power-splitting energy harvesting relaying system. Since the decode-and-forward relay operates in the full-duplex mode, the relay energy state exhibits a complex charge-discharge behavior. Based on the discretization of the relay battery energy, the transfer probability of the relay energy state is analyzed by using the Markov chain, and the initial distribution of the relay energy state is presented. We further derive the closed-form expression of the outage probability. The numerical results verify the accuracy of the derived closed-form expression and reveal the influence of the power allocation factor and the relay transmit power on the system performance.

RF Energy Harvesting Based Relays Non-orthogonal AF Vs Dynamic DF
Authors: Yepuri Sudhakar Rao, A S Madhukumar and Sirigina Rajendra Prasad (Nanyang Technological University, Singapore)

Abstract: A relay-based system, where the relay node is powered by radio frequency (RF) based energy harvesting (EH), has been considered. This work characterizes the diversity-multiplexing tradeoff (DMT) of non-orthogonal EH based amplify-and-forward (EH-NAF) protocol. Analysis of the protocols reveals that its DMT performance approaches that of non-EH based counterpart for smaller energy harvesting durations. Finally, EH-NAF is compared with EH based dynamic decode-and-forward (EH-DDF) protocol.

Robust Beamforming and Power Splitting Ratio Optimization in Cognitive Downlink Multiuser MISO Networks
Authors: Xueyan Chen, Li Gua, Jiuru Lin, Qian Deng and Guangqian Chu (Beijing University of Posts and Telecommunications, P.R. China); Jingjing Huang (Beijing Aerospace Times Laser Inertial Technology Company, LTD, P.R. China)

Abstract: In this paper, we investigate a robust beamforming and power splitting ratio (RBFPS) optimization problem with simultaneous wireless information and power transfer (SWIPT) for the downlink multiuser multi-input-single-out (MISO) cognitive networks. Since the perfect channel state information (CSI) is difficult to obtain in practice, we consider theCSI errors follow a complex Gaussian distribution in this paper. We aim to minimize the average total transmit power at the cognitive base station (CBS) subject to the probabilistic signal-to-interference-plus-noise ratio (SINR) and energy harvesting (EH) constraints at each secondary user (SU) and probabilistic interference temperature constraint at primary receiver (PR), respectively. As the probabilistic constraints have no closed-form expression, the original optimization problem is difficult to be solved. As a solution, the probabilistic approach based on two kinds of Bernstein-type inequalities is proposed to reformulate the original non-convex problem to the form of semi-definite programming (SDP) after rank-one relaxation. We also propose the worst-case approach based on S-Procedure to solve the original problem. Simulation results are performed to demonstrate that the proposed RBFPS based on both probabilistic approach and the worst-case approach are robust to the CSI errors. In addition, the probabilistic approach is less conservative and more energy saving.
Wireless Network 4 (WN 4) Session  
December 20, 2017 (08.00 - 09.30)

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**A Novel Localization C# Framework for RAN Optimization Using Extreme Programming Methodologies**  
Authors: Rúben Borralho (Instituto Superior Técnico & Celfinet, Portugal); António J. Rodrigues (IT / Instituto Superior Técnico, Portugal); Maria Paula Queluz (Instituto Superior Técnico, Portugal); Sérgio Ferreira (Celfinet, Portugal); Pedro Vieira (Instituto de Telecomunicações and ISEL, Portugal)

Abstract: —With the current traffic increase in cellular networks, it becomes demanding and complex for operators to manage and optimize its networks in order to provide enhanced Quality of Service (QoS) to users. One of the network optimization options is to use drive-tests data. Unfortunately, drive-tests are cost demanding, and are limited to the outdoor environments where radio measurements have been performed. A more cost effective solution is proposed in this paper as an alternative to drive-tests. A framework that gathers and locates exchanged signalling (called traces) between the real network users and network elements is proposed, enabling indoor/outdoor network optimization. To achieve that, a C# application was developed, using Extreme Programming methodologies, which were applied to produce an high quality and robust application. After event localization, a comparison was performed with drive tests data, presenting a 0.3 dB and 2.4 dB average and median error, respectively.

**Indoor Positioning Through Fingerprinting Techniques: How Many Beacons Should Be Deployed and Where?**  
Authors: Alain Moretto (ESIGETEL, France); Irene Barras (ETSETB — UPC. Universitat Politècnica de Catalunya, France)

Abstract: In this paper, we try to answer two questions. First, how many beacons should be deployed, regardless their placement, to reach a given location performance in a fingerprinting localization architecture? Second, where shall we deploy our beacons to enhance location performances, yet with a reduced number of beacons? At last, hints are given on how a given level of performance can be maintained as the number of beacons is further decreased. To answer those two questions, almost 30 433MHz/868MHZ-UHF-RFID active tags have been deployed both in a corridor and in a hall environment. An
A Throughput Study of Grant-Free Multiple Access for Massive Wireless Communications

Authors: Chang-Woo Pyo (NICT, Japan); Kenichi Takizawa and Masafumi Moriyama (National Institute of Information and Communications Technology, Japan); Masayuki Oodo (NICT, Japan); Hayato Tezuka (National Institute of Information and Communication Technology, Japan); Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: As a demand of diverse services and a rapid increase of Internet of Things (IoT) devices, it requires a new medium access control (MAC) to support a massive and variable IoT devices in the next generation wireless communications. As the viewpoints of simplicity, flexibility and scalability, a contention-based multiple access (CMA) is a potential function of MAC in the massive wireless communications. So that a grant-free multiple access (GFMA) method as a new CMA has been proposed to provide a simultaneous massive connectivity and to reduce the latency of data transmission. This paper introduces a novel GFMA and studies the performance of GFMA throughput numerically. In addition, we conduct the performance comparison the proposed GFMA with the legacy CMAs such as slotted aloha (SA) and grant multiple access (GMA) of LTE random access channel (RACH) and shows that the proposed GFMA achieves a higher throughput rather than others.

Throughput Analysis for String-Topology Full-Duplex Multi-hop Network

Authors: Chikara Fujimura, Kosuke Sanada and Kazuo Mori (Mie University, Japan)

Abstract: Full-duplex (FD) communication can double point-to-point throughput. By applying the FD technique to multi-hop networks, the throughput enhancing is expected. For achieving the benefits in the networks, it is necessary to design medium access control (MAC) protocol for FD communications. Developing an analytical model for FD multi-hop networks is effective and useful for not only developing the optimal protocol design but also clarifying such network dynamics. This paper proposes analytical expressions for string-topology wireless FD multi-hop network. For achieving that, analytical model of airtime expressions, which is effective analytical approach in a half-duplex multi-hop network, and Markov-chain model for FD MAC are integrated. This model is the first analytical model for string-topology FD multi-hop networks. End-to-end throughput of FD multi-hop network for any number of hops and any payload size can be obtained from the proposed model. The analytical expressions are verified by comparisons with simulation results. From the comparison with the results in half-duplex (HD) multi-hop network, the effectiveness of FD communication in multi-hop networks are confirmed.

Field Experimental Evaluation of Higher Rank MIMO in Quad-directional UE Antenna Configuration for 5G Radio Access System

Authors: Yuta Takahashi, Yuki Inoue, Shohei Yoshioka, Yoshihisa Kishiyama, Satoshi Suyama, Jun Mashino and Yukihiko Okumura (NTT DOCOMO, INC., Japan); Tsuneomi Haruna and Takeshi Tanaka (Nokia, Japan); Armin Splett (Nokia, Germany); Henrik Liljestrom (Nokia Siemens Networks, Finland)

Abstract: This paper presents field experiments on the downlink performance of a 5G radio access system employing higher rank MIMO in the quad-directional antenna configuration at UE side comparing the uni-directional antenna configuration in typical small cell environments. Each antenna branch of the quad-directional antenna directs for intervals of 90 degrees in horizontal plane. The results show that the performance of the quad-directional antenna configuration even the antenna gain is degraded, because the spatial correlation of UE becomes low using the quad-directional antenna in the environment has many complex reflection paths. And also it shows the stable performance of throughput about the dependency of the UE antenna direction. The antenna covers omni direction with combining all antenna branches and the spatial correlation is low compare to the uni-directional antenna. The performance is tradeoff of degradation of the total antenna gain.

electromagnetic mapping of these two environments is recorded by a reader and a post-processing is carried out to answer these two fundamental questions of which there is little response in the scientific literature.
**Human Mobility Prediction Based on A Hierarchical Interest Model**

*Authors*: Wei Liu and Yozo Shoji (National Institute of Information and Communications Technology, Japan); Ryoichi Shinkuma (Kyoto University, Japan)

**Abstract**: We propose a scheme to predict human mobility in this paper. First, a hierarchical interest model is introduced to organize the semantic category of locations in human mobility logs as well as representing their personalized mobility patterns. Then, by combining the interest models of different people, a 3-modes tensor with the features of person identity, time, and the semantic category of location is constructed. Tensor factorization is utilized to reveal people’s mobility interest on different kinds of locations. Finally, personalized interest models are recovered from cumulative tensor to predict human mobility in a person-byperson way. Extensive evaluation results based on a large scale check-in dataset from real location-based social networks have validated that our proposal achieves better recall, precision, and F-Score in human mobility prediction as compared with the state-of-art approach.

**Naming Scheme Using NLP Machine Learning Method for Network Weather Monitoring System Based on ICN**

*Authors*: Toru Mochida and Daichi Nozaki (Waseda University, Japan); Koki Okamoto (University of Waseda, Japan); Xin Qi, Zheng Wen, Takuro Sato and Keping Yu (Waseda University, Japan)

**Abstract**: The market for IoT devices has been expanding rapidly for several years, and many fields are anticipating further demand in the future. However, together with this expansion, increased communication failures are expected, and solutions to prevent them are needed. Here, we aim to solve communication problems using a new network, called the CCN x (Contents Centric Networking), which is one of the leading ICN (Information Centric Networking) solutions. Our system was constructed by assuming the case of a weather monitoring IoT application in which large data communications were very likely to occur. In this paper, we propose a technique for distributing meteorological data gathered with a weather observation device and 4K camera by ICN, and caching content with a new Naming scheme using machine learning.
Machine Learning Based Subjective Quality Estimation for Video Streaming over Wireless Networks
Authors: Chetna Singhal and Goutham Tadepalli (Indian Institute of Technology Kharagpur, India)

Abstract: Now-a-days Wireless transmission is the major medium for video streaming. The standard codecs employed in video transmission removes the spatial and temporal redundancies to decrease the required bandwidth, This may decrease the perceptual quality of the video. So, it is important to develop frameworks that will measure the integrity of video just as a human does. Various objective and subjective parameters can be used to rate the quality of a video. The proposed algorithm employs machine learning (linear regression and support vector regression) to predict subjective quality of H.264 videos streamed over wireless networks from their objective scores. This method helps in evaluating Quality of user experience (QoE) without involving human efforts with an accuracy of 85.96% and 90.049% (on average) using linear regression and support vector regression, respectively.

Supporting System for Fishery Resource Management Utilizing Convolutional Neural Network
Authors: Xiaokang Yang, Qiang Wang and Yi Wang (Beijing University of Posts and Telecommunications, P.R. China)

Abstract: In recent years, the amount of parent fish stock of Pacific bluefin tuna is decreasing. For this reason, efforts are underway to protect tuna resources in countries around the world. In Japan, an upper limit value of the catch amount is set, and when there is a possibility that the catch amount may exceed the upper limit value, the fishing operation is refrained to protect tuna resources. The set-net fishing covered in this research is a passive fishing method, it is almost impossible to avoid or catch only certain fish species. In addition, if the fixed net fishing is prohibited, the income of fishermen is lost because of fish species other than tuna aren’t also caught. In this paper, we propose a method aiming at compatibility between resource protection of tuna and income guarantee of fishermen. An acoustic image of the 30-minute interval obtained by the fish finder is divided into a plurality of divided images, and whether or not the response of tuna is included by convolution neural network (CNN). Finally, based on the identification result of the divided image, it is judged whether the acoustic data of 30 minutes includes tuna. In this paper, to evaluate the performance of the proposed method, we derived the discrimination accuracy of the proposed method, and we also estimated the tuna resource protection effect when applying the proposed method, and the decrease rate of catch.

An Artificial Neural Network-Based Distributed Information-Centric Network Service
Authors: Zheng Wen and Takuro Sato (Waseda University, Japan)

Abstract: Artificial neural networks (ANN) have been widely used in various areas. As a bottleneck, hardware specification affects the efficiency of an ANN. With the development of distributed computing, distributed ANNs show advantages in dealing with huge data. The network bandwidth is a new bottleneck restricting the performance of distributed ANNs. Information-Centric Networking (ICN) [1], as the Next Generation Network (NGN) solution, has shown merits regarding mobility, security, power consumption and network traffic. In this paper, we remodel the architecture of network service using ANNs. We proposed an ANN-Based Distributed Information Centric Network Service (ANN based DICNS). The distributed nodes are connected like a neural network. When a client utilizes the DICNS, the data flow from the source to the consumer node like the signal traveling from an input layer to an output layer in a neural network. By using an ICN, our proposal can significantly reduce network consumption, and the named data can help the DICNS effectively manage and classify the data.
## Bayesian Compressive Spectrum Sensing Joint DOA Estimation and Polarization Signal Processing

**Authors**: Xuekang Sun (Beijing University of Posts and Telecommunications, P.R. China); Rikang Zhou (Beijing University of Posts and Telecommunications, P.R. China); Kun Su and Li Gao (Beijing University of Posts and Telecommunications, P.R. China); Muyan Ma (Beijing Information Science & Technology University, P.R. China)

**Abstract**: In this paper, we proposed a Bayesian compressive spectrum sensing (BCSS) joint direction of arrival (DOA) estimation and polarization signal processing with adaptive threshold (ADD-BCS) in a dual polarization antenna (DPA) receiving system. In this scheme, we first use Bayesian sampling matrix to achieve the compressive sensing data in two branches of a dual polarization antenna separately, before a proposed fusion model which aims to decrease the amount of complex computation is used. Then, DOA estimation and adaptive threshold are introduced to increase the accuracy and efficiency of wideband spectrum sensing. The simulation results show that this method is more accurate and faster in compressing and recovering signals.

## Carrier Sense Towards Spectrum Sharing via Control Channel in LTE Systems

**Authors**: Hikaru Kawasaki, Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

**Abstract**: In spectrum sharing, Carrier Sense (CS) to detect other radio entities is very important in situations where coordination based on wired network is not easy for different operators or many deployments. Energy detection as a conventional CS is possible to detect unknown signals but so sensitive to noise variance that only a coarse spectrum sensing is performed in a short time. This paper proposes a novel CS for fine sensing based on LTE decoding in context of spectrum sharing in LTE systems among different operators by utilizing a prior knowledge of a control channel for resource scheduling. Numerical experiments show that the proposed method can achieve significant performances in terms of miss detection rate, false alarm rate, and the average of these.

## Study of Spectrum Sensing Scheme Using Received Power Within Preamble Signals

**Authors**: Hiroaki Sudo (Panasonic Corporation, Japan)

**Abstract**: Time Division Duplex (TDD)-based bidirectional digital field pick-up unit (FPU) system is now being studied. This new digital FPU system shares its frequency band with other wireless systems. Therefore, digital FPU system should detect and avoid the interference from other systems of which the signal format is unknown. To FPU system, it is impossible to apply conventional spectrum sensing schemes which detect known signals such as preamble in other systems. We studied the spectrum sensing scheme using the received power within preamble signals of FPU system. From the results of the baseband link-level computer simulation, it was confirmed that the proposed scheme achieved an excellent performance of the interference detection (the interference false detection rate both with and without the presence of the interference).
Furthermore, the distribution of the output log likelihood ratio is improved by using chaos scheme in which only pairs sharing common keys can decode data by utilizing a chaotic codebook of is supplied based on chaos signals and physical layer security is ensured. GF grant of signal processing required at the central receive stations. In this paper, to satisfy these requirements, we propose a nov ensuring the security of mMTC systems is required to suppress the energy overloaded transmission of more than one hundred percent proposed. In these schemes, both system capacity enhancement and transmit protocol simplification are achieved, and an support the dynamic traffic pres communications are currently being considered for implementation in fifth generation mobile communication systems. To

Abstract :

Performance of Physical Cell ID Detection Using PVS Based Transmit Diversity for NB-IoT
Authors : Aya Shimura and Mamoru Sawahashi (Tokyo City University, Japan); Satoshi Nagata (NTT DoCoMo, Inc., Japan); Yoshihisa Kishiyama (NTT DOCOMO, INC., Japan)

Abstract : The Narrowband (NB)-Internet-of-Things (IoT) radio interface by the 3rd generation partnership project (3GPP) achieves efficient low-cost transmission of IoT traffic with low power consumption for a set of user equipment (UE). Transmit diversity at a base station is effective in achieving a high detection probability for the NB primary synchronization signal (NPSS) and NB secondary synchronization signal (NSSS) without increasing computational complexity at the UE. This paper investigates the effect of precoding vector switching (PVS) based transmit diversity employing up to 8 transmitter antennas on the physical cell ID (PCID) detection probability for NB-IoT. Computer simulation results show when the fading among transmitter antennas is uncorrelated, and that the NPSS detection probability using PVS based transmit diversity with NTx = 4 antennas is improved by approximately 14% compared to that with NTx = 2 at the average received signal-to-noise power ratio of -5 dB. Moreover, the PCID detection probability with NTx = 4 is improved by approximately 10% compared to that with NTx = 2 even for a high fading correlation among transmitter antennas such as 0.6. When increasing the NTx value to 8, the PCID detection probability increases by approximately 8% compared to that with NTx = 4 for the large frequency offset of Δf = 70 kHz. Therefore, we conclude that the PVS based transmit diversity with more antennas up to NTx = 8 is effective in improving the PCID detection probability when considering the actual impairments including fading correlation among transmitter antennas and frequency offset due to the frequency error of the oscillator in the IoT equipment.

Sparse Chaos Code Multiple Access Scheme Achieving Larger Capacity and Physical Layer Security
Authors : Eiji Okamoto and Naoto Horiike (Nagoya Institute of Technology, Japan); Tetsuya Yamamoto (Panasonic Corporation, Japan)

Abstract : Massive machine-type communications (mMTC) scenarios that can accommodate Internet of things (IoT) device communications are currently being considered for implementation in fifth generation mobile communication systems. To support the dynamic traffic present in mMTC systems, grant-free non-orthogonal multiple access schemes have been proposed. In these schemes, both system capacity enhancement and transmit protocol simplification are achieved, and an overloaded transmission of more than one hundred percent of the capacity of the number of transmit samples is conducted. However, demand still exists for more capacity to accommodate massive devices. On the other hand, a simple method for ensuring the security of mMTC systems is required to suppress the energy consumption of IoT devices and reduce the amount of signal processing required at the central receive stations. In this paper, to satisfy these requirements, we propose a novel grant-free sparse chaos code multiple access (GF-SCMA) scheme for mMTC systems in which sparse code multiple access is supplied based on chaos signals and physical layer security is ensured. GF-SCMA is a non-orthogonal multiple access scheme in which only pairs sharing common keys can decode data by utilizing a chaotic codebook of transmission sequences. Furthermore, the distribution of the output log likelihood ratio is improved by using chaos-based quasi-Gaussian modulation,
and enhancement of the capacity is achieved for conventional schemes when the outer channel code is concatenated. The improved performances in terms of capacity and security are shown through numerical simulations.

**Hardware Demonstration on an Efficient Radio Access for Massive Machine-Type Communication (mMTC)**

Authors: Hayato Tezuka (National Institute of Information and Communication Technology, Japan); Masafumi Moriyama and Kenichi Takizawa (National Institute of Information and Communications Technology, Japan); Masayuki Oodo and Chang-Woo Pyo (NICT, Japan); Homare Murakami, Kentaro Ishizu and Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

Abstract: A rapid increase of uplink traffic is predicted with the spread of IoT (Internet of Things) devices. The 5G (5th generation mobile communications systems) requires that base stations effectively receive small-size packets but massive uplink signals transmitted by the IoT devices. To solve this problem, we have researched and developed techniques to increase number of devices that one base station can accumulate and to decrease delay time. We have evaluated channel estimation techniques and interference suppression and cancellation techniques by computer simulation. However, we have not evaluated the techniques on real machine yet. In this paper, we use software defined radio (SDR) on wired environment and evaluate accuracy of the proposed channel estimation techniques and signal separation performance of successive interference cancellation techniques.
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<td>Low-Energy Operation Management Scheme Using Superframe Modification for Wireless Grid Network Structures</td>
<td>Fumihide Kojima (National Institute of Information and Communications Technology, Japan)</td>
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<td>2</td>
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<td>Mengshi Hu (Beijing University of Posts and Telecommunications, P.R. China); Chang Yongyu (Beijing University of Posts &amp; Telecommunications, P.R. China); Tianyi Zeng (Beijing University of Posts and Telecommunication, P.R. China); Wei Quan (Beijing Institute, Huawei Technologies Co., Ltd, P.R. China); Jian Zhang (Huawei Technologies Co., Ltd., P.R. China)</td>
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<td>Approximated Teletraffic Analysis for the Performance Evaluation of Mobile Cellular Networks with MMPP-2 New Call Arrivals</td>
<td>S. Lirio Castellanos-Lopez (UAM, Mexico); Daniela Toral-Valdez (UAM-Azcapotzalco, Mexico); Felipe A. Cruz-Pérez (Cinvestav-IPN, Mexico); Genaro Hernandez-Valdez (UAM-A, Mexico)</td>
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<td>A Jammer-Resilient Cognitive Radio Network Using Evolutionary Game Theory</td>
<td>Amar Taggu (North Eastern Regional Institute of Science and Technology, India); Mannmi Nath (North Eastern Regional Institute of Science and Technology, India); Poulami Banik (North Eastern Regional Institute of Science and Technology, India); Ningrinla Marchang (North Eastern Regional Institute of Science and Technology, Arunachal Pradesh, India)</td>
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<td>Approximating Log-Normally Distributed Secondary Service Time by Hyper-Exponential Distribution for the Analytical Performance Evaluation of Cognitive Radio Networks</td>
<td>Felipe A. Cruz-Pérez (Cinvestav-IPN, Mexico); José Serrano-Chávez (CINVESTAV, Mexico); S. Lirio Castellanos-Lopez (UAM, Mexico); Genaro Hernandez-Valdez (UAM-A, Mexico)</td>
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**Low-Energy Operation Management Scheme Using Superframe Modification for Wireless Grid Network Structures**

*Authors*: Fumihide Kojima (National Institute of Information and Communications Technology, Japan)

**Abstract**: This paper proposes a low-energy operation management scheme that enables the customization of device functions in the wireless grid structures according to the assumed applications that are diversified in service area, device number, communication range and use cases in order to support the required data collection that is also necessary for the big data management in the Internet of Things (IoT) services. To satisfy the required specifications, effective deployment of the Smart Utility Network (SUN) standardized as the IEEE 802.15.4g/4e standards and is under certification by Wi-SUN alliance. We have introduced the concept of three basic network categories of high capacity data collection network, ultra low-energy operation network and reinforced mesh network. In this paper, we have focused on the ultra low-energy operation network that is realized with the modified superframe structure defined in IEEE 802.15.4e where periodically deployed sleeping periods drastically decrease the average power consumption. In this paper, we confirm that the proposed low-energy operation enables more than 10 years data exchange operation with three AA batteries. Furthermore, we propose an effective low-latency control signal transmission based on the assumed low-energy operation in order to avoid the serious latency for the control data to the devices equipped with the actuators. Then, the proof test of the proposed low-latency enhancement is conducted in the agricultural water management testbed. The paper confirms that the proposed low-energy operation management scheme effectively works not only for low-energy data collection utilities but also low-latency control signal transmission functions.

**Centralized Macrocell Muting at Subchannel Level in LTE Heterogeneous Networks**

*Authors*: Mengshi Hu (Beijing University of Posts and Telecommunications, P.R. China); Chang Yongyu (Beijing University of Posts & Telecommunications, P.R. China); Tianyi Zeng (Beijing University of Posts and Telecommunication, P.R. China); Wei Quan (Beijing Institute, Huawei Technologies Co., Ltd, P.R. China); Jian Zhang (Huawei Technologies Co., Ltd., P.R. China)

**Abstract**: Enhanced inter-cell interference coordination (eICIC) is a technique for improving the performance of small cells in LTE heterogeneous networks. By using almost blank subframes (ABSs), the performance of range extension (RE) UEs in
small cells can be improved. However, due to the different user numbers and needs in small cells, the configuration of ABSs in a macro cell may not be appropriate to each small cell deployed in it. This disadvantage can affect the improvement of system performance, especially when the number of small cells increases. To further improve the system performance, in this paper we propose a centralized macrocell muting scheme. In this scheme, macrocells will be muted at subchannel level instead of subframe level. Meanwhile, the fairness among different user types is taken into consideration. Simulation results show that our centralized muting scheme improves the throughput and fairness performance compared with non-ABS and ABS schemes.

**Approximated Teletraffic Analysis for the Performance Evaluation of Mobile Cellular Networks with MMPP-2 New Call Arrivals**

Authors: S. Lirio Castellanos-Lopez (UAM, Mexico); Daniela Toral-Valdez (UAM-Azcapotzalco, Mexico); Felipe A. Cruz-Pérez (CINVESTAV-IPN, Mexico); Genaro Hernandez-Valdez (UAM-A, Mexico)

Abstract: In this paper, the performance of mobile multicellular networks with time-varying traffic is mathematically analyzed and numerically evaluated. To model time-varying traffic demand, new call requests in each cell are considered to follow an independent two-state Markov Modulated Poisson Process (MMPP). A novel approximated teletraffic analysis for the system-performance evaluation is proposed and developed. The proposed analysis is based on both a bi-dimensional and a tri-dimensional birth and death processes. In our developed queuing analysis, handoff call requests arriving to the reference cell are modeled through a seven-state MMPP. Contrary to previously published related works, the parameters of the MMPP are iteratively calculated as function of the different system parameters. Numerical results obtained with the proposed approximated method are compared against those obtained by both a teletraffic analysis considering that handoff call requests follow a Poisson process and a discrete-event simulation study. The effect of users’ mobility factor and burstiness of new call arrivals on the system performance are evaluated.

**A Jammer-Resilient Cognitive Radio Network Using Evolutionary Game Theory**

Authors: Amar Taggu (North Eastern Regional Institute of Science and Technology, India); Mammi Nath (North Eastern Regional Institute of Science and Technology, India); Poulami Banik (North Eastern Regional Institute of Science and Technology, India); Ningrinla Marchang (North Eastern Regional Institute of Science and Technology, Arunachal Pradesh, India)

Abstract: Cognitive Radio Network (CRN) is an emerging technology that holds promises for solving the wireless spectrum scarcity problem by allowing secondary users (SU), also called unlicensed users, to coexist with primary user (PU), also called licensed users, without causing any interference to the PU’s communication. However, similar to any networking technology, CRNs are susceptible to many attacks, one of which is the jamming attack. A jamming attack can be referred to as an intentional interference attack on wireless channels with an intent to either interfere with the transmissions of SUs or to gain access to the channel for selfish utilisation of the channel. This paper presents an evolutionary game theoretic approach to mitigate such a jamming attack. The proposed evolutionary game helps normal secondary users gain fair utilization of channels even though a malicious SU (jammer) could be present in those channels. Results obtained from this study establishes the fact that the proposed algorithm works.

**Approximating Log-Normally Distributed Secondary Service Time by Hyper-Exponential Distribution for the Analytical Performance Evaluation of Cognitive Radio Networks**

Authors: Felipe A. Cruz-Pérez (CINVESTAV-IPN, Mexico); José Serrano-Chávez (CINVESTAV, Mexico); S. Liria Castellanos-Lopez (UAM, Mexico); Genaro Hernandez-Valdez (UAM-A, Mexico)

Abstract: In this paper, hyper-exponential distribution is proposed to approximate log-normally distributed secondary service time in a cognitive radio network (CRN). Hyperexponential distributions of different orders (i.e., number of phases) are considered. Both moment matching and expectation maximization algorithm are employed and evaluated to determine the parameters of the hyper-exponential distributions that provides the best fit to the corresponding log-normal ones. A general teletraffic analysis is developed for the performance evaluation of the CRN considering an arbitrary order of the hyper-exponential distribution. The performance of the CRN is evaluated in terms of the new call blocking and forced termination probabilities of secondary users. Numerical results are obtained for both different ratios (acceleration factor) of the mean service times of PUs and SUs and different values of the number of phases of the hyper-exponential distribution. Numerical results show that, except for small values of the acceleration factor, the values of the different performance metrics obtained considering an n-th order hyper-exponential distribution become closer to those obtained by discrete event computer simulation (where the log-normal distribution is used to model the secondary service time) as n increases. For small values of the acceleration factor, the different performance metrics are insensitive to the probability distribution beyond the mean of the secondary service time.
### Communication Services and Multimedia Applications 2 (CSMA 2) Session
December 20, 2017 (11.00 - 12.30)

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<td>LOS/NLOS Channel Identification Algorithm in VLC-based Indoor Positioning System</td>
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**QoS Analysis for WebRTC Videoconferencing on Bandwidth-Limited Network**
Authors: Yoanes Bandung (Institut Teknologi Bandung, Indonesia); Luki Subekti (School of Electrical Engineering and Informatics ITB, Indonesia); Dion Tanjung (Institut Teknologi Bandung, Indonesia); Chrysostomos Chrysostomou (Frederick University, Cyprus)

Abstract: This paper presents a quality of service analysis conducted for real-time multimedia communication services particularly over limited capacity network. This research aims to examine quality of videoconferencing service based on WebRTC technology. We investigate several implementation challenges of videoconferencing in bandwidth limited network by conducting a thorough experimental study. We analyze videoconferencing quality from the implementation of WebRTC based system for supporting distance learning between two schools in Cianjur, West Java, Indonesia. Further, we study adaptability feature of WebRTC by performing experiments for several network conditions. Result of the experiment shows that fair quality of video (peak signal-tonoise ratio, PSNR, between 30dB to 33dB) can be reached when bandwidth capacity is 2048kbps. On the other hand, the experiment shows acceptable audio and video stream quality with packet loss rate (PLR) less than 1% and jitter less than 100ms can be reached in network condition with bandwidth capacity higher than 128kbps. Outcome of this research supports understanding and addressing of the challenges of real-time videoconferencing on bandwidth limited network.

**Data Aggregation Among Mobile Devices for Upload Traffic Reduction in Crowdsensing Systems**
Authors: Morihiko Tamai (Advanced Telecommunications Research Institute International, Japan); Akio Hasegawa (ATR Adaptive Communications Research Lab., Japan)

Abstract: Crowdsensing systems exploit widely scattered mobile devices for large scale sensing applications. In crowdsensing systems, since there is a possibility that a huge amount of data is uploaded through cellular networks or Wi-Fi, a general framework for reducing the traffic volume is required to avoid overloading these network infrastructures. In this paper, we propose a data aggregation method among mobile devices to reduce traffic volume incurred by uploading of sensory data. By utilizing opportunistic contacts between mobile devices, sensory data are moved using short range communication over...
mobile devices so that aggregation performance is improved. To achieve effective data movement, our method utilizes contact history among mobile devices, and let the mobile devices that are frequently contacted by the other devices collect sensory data intensively from the other devices. Experiments show that our method can achieve high aggregation performance in various settings.

An Architecture for QoS-aware Service Deployment in Software-Defined IoT Networks
Authors: Slavica Tomovic (University of Montenegro, Montenegro); Walter Cerroni (University of Bologna, Italy); Franco Callegati (Università di Bologna, Italy); Roberto Verdone (University of Bologna, Italy); Igor Radusinovic (University of Montenegro, Montenegro); Milica Pejanovic-Djurisic (University of Montenegro & Centre for Telecommunications, Montenegro); Chiara Buratti (University of Bologna, Italy)

Abstract: One of the major challenges in Internet of Things (IoT) will be management and orchestration of multitechnology/multi-vendor network environments. According to many stakeholders, the adoption of software defined networking (SDN) principles in 5G (5-th Generation) wireless networks will allow the integration of mobile networks and the internet of things and will make it possible to manage billions of connected smart objects through intelligent orchestration and provisioning systems. The special value of SDN lies its ability to support network virtualization and to automate deployment of new services on top of the virtualized network infrastructure. To pave the way towards this novel approach, we present a SDN-based architecture for virtualization of IoT networks, including an intent-based north-bound interface and a virtualized infrastructure manager, allowing virtualization of IoT resources. The architecture exploits SDN controller to program different IoT networks in order to provide to users the intended service at the requested level of quality. A prototype of the architecture is presented and numerical results related to round trip time, measured at the different levels of the architecture, are reported.

An In-Network Service System Based on Smart Routers and Edge Devices
Authors: Zhenyu Zhao (University of Science and Technology of China, P.R. China); Yiqiang Sheng (Chinese Academy of Sciences, P.R. China); Wang Jinlin (the Institute of Acoustics, CAS, P.R. China); Ming Zhu (University of Science and Technology of China, P.R. China)

Abstract: Watching and downloading of the online high-definition video has become one of our daily needs. The user experience of traditional service system based on content delivery network (CDN) and peer to peer (P2P) is limited by the bandwidth and the service ability. These technologies mostly concentrate on content servers and personal computers rather than routers and devices in the network. In this paper, we propose an in-network service system by taking full advantage of the smart routers and edge devices to relieve the load of CDN. We mainly do the following works. 1) We propose the basic architecture of the in-network service system and deploy it on a real network environment. 2) We introduce a hybrid node management algorithm for large scale, flexible, high churn network to manage the smart routers with the edge devices. 3) We design a file self-diffusion algorithm for content delivery. The evaluation shows the high performance of the hit rate of service using the proposed system. In the experiment, up to half of the user requests can be serviced by the proposed system without accessing the CDN.

LOS/NLOS Channel Identification Algorithm in VLC-based Indoor Positioning System
Authors: Xun Zhang (Institut Superieur d Electronique de Paris, France); Chuaxi Huang (ISEP, France)

Abstract: With the development of Visible light communication (VLC) and the requirement of position based service, VLC based Indoor Positioning System (VLC IPS) has been a popular research area. But there is an important impact of multipath on positioning accuracy (1m positioning error). In this paper, the multipath is characterized as normalization Signal to Interference plus Noise Ratio (SINR). Then the LOS-NLOS identification algorithm is proposed which can calculate the SINR and eliminate the effect of multipath. According to simulation result, the positioning accuracy could achieve a 7 cm and 20 cm in the corner area.
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About the event
The 21st International Symposium on Wireless Personal Multimedia Communications (WPMC-2018) and 6th Global Wireless Summit (GWS-2018) will be jointly held in Chiang Rai, Thailand from the 25th to the 28th of November 2018, Co- hosted by Center for Teleinfrastruktur Global Capsule (CUC) and Mae Fah Luang University (MFU). The theme of this year's conference is "Body and Mind Integration through Information and Communication Technology."

Introduction to WPMC
The WPMC symposia series were inaugurated in 1998, as a global platform which aims at enabling collaboration in the field of wireless information. Held in Asia, Europe and America, WPMC has established itself as a unique global conference dedicated to wireless multimedia convergence. Continuing the series, the 21st WPMC will bring together academia, industries and standardization bodies to explore activities, trends and future challenges towards ICT globalization for health and wellness issues in existing and future wireless technologies.

Introduction to GWS
Global Wireless Summit (GWS) is the continuous event of one of the world’s largest annual international conferences on wireless technology covering its latest advances. A key emphasis of this year’s conferences is borderless smart society - bridging across industries, public and private companies, universities, research labs, and other knowledge societies in exploration of the newest wireless technologies pursuing new ways of living as well as innovative and sustainable solutions for the future.

We look forward to receive your contributions and to see you at the joint conference of WPMC-2018 and GWS-2018.

Technical Tracks
WPMC-2018
1. Wireless Communications and PHY.
2. Wireless Networks.
3. Communications Services and Multimedia Applications.
5. Security and Privacy in Communications.

GWS-2018
1. Multi business model innovation in a world of human bond communication.
4. Next Generation Communications

Additional Proposals
A proposal for Special Sessions, Tutorials, Workshops, Panel Sessions, and Round Table topics can be submitted before the deadlines. The session topic can be varied upon one’s interest but still relate to the technical tracks.

Important Dates
Deadline for Additional Proposals: 1 May 1, 2018
Deadline for Papers Submissions: July 31, 2018
Notification of Acceptance: August 31, 2018
Deadline for Final Manuscript Submission: September 15, 2018
Deadline for Early Registration: October 15, 2018
Conference Dates: 25 – 28 November 2018

Papers’ Submissions
1) Prospective authors are invited to submit original full papers in English, of 4 – 6 (max) pages in standard IEEE two- column format only, reporting their original work and results, applications, and/or implementation in one or more of the listed areas.
2) Papers must be submitted online only through the submission system of the conference website.
3) At least one author of each accepted paper MUST register and present the paper at the conference in order that the paper is to be included in the program. The program will also be submitted for inclusion in the IEEE Xplore.

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Further Publication
Potential papers are encouraged for their extension and submit to Wireless Personal Communications Journal (indexed in Web of Science with annual impact factor), and other reputed journals such as River Publishers for further publication.

More information is available at http://www.mfu.ac.th/wpmc2018/