

ITU Kaleidoscope 2016
ICTs for a Sustainable World

CLOSING

Alessia Magliarditi
ITU Kaleidoscope Coordinator

Bangkok, Thailand
14-16 November 2016



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Bangkok, Thailand, 14-16 November 2016
ITU Kaleidoscope 2016 - ICTs for a Sustainable World

ITU staff

Alessia Magliarditi, Kaleidoscope Coordinator



Erica Campilongo, Collaborator and Coordinator of Jules Verne's corner and Local Universities Exhibit

Martin Adolph, Technical Adviser



Pascal Borde, Promotional support

K-2016 PAPERS

- **83 papers submitted** for review from **23 countries**
- **25 papers (19 Lecture/6 Poster) accepted** for publication and presentation from **15 countries** (all from academic institutions)
- **Acceptance ratio: 30.1**
- **2 Invited papers**
- **3 Keynote speakers (1 paper)**

<http://itu.int/go/K-2016>

Special Session

Jules Verne's corner

*"Artificial Intelligence for a sustainable future:
friendly companion or threatening conqueror?"*

Objective: imagine the potentially limitless AI applications that can help address environmental, economic, and societal challenges concerning sustainable development and a sustainable future.

Moderator: *Stephen Ibaraki*, International Federation for Information Processing

Panelists:

- *Malavika Jayaram*, Digital Asia Hub, Hong Kong, China
- *Sauvik Banerjee*, SAP
- *Prabhas Chongstitvatana*, Chulalongkorn University, Thailand



Local Universities Exhibit

14-17 November 2016

Showcase of academic research, special projects, and literature on how ICTs and international standards will help achieve the United Nations Sustainable Development Goals (SDGs)

- Exhibitors:
 - Department of Electrical Engineering, Faculty of Engineering, **Chulalongkorn University** (Thailand)
 - Singapore Internet Research Centre, Wee Kim Wee School of Communication and Information, **Nanyang Technological University** (Singapore)
 - **Waseda University** (Japan)
 - *Guest exhibitor:* **Universidad Distrital Francisco Jose de Caldas** (Colombia)

Local Universities Exhibit

14-17 November 2016



Located within the “ITU-T Standards for Global ICTs” pavilion at the ITU Telecom World Exhibition space

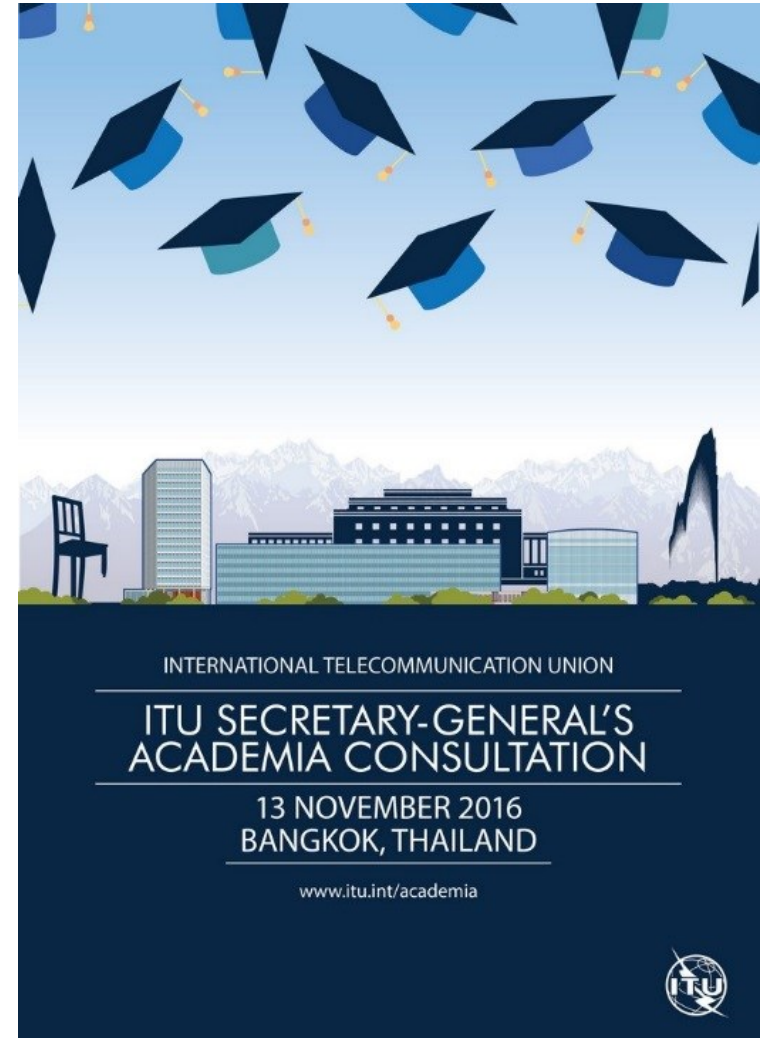
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ITU Kaleidoscope 2016 - ICTs for a Sustainable World

Side event

13 November 2016

ITU Secretary-General's Academia Consultation

- Representatives from academia, industry members and governments discussed ways of strengthening collaboration between ITU and academia:
 - New ITU Journal
 - New Advisory Board of Academia to the ITU Secretary-General
 - e-Networking and content sharing platform.



Proceedings

Selected and presented papers



IEEE Xplore®
Digital Library

Bangkok, Thailand, 14-16 November 2016
ITU Kaleidoscope 2016 - *ICTs for a Sustainable World*

Optical Communications: Highways of the Future

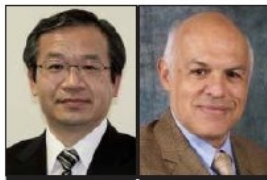
*The First ITU-T Kaleidoscope Event:
"Innovations in NGN"*

Topics in Automotive Networking

... featuring
Kaleidoscope 2008

IEEE Communications
Magazine
Issue May 2009

SERIES EDITORIAL



Yoichi Maeda

Mostafa Hashem
Sherif

THE FIRST ITU-T KALEIDOSCOPE EVENT: "INNOVATIONS IN NGN"

The Feature Topic of this issue is about the first International Telecommunication Union (ITU-T) Kaleidoscope event that took place in Geneva, Switzerland on 12–13 May 2008. This was an academic conference on "Innovations in NGN (Next Generation Networks)" that brought together over 220 participants from 48 countries, including students and professors from 43 academic institutions.

In organizing this conference, the goals of the ITU-T were to increase collaboration among academia and experts working on the standardization of information and telecommunications technologies (ICTs) to identify possible applications of the NGN that may require standardization. The conference was technically co-sponsored by the IEEE Communications Society, and the *Proceedings* are now available electronically via IEEE Xplore. Cisco Systems donated a total of US\$10,000 for the three best paper awards (respectively \$5000, \$3000 and \$2000). Other sponsors were Intel, the International Communications Foundation (ICF) of Japan, and Sun Microsystems.

A total of 141 papers were submitted and underwent a double-blind peer review process. Each proposal received at least three full paper reviews. The three best papers were selected from nine nominations following the presentation of all papers, and a number of young authors were recognized. The awards recipients were:

- First prize: "Architecture and Business Model of Open Heterogeneous Mobile Network," by Yoshitoshi Murata, Mikio Hasegawa, Homare Murakami, Hiroshi Harada, and Shuzo Kato
- Second prize: "Differential Phase Shift Quantum Key Distribution" by Hiroki Takesue, Toshimori Honjo, Kiyoshi Tamaki, and Yasuhiro Tokura
- Third prize: "Open API Standardization for the NGN Platform" by Catherine Mulligan

The keynote speech was given by Professor Myung Oh, President of Konkuk University, Korea, on the importance of research and development (R&D) and its socio-economic implications, and the need to balance profit-driven industry and innovation-led academia in standardization. Mr. Alexander D. Gelman, Director of Standards, IEEE

Communications Society, gave a keynote presentation on IEEE standards and future collaborations between the ITU-T and the IEEE in the area of standardization. Three papers were invited for each track of the conference. For Track 1, this paper was "A New Generation Network — Beyond NGN" by Professor Tomonori Aoyama, Research Institute for Digital Media and Content, Keio University, Japan. Track 2's invited paper was by Dr. Martin Körbling from Ericsson on "Evolution of Open IPTV Standards and Services." The invited paper for track 3 was "Open Standards: A Call for Action" by Mr. Ken Krechmer, University of Colorado.

This issue of the Standards Series contains updated versions of the winning papers and two of the three invited papers. The first article, "A New Generation Network: Beyond the Internet and NGN" by Tomonori Aoyama, describes the requirements and fundamental technologies to provide a new generation network beyond the Internet and the next generation network (NGN), both of which are based on IP protocols. Although the Internet has grown into a social infrastructure, and the NGN is expected to replace both legacy telephone networks and cellular phone networks in the near future, there are many technological, economic, and societal factors pushing the search for revolutionary network technologies and a clean-slate designed architecture beyond the IP structure.

The second article, "Open Standards: A Call for Change" by Ken Krechmer, reviews the different needs of specific groups of society and develops 10 different requirements for open standards. Digital communications is both pervasive and vital across society. This creates growing public interest in the technical standards that proscribe public communications. While there is public demand for "open standards," this rallying cry means different things to different groups. To implement these requirements, changes to the rules and procedures of standardization organizations, international bodies, and national patent office rules are proposed. Interestingly, technical changes, in the form of new standardized protocols rather than legal or policy changes, appear to be the most important to meet the requirements of open standards.

SERIES EDITORIAL

The third article, "The Architecture and a Business Model for the Open Heterogeneous Mobile Network" by Yoshitoshi Murata, proposes revised architectures for TISPAN-NGN that correspond to heterogeneous networks and open mobile markets, and present new business models. The mobile communications market has grown rapidly over the past 10 years, but the market may reach saturation in the foreseeable future. More flexible mobile networks able to meet various user demands and create new market openings are needed for further growth. Heterogeneous networks are more suitable than homogeneous networks for meeting a wide variety of user demands. There are two types of heterogeneous network: a closed type whose network resources are deployed and operated by communication carriers, and an open type whose network resources would be deployed not only by existing operators but also by companies, universities, and so on. It will be easy for newcomers to enter mobile businesses in an open heterogeneous mobile network, so many innovative services are likely to be provided through cooperation between various companies or organizations.

The fourth article, "Differential Phase Shift Quantum Key Distribution" by Hiroki Takesue, describes quantum key distribution (QKD), which has been studied as an ultimate method for secure communication and is now emerging as a technology that can be deployed in real fiber networks. The authors present their QKD experiments based on the differential phase shift QKD (DPS-QKD) protocol. A DPS-QKD system has a simple configuration that is easy to implement with conventional optical communication components, and is suitable for a high clock rate system. Moreover, although the DPS-QKD system is implemented with an attenuated laser source, it is inherently secure against strong eavesdropping attacks called photon number splitting attacks, which pose a serious threat to conventional QKD systems with attenuated laser sources. It also describes three types of single photon detectors that are suitable for high-speed long-distance QKD: an up-conversion detector, a superconducting single photon detector, and a sinusoidally gated InGaAs avalanche photodiode. The article presents the record setting QKD experiments that employed those detectors.

The last article, "Open API Standardization for the NGN Platform" by Catherine Mulligan, offers outlines the importance of open APIs, what currently exists in the standards bodies, and concludes with a brief set of issues standards bodies need to resolve in relation to these APIs.

NGNs are meant to enable a richer set of applications to the end user, creating a network platform that allows rapid creation of new services. Significant progress has been made in the standardization of NGN architecture and protocols, but little progress has been made on open APIs.

The Organizing Committee was chaired by Mr. Yoichi Maeda (NTT, Japan), and the Program Committee was chaired by Mr. Pierre-André Probst (OFCOM, Switzerland). He was assisted by Messrs. Mostafa Hashem Sherif (AT&T, United States), Mitsui Matsumoto (Waseda University, Japan), and James Carlo (JC Consulting, United States).

The Guest Editors would like to express their sincere thanks to all the authors for this Feature Topic, and to the reviewers for the Kaleidoscope event and for this issue for their helpful remarks that contributed to the outstanding quality of the articles. They would like to express their gratitude to the Editor-in-Chief and production staff for their strong support.

The second Kaleidoscope academic conference will take place in Argentina, 31 August–1 September 2009, just before the NGN-GSI event in the same venue. Additional information is available at <http://www.itu.int/ITU-T/uni/kaleidoscope/2009>.

BIOGRAPHIES

YOICHI MAEDA [M] (yoichi.maeda@ntt.co.jp) received B.E. and M.E. degrees in electronic engineering from Shizuoka University, Japan, in 1978 and 1980, respectively. Since joining NTT in 1980, for the last 28 years he has been engaged in research and development on access network transport systems for broadband communications including SDH, ATM, and IP. From 1988 to 1989 he worked for British Telecom Research Laboratories in the UK as an exchange research engineer. He currently leads the standardization promotion section in NTT Advanced Technology Corporation and is NTT's Senior Adviser on Standardization. In October 2008 at the World Telecommunication Standardization Assembly (WTS-08), he was appointed to the chair of ITU-T SG15 for the 2009–2012 study period for his second term. He is a Fellow of the IEEE of Japan. He has been a feature editor of the Standards Series in IEEE Communications Magazine since 1999.

MOSTAFA HASHEM SHERIF (mhshef@att.com) has been with AT&T in various capacities since 1983. He has a Ph.D. from the University of California, Los Angeles, an M.S. in management of technology from Stevens Institute of Technology, New Jersey, and is a certified project manager from the Project Management Institute (PMI). Among the books he authored are *Protocols for Secure Electronic Commerce* (2nd ed., CRC Press, 2003), *Pratiques électroniques sécurisées*, *Presses polytechniques et universitaires romandes*, 2006, and *Managing Projects in Telecommunication Services* (Wiley, 2006). He is a co-editor of two books on management of technology published by Elsevier Science and World Scientific Publications in 2006 and 2008, respectively, and is the editor of the forthcoming *Handbook of Enterprise Integration* (3rd ed.), Auerbach. He is also a standards editor for IEEE Communications Magazine, an associate editor of the *International Journal of IT Standards & Standardization Research*, and a member of the editorial board of the *International Journal of Marketing*.

- *LTE Update*
- *Optical Communications*
- *ITU-T Standards: Innovations for Digital Inclusion*

Free ComSoc Tutorial — 4G
See Page 9

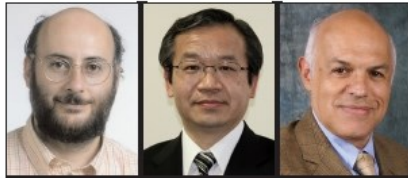
... featuring
Kaleidoscope 2009

IEEE Communications
Magazine
Issue February 2010

Bangkok, Thailand, 14-16 November 2016
ITU Kaleidoscope 2016 - ICTs for a Sustainable World

SERIES EDITORIAL

THE SECOND ITU-T KALEIDOSCOPE CONFERENCE: "INNOVATIONS FOR DIGITAL INCLUSION"



Simão Ferraz
de Campos Neto

Yoichi Maeda

Mostafa Hashem
Sherif

This Standards section presents selected articles from the second International Telecommunication Union — Telecommunication Standardization Sector (ITU-T) Kaleidoscope Academic Conference, which was technically co-sponsored by the IEEE Communications Society and took place in Mar del Plata, Argentina, 31 August–1 September 2009. The conference focus was on the role that standards play in "Innovations for Digital Inclusion."

The selection illustrates the reciprocal influences of technological innovations and standardization as they relate to various aspects of digital inclusion. It comprises two sets of articles: invited and awarded. The first invited paper, by Richard Stallman, founder of the GNU Linux project and now President of the Free Software Foundation, asked two fundamental questions: "Is Digital Inclusion a Good Thing? How We Can Make Sure It Is?" These questions set the tone of the conference, and stimulated many interesting discussions in the session where it was presented and during coffee breaks (some of the exchanges are available at <http://www.sabermenos.com.ar/richard-stallman-en-mar-del-plata>). The gist of the argument is that digital inclusion should not be at the expense of privacy rights and freedom of choice, a side-effect that many technologists tend to overlook. Discussions turned around whether the proposed solution (using free, i.e., unencumbered or libre, software) would fit current business models and the pressures for shorter development cycles.

The provocative title of the second article, by Erkki Sutinen, from the University of Joensuu, Finland, "Technology for Losers: Re-Equipping The Excluded," was meant to shake up patronizing and condescending attitudes toward "losers." These people are marginalized because of unemployment, special needs, poverty, or lack of development. In other words, they are those who, for any number of reasons, have been deprived of something valuable they possessed. From that perspective, losers are the majority of humanity. To work with and for losers, the author proposes that designers learn how to focus on

urgent, relevant, and concrete problems, and to supplement needs-based requirements with a strength-based approach.

The final invited article, by Louis Masi and Dawn Tew, "Interplay and Implications of Intellectual Property and Academic-Industry Collaboration to Foster Digital Innovation," summarizes lessons that IBM, together with the Kauffman Foundation, has learned from experimentation with new styles of collaboration. The authors offer 10 key points to guide and challenge the academic and industrial communities into thinking of innovative ways to accelerate economic development for all.

The remaining articles are revised versions of contributions chosen by an award committee to share a prize of \$10,000 funded by Nokia and Cisco Systems. The committee included representatives of both industry and universities, whose names and affiliations are listed in alphabetical order: Thoru Asami (University of Tokyo, Japan), Kai Jacobs (RWTH Aachen University, Germany), Louis Masi (IBM, USA), Helmut Schink (Nokia Siemens Networks, Germany), and Erkki Allan Sutinen (University of Joensuu, Finland). The committee was chaired by Mostafa Hashem Sherif (AT&T, USA).

The original intention was to have three prizes only. However, after reviewing the articles and evaluating the actual presentations, it was decided to share the second prize among three papers that were deemed of equal quality and relevance to the theme of the conference.

The first prize went to Kazaura *et al.* for the article entitled "RoFSO: A Universal Platform for Convergence of Fiber and Free-Space Optical Communication Networks." This is a description of a joint project by Waseda and Osaka Universities, both in Japan, regarding the use of analog/digital radio frequency (RF) signals over fiber and free-space optics (FSO) links. Based on their experimental results, the authors consider that FSO offers a viable alternative for high-speed data transmission in rural and remote areas, and over difficult terrains.

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The article "An ID/Locator Split Architecture of Future Networks" by Kalle *et al.*, from the National Institute of Information Communications Technology in Japan, is a contribution to the current discussions in the ITU-T, Internet Engineering Task Force (IETF), and Internet Research Task Force (IRTF) on ways to distinguish between the two roles IP addresses play in IP networks. Currently, the IP address is a locator for forwarding packets toward their final destination at the network layer and a host identifier at the higher layers. This dual role poses unnecessary constraints on new mobility applications that would require rapid changes of the locator while preserving the host identifier. The authors define a network architecture with several new entities (registries, gateways, etc.) to track various bindings between host names, host identifiers, locators and security keys, and so on, and a new naming system with several components: a host identifier with a one-way cryptographic hash of the local host name and domain name, and, depending on the application, one or more locators corresponding to that host identifier. The large-scale applicability of the proposal, however, is still open for future investigations.

The *ex aequo* second prize went to the article "Quality of Service Management for ISP: A Model and Implementation Methodology Based on ITU-T Rec. E.802 Framework" by Ibarrola *et al.*, a joint contribution from the University of the Basque Country in Spain and the University of Waterloo in Canada. ITU-T E.802 provides guidelines on how to define and prioritize quality of service (QoS) requirements. The significance of this article is that it is one of the first attempts to apply that framework to assist Internet service providers in defining the quality policies of their service offers to residential customers.

The final awarded article, "Discrimination in NGN Service Markets: Opportunity or Barrier to Digital Inclusion" by Beltrán and Gómez, from the University of Auckland in New Zealand and the Colombian Telecommunications Research Center, respectively, is a contribution to the current "net neutrality" debate. The core issue is whether a mandate for network access or discrimination based on pricing, QoS, or content would encourage innovation and competition. The basis of the discussion is a model the first author developed with W. Sharkey from the Federal Communications Commission (FCC) to investigate pricing structures in next-generation networks (NGN). Although the article does not give explicit recommendations, it provides a framework to discuss the effects of policy and regulations using a two-sided market model.

The conference was chaired by Yoichi Maeda (NTT, Japan) and was piggybacked on an NGN-GSI (Global

Standards Initiative)¹ event. Participation statistics show that the target public (academia and R&D) was well represented. The program comprised 20 papers and 12 poster presentations, selected out of the original 83 submissions with the help of 113 subject matter experts. All these papers are available through the IEEE Xplore digital library. The conference included an exhibit where six South American universities presented their activities.

The theme of the Kaleidoscope 2010 conference is "Beyond the Internet? Innovations for Future Networks and Services." The conference venue will be near Bombay, India, 13–15 December 2010. Further information will be posted at <http://itu-kaleidoscope.org/2010>.

BIOGRAPHIES

SIMÃO FERRAZ DE CAMPOS NETO (simao.campos@itu.int) joined the secretariat of the ITU Standardization Sector in 2002, and is the Counselor for ITU-T Study Group 16 (for standardization work on multimedia services, protocols, systems, terminals, and media coding). He has organized several workshops (e.g., Multimedia in NGN, Telecoms for Disaster Relief, R&D, Standardization in E-health, SIIT2005) and was the editor of the first version of the ITU-T Security Manual. Prior to joining ITU in 2002, he worked for eight years as a scientist in COMSAT Laboratories performing standards representation and quality assessment for digital voice coding systems, and before that he was a researcher at Telebrás's R&D Center (CPRD). He authored several academic papers and position papers, served on the review committee of several IEEE-sponsored conferences, and organized the first ITU-T Kaleidoscope Conference. He is a graduate of the State University of Campinas, Brazil (B.Sc., 1986; M.Sc., 1993).

YOICHI MAEDA [M] (yoichi.maeda@ntt-at.co.jp) received B.E. and M.E. degrees in electronic engineering from Shizuoka University, Japan, in 1978 and 1980, respectively. Since joining NTT in 1980, for the last 26 years he has been engaged in research and development on access network transport systems for broadband communications including SDH, ATM, and IP. From 1988 to 1989 he worked for British Telecom Research Laboratories in the United Kingdom as an exchange research engineer. He currently leads the standardization promotion section of NTT Advanced Technology Corporation and is NTT's senior adviser on standardization. In October 2008 at the World Telecommunication Standardization Assembly (WISA-08), he was appointed chair of ITU-T SG15 for the 2009–2012 study period for his second term. He is a Fellow of the IEICE of Japan. He has been a Series Editor of the Standards Series in IEEE Communications Magazine since 1999.

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¹ GSI is an ITU initiative to promote the research and standardization of NGN technologies. The first NGN-GSI event took place in Beijing, China, in August 2007. Meetings are held regularly, three to four times a year.

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- Traffic Management for Mobile Broadband Networks
- ITU Kaleidoscope Conference
- Integrated Circuits for Communications

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GUEST EDITORIAL

THE THIRD ITU KALEIDOSCOPE CONFERENCE: "INNOVATIONS FOR DIGITAL INCLUSION"



Mostafa Hashem Sherif Yoichi Maeda Stefano Polidori

This Standards section contains selected papers from the third International Telecommunication Union Telecommunication Standardization Sector (ITU-T) Kaleidoscope Academic Conference, organized with the technical co-sponsorship of the IEEE Communications Society. The aim of the Kaleidoscope conference series is to identify emerging developments in information and communication technologies (ICTs) at an early stage to generate successful products and services through the development of international and open standards.

The 2010 conference took place at the Narhe Campus, Pune, Maharashtra, India, 13–17 December. It was hosted by the Sinhgad Technical Education Society (STES), at the invitation of the Ministry of Communications and Information Technology of India. The local partners, the Global ICT Standardization Forum for India (GISFI), the ITU-APT Foundation of India, and the CMAI Association of India were successful in increasing awareness of the event; 79 percent of the audience was from India. In addition, several Indian institutions contributed to an exhibit that paralleled the conference: Anna University, MIT Campus, Chennai; Telecom Centres of Excellence, New Delhi; College of Engineering (COEP), Pune; Sinhgad College of Engineering, Sinhgad Technical Education Society, Pune; Bharati Vidyapeeth Deemed University, Pune; and MIT School of Telecom Management, Pune.

Three other ITU events took place in parallel with the conference: the ITU IPTV Global Standards Initiative¹ (IPTV-GSI), 13–17 December, and the ITU IPTV Interoperability event, 14–17 December, as well as an IPTV Workshop on 17 December. The workshop included a panel moderated and broadcast by Bloomberg TV with a

"Bollywood" producer among the panelists. In addition, the Global ICT Standardization Forum for India (GISFI) had their meeting on 13–15 December, while the European MyFIRE project had theirs on 16–17 December. Finally, a Standardization Tutorial was organized for the conference attendees on 16 December 2010.

The IPTV interoperability event is a response to resolutions from the ITU-D (Development Sector) to assist developing countries in selecting equipment from multiple vendors and ensure that they can work together to provide IPTV services. This was the third such event; the previous two took place in Geneva and Singapore. This time, however, the participant companies were restricted to Japanese and Korean manufacturers, and their number was low (4), because their Chinese counterparts experienced visa difficulties. *GISFI* (<http://www.gisfi.org>) is a new public-private partnership that started in 2009 to provide a neutral ground for all Indian stakeholders to harmonize their position in the knowledge-based economy [1]. The project *MyFIRE* is funded by the European Union to develop the use of experimental facilities in Europe and increase awareness of best practices in testing. The framework is interdisciplinary, engaging network researchers with experts from key areas of sociology, policy makers, economic models, and standardization. The *CMAI Association of India* is a professional association for the promotion of the Indian IT and telecom sector (<http://www.cmai.asia>). Lastly, the *ITU-APT Foundation of India* is an Indian society related to activities concerning research and study on telecommunications with special emphasis on rural development (<http://itu-apt.org>).

The conference title was "Beyond the Internet?—Innovations for Future Networks and Services." Judging by the number of similar activities on that subject, this seems to be a pressing issue. One possible reason is that the original architecture of the Internet was based on the so-called end-to-end argument: that the final decisions should be

GUEST EDITORIAL

made by the users themselves, that network intelligence is unnecessary and that networking functions should be done as much as possible outside the network [2]. In other words, advanced networking services violate the fundamental postulate of network transparency; a service-based network connectivity must provide means to differentiate traffic based on individual criteria (traffic class, customer, etc.). Furthermore, security considerations are constantly threatening the resilience and availability of network connectivity [3]. Next-generation networks (NGN) are one short- to medium-term solution to ensure the quality of service by revisiting the concepts of the telecommunication network with those of the Internet. In 2007, however, Stanford University, Deutsche Telekom, and NEC formed a Clean Slate Laboratory to prototype "disruptive" new Internet technologies rather than "incremental patches and work-arounds," given that the spread of mobile technologies has changed the landscape within which the protocols were initially designed [4]. The founders were joined by Cisco, NTT DoCoMo, Xilinx, and Ericsson. In Europe, the Forum Atena invited many of the Internet founders (e.g., Vinton Cerf, John Day, Bob Kahn, and Louis Pouzin) to two sets of conferences in January and June 2010 to investigate new resilient architectures and governance models that could handle new applications such as the Internet of things and the concomitant rise of security needs [5]. The Kaleidoscope 2010 contributed to this ongoing search for architectures and infrastructures that could accommodate future applications and services and their expected growth of convergent traffic, with an emphasis on the reciprocal influences of technological innovation and standardization. (Note: The July 2011 issue of *IEEE Communications Magazine* presented six articles on current design efforts worldwide for the future Internet).

Of the 115 papers submitted for review, 37 papers were accepted for publication and presentation (23 in the lecture sessions and 14 in a poster session). Accepted papers came from 24 countries; but participants from China and Iran did not receive their visas in time, and two presentations had to be done via teleconferencing. The conference proceedings are available from the IEEE Xplore online repository as well as from the ITU publications page, and the archived webcast of the event can be seen at <http://www.itu.int/itu-t/2010/12/kaleidoscope/index.html>.

The conference supporters (Cisco, Nokia Siemens Networks, and MyFIRE) funded award prizes to the three best papers. The following award committee, whose names and affiliations are listed in alphabetical order by last name, made the final selection of the three best papers: Simão Campos Neto (ITU), Alex Galis (University College London, United Kingdom), Abhay Karandikar (Indian Institute of Technology Bombay, India), Mitsuru Matsumoto (Waseda University, Japan), and Detlev Ott (Nokia Siemens Networks, Germany). The award committee was headed by Mostafa Hashem Sherif (AT&T, United States). The awardees were as follows:

- 1st prize (US\$5000): "A User-Centric Approach to QoS Regulation in Future Networks," presented by Eva Ibarrola (University of the Basque Country, Spain), co-authored by Fidel Liberal, Armando Ferro

(University of the Basque Country, Spain), and Jin Xiao (University of Waterloo, Canada).

- 2nd prize (US\$3000): "How Can an ISP Merge with a CDN (Content Delivery Network)?" presented by Kideok Cho (Seoul National University, Korea) and co-authored by Hakyoung Jung, Munyoung Lee, Diko Ko, Taekyoung Kwon, and Yanghee Choi (Seoul National University, Korea).
- 3rd prize (US\$2000): "Introducing Elasticity and Adaptation into the Optical Domain Toward More Efficient and Scalable Optical Transport Networks," presented by Masahiko Jinno (NTT, Japan) and co-authored by Yoshiaki Sone, Osamu Ishida, Takuya Ohara, Akira Hirano, and Tomiwa (NTT, Japan).

These papers have been revised to meet the requirements of *IEEE Communication Magazine* before their inclusion in this section. In addition, a revised version of one of the invited papers, "Toward a Polymorphic Future Internet: A Networking Science Approach" by Kave Salamatian (Université de Savoie, France) is also made available.

Unfortunately, not all excellent papers could be recognized monetarily. For example, an interesting paper by Brad Biddle, Andrew White, and Sean Woods (Arizona State University Sandra Day O'Connor College of Law) considered "H-Other Empirical of the number of typical manifold."

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In closing, the editors would like to thank the authors for their cooperation in making the requested revisions. In addition, the 17 reviewers listed below in alphabetical order helped select among the invited papers and provided indispensable comments that have shaped and improved the initial submissions to *IEEE Communication Magazine*.

Aguiar, Javier, University of Valladolid, Spain
Botta, Alessio, University of Napoli, Federico II, Italy
Campos-Neto, Simão, ITU, Switzerland
Carraschi, Antonio, DISI, University of Bologna, Italy
Denning, Peter, Naval Postgraduate School, USA
Jakobs, Kai, RWTH Aachen University, Germany
Kiekamp, Axel, Axiom-Luxem, Bell Labs, Germany
Markandey, Shriram, STES, St. Kashibai Navale College of Engineering, Electronics & Telecommunication Engineering, India
Moraes, Anaflia, Alcatel-Lucent, Bell Labs, France
Oliveira, José Manuel, INESC Porto, Portugal
Pothan, Mukundam, CSIRO ICT Center, Australia
Pulidori, Antonio, University of Messina, Italy
Rajkowski, Tony, Nemagig Associates, United States
Salvadore, Elio, CRIATE-NTT, Italy
Shenker, Scott, University of California, Berkeley, United States
Van Een, Michel, Delft University of Technology, The Netherlands
Wang, Jeanette, Carnegie Mellon University, United States

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BIOGRAPHIES

MOSTAFA HASHEM SHERIF (ms220@att.net) has been with AT&T in various capacities since 1982. He has a Ph.D. from the University of California, Los Angeles, in M.S. in the management of technology from University Institute of Technology, New Jersey, and a current project manager of the Future Management Institute (FMI). Among the books he authored are *Protocols for Service-Based Computing* (2nd ed., CRC Press, 2002), *Networks: The Transport Network* (Prentice-Hall, 1996), and *Networks: The Transport Network* (Prentice-Hall, 1996). He is a co-author of two books on the management of technology published by Elsevier Science and World Scientific Publications in 2004 and 2006, respectively, and is the editor of the *Handbook of Enterprise Information Systems* (2nd ed., Amsterdam, 2006).

YOICHI MAEDA (yoichi.maeda@ntt.net) received B.S. and M.E. degrees in electronic engineering from Shinjuku University, Japan, in 1978 and 1980, respectively. Since joining NTT in 1980, for the last 28 years he has been engaged in research and development on access network transport systems for broadband communications including SD-WAN, and IP from 1980 to 1990 he worked for British Telecom Research Laboratories in the United Kingdom as an exchange research engineer. He currently leads the Standardization promotion section of NTT Advanced Technology Corporation and is NTT's senior advisor on standardization. In October 2010, at the World Information Standardization Assembly (WISA-08), he was appointed chair of ITU-T SG15 for the 2009-2012 biennial period for his second term. He is a fellow of the IEEE of Japan. He has been a Senior Editor of the *Standards Series in IEEE Communication Magazine* since 1995.

STEFANO POLIDORI has been working as a study group engineer at the International Telecommunication Union (ITU) since 2004. In 2007 he received his Master's degree in decision engineering from the University of Pisa. He is also a Member of Science in engineering with specialization in mobile communication systems. He is currently working in the electronic and software, he joined ITU-T and is currently engaged in the Standardization Series profile. He is in charge of the secretariat of Study Group 15. He received his M.S. in "Signaling requirements, protocols and test specifications" in the area of the Internet of Things (IoT) in the last coordination activity on the Internet of Things (IoT) held in the Internet of Things Global Standards Initiative (IoT-GSI), as well as the IPTV Global Standards Initiative (IPTV-GSI) in 2010. He is currently working as a Senior European Standardization Policy. He was responsible for the organization of the ITU Kaleidoscope academic conference in 2010.

¹ See <http://www.itu.int/itu-t/2010/12/iptv>. Other ITU global standard initiatives concern Next Generation Networks (NGN-GSI) and the Internet of Things (IoT-GSI).



... featuring
Kaleidoscope 2011

IEEE Communications
Magazine
Issue August 2012

Kaleidoscope special edition from page 135

SERIES EDITORIAL

THE 4TH ITU KALEIDOSCOPE CONFERENCE "THE FULLY NETWORKED HUMAN? INNOVATIONS FOR FUTURE NETWORKS AND SERVICES"



Mostafa Hashem
Sherif

Kai Jakobs

Martin Adolph

Yoichi Maeda

Kaleidoscope 2011 took place in Cape Town, South Africa, from December 12–14, 2011. This fourth event in the series focused on the central role of users of information and communication technologies (ICT). Accordingly, one of the aspects discussed was the adaptation of ICT to the African context (e.g., to monitor solar and climatic variations and to help microenterprises). Parallel with the conference, an exhibit of local universities organized by the International Telecommunication Union (ITU) Secretariat offered a glimpse into ICT activities in South Africa.

Of the 84 papers submitted for review, 30 were retained (21 for the lecture sessions and 9 for the poster session). The program consisted of contributions from 13 countries, many from Africa. The papers related to various aspects of ITU activities such as quality of service, cybersecurity, cloud computing, and other technologies associated with the Internet of Things (IoT). All papers are available from IEEE Xplore, and the conference proceedings can be downloaded from <http://www.itu.int/oth/T2905000016/en>.

The attendees came from 23 countries: 127 delegates from academia, industry, and governmental institutions. The archived webpage of the event can be seen at <http://www.itu.int/ITU-T/uni/kaleidoscope/2011/index.html>.

Four papers shared the prize fund of US\$10,000 provided by Nokia Siemens Networks and Telekom SA. Kai Jakobs (RWTH Aachen University, Germany) chaired the award committee, whose members were Martin Adolph (ITU), Armando Ferro (University of the Basque Country, Spain), Ian Graham (University of Edinburgh, United Kingdom), Yoshikazu Ikeda (Otani University, Japan), and Mostafa Hashem Sherif (AT&T, United States). The winning papers and two invited papers were considered for publication in the IEEE Communication Magazine. With the help of the 25 reviewers listed below, the article "Transmission Analysis of Digital TV Signals over a Radio-on-FTO Channel" by Ben Naila *et al.* was selected for this issue. This is an enhanced version of the paper that

won the first prize. It presents an experimental evaluation of the performance of Japanese integrated services digital broadcasting-terrestrial (ISDB-T) TV signals over free space optical (FSO) links. The results show that an alternative way to provide broadband wireless connectivity in underserved areas is possible.

In a half-day tutorial, Professor Dr. Thomas Magedanz, TU Berlin/Fraunhofer Institute FOKUS, Germany, provided an overview of possible network evolutions, including emerging mobile broadband networks, and their impact on infrastructures and services. The related activities of FOKUS and its toolkits were described. The presentation can be downloaded from http://www.fokus.fraunhofer.de/en/ngni/downloads/_request/index.html. (A request for access to the download area of the tutorial slides must be filled to receive an email with the activated hyperlink).

The Jules Verne's Corner is a platform for more speculative ideas and views, looking far into the future. In this session, Roberto Saracco (Telecom Italia) speculated about the "The Disappearance of Telecommunications and the Fading of Boundaries among Atoms and Bits." The principal message was that at singularity points, prolonging trends can be misleading because what used to be true may no longer apply. Along the same lines, Professor Rias van Wyk, director of the Technoscan Centre and Professor Extraordinaire at the University of Stellenbosch, South Africa, presented a functionality grid to construct an Atlas of technology that could help forecast and anticipate future technological developments. Professor van Wyk's presentation is available at http://www.itu.int/dms_pub/itu-t/oth/29/05/T29050000100003PDF.pdf.

Kaleidoscope 2013 will convene at Kyoto University in Kyoto, Japan from 22–24 April 2013 around the theme of "Building Sustainable Communities." The deadline for paper submission is September 10, 2012. Additional information can be found at <http://www.itu.int/ITU-T/uni/kaleidoscope/2013/index.html> or by contacting the Kaleidoscope

SERIES EDITORIAL

2013 coordinator Alessia Magliarditi at alessia.magliarditi@itu.int.

In closing, the editors would like to thank the reviewers listed below in alphabetical order:

Aguiar, Javier, University of Valladolid, Spain
Bachir, Abdelmalik, Imperial College, London, United Kingdom
Basson, Sara, IBM Research, United States
Blum, Niklas, Fraunhofer FOCUS, Germany
Demirkol, Ilker, Polytechnic University of Cartagena (UPC), Spain/Bogaziçi University, Turkey
Dohler, Mischa, Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), Spain
Egea-Lopez, Esteban, Polytechnic University of Cartagena (UPC), Spain
Egyedi, Tineke, Delft University of Technology, The Netherlands
Ersoy, Cem, Bogaziçi University, Turkey
Jahns, Juergen, Fern Universität in Hagen, Germany
Jamieson, Kyle, University College London, United Kingdom
Krechmer, Ken, University of Colorado, United States
Moser, Stefan, National Chiao Tung University (NCTU), Taiwan
Nozaki, Kazunori, Osaka University, Japan
Polyzos, George, Athens University of Economics and Business, Greece
Qi, Sen, Gallaudet University, United States
Sandvig, Christian, University of Illinois at Urbana-Champaign, United States
Sastry, Nishanth, King's College London, United Kingdom
Simpson, Richard, University of Pittsburgh, United States
Sum, Chin-Sean, National Institute of Information and Communications Technology (NICT), Japan
Sun, Zhi, Georgia Institute of Technology, United States
Turner, Kenneth, University of Stirling, United Kingdom
Vitasek, Jan, VSB (Technical University of Ostrava), Czech Republic
Willig, Andreas, University of Canterbury, New Zealand

Zheng, Jianliang, City College of New York, United States

BIOGRAPHIES

MOSTAFA HASHEM SHERIF (ms5285@att.com) has been with AT&T in various capacities since 1983. He has a Ph.D. from the University of California, Los Angeles, an M.S. in the management of technology from Stevens Institute of Technology, New Jersey, and is a certified project manager of the Project Management Institute (PMI). Among the books he authored are *Protocols for Secure Electronic Commerce* (2nd ed., CRC Press, 2003), *Pailements électroniques sécurisés* (Presses polytechniques et universitaires romandes, 2006), and *Managing Projects in Telecommunication Services* (Wiley, 2006). He is a co-editor of two books on the management of technology published by Elsevier Science and World Scientific Publications in 2006 and 2008, respectively, and is the editor of the *Handbook of Enterprise Integration* (3rd ed., Auerbach, 2009).

KAI JAKOBS (kai.jakobs@cs.rwth-aachen.de) joined RWTH Aachen University's Computer Science Department as a member of technical staff in 1985. Since 1987, he has been head of technical staff at the Chair of Informatik 4 (Communication & Distributed Systems). He holds a Ph.D. in computer science from the University of Edinburgh. His research interests and activities focus on various aspects of ICT standards and the underlying standardization process. He is Vice President of the European Academy for Standardization (EURAS), as well as founder and Editor-in-Chief of the *International Journal on IT Standards & Standardization Research*, *Advances in Information Technology Standards and Standardization Research*, and the EURAS Contributions to Standardization Research book series.

MARTIN ADOLPH is Program Officer in ITU's Standardization Policy and Technology Watch Division. He is responsible for ITU-T Technology Watch activities, surveying the ICT environment to capture new topics for standardization activities. Fascinated with innovation and new technologies, he authored several Technology Watch Reports on topics such as biometrics, cloud computing, gaming, and sensor networks. He is in charge of ITU-T's Focus Group on M2M and acting as technical advisor to ITU Kaleidoscope, an academic conference on innovation and standards in ICT. He holds a diploma in computer science from Dresden University of Technology, and one in engineering from Ecole Centrale, Paris, France.

YOICHI MAEDA [M] (yoichi.maeda@ttc.or.jp) received B.E. and M.E. degrees in electronic engineering from Shizuoka University, Japan, in 1978 and 1980, respectively. Since joining NTT in 1980, for the last 30 years he has been engaged in research and development on access network transport systems for broadband communications including SDH, ATM, and IP. From 1988 to 1989 he worked for British Telecom Research Laboratories in the United Kingdom as an exchange research engineer. He currently leads the Japanese telecommunication standardization organization, TTC (The Telecommunication Technology Committee) since October 2010. In October 2008 at the World Telecommunication Standardization Assembly (WSA-08), he was appointed chair of ITU-T SG15 for the 2009–2012 study period for his second term. He is a Fellow of the IEICE of Japan. He has been a Series Editor of the Standards Series in IEEE Communications Magazine since 1999.



... featuring
Kaleidoscope 2013

IEEE Communications
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Issue January 2014

SERIES EDITORIAL

SELECTED PAPERS FROM THE FIFTH ITU KALEIDOSCOPE ACADEMIC CONFERENCE



Mostafa Hashem
Sheriff



Yoichi Maeda



Kai Jakobs



Martin Adolph

Join the online discussion group for this Series Topic here:
<http://community.comsoc.org/forums/commag-features-and-series>

This Series presents selected papers from the ITU Kaleidoscope Academic Conference that convened in Kyoto, Japan from the 22nd to 24th of April 2013. The topic of the conference was "Building Sustainable Communities," in recognition of the challenges that Japan is facing after the Great East Earthquake. The hosts were the Ministry of Internal Affairs and Communication (MIC) of Japan and Kyoto University. Kyoto University is the second oldest Japanese national university after the University of Tokyo. It was founded in 1897 following the Meiji Restoration, which adopted various western systems to build a modern state.

Kyoto was the capital of Japan from 794 to 1868. The historical city has many interesting sites (temples, shrines, gardens, palaces). The conference venue was the Clock Tower, International Conference Hall of Kyoto University. The Clock Tower is the emblematic building of the university and was completed in 1925. In 2013, the university has more than 1000 professors, 10 faculties, and 17 graduate schools. Members of the academic staff include several Nobel laureates in chemistry and physics. The current undergraduate enrollment is about 13,500, while the number of post-graduates exceeds 9000, many of them foreign students.

Professor Akihiro Nakao from the University of Tokyo delivered the first keynote speech, "Deeply Programmable Network: Emerging Technologies for Network Virtualization and Software Defined Network (SDN)." The title of the second keynote, by Professor Makoto Nagao from Kyoto University, was "Digital Library for Creative and Sustainable Society."

Many companies provided financial and organizational support for the conference (NICT, NTT, KDD, OKI, Fujitsu, Mitsubishi Electric, and Huawei Japan in addition to

Telekom South Africa). This financial support provided a prize fund totaling U.S. \$10,000 awarded to the three best papers. Research in Motion (RIM) donated two BlackBerry PlayBook tablets that were given to the authors of the best student papers.

The first prize of U.S. \$5000 was awarded to the article entitled "Sustaining Life During the Early Stages of Disaster Relief with a Frugal Information System: Learning from the Great East Japan Earthquake." This article is a joint contribution from Japan and the United States, co-authored by Mihoko Sakurai, Jiro Kokuryo (Keio University, Japan); Richard Watson (University of Georgia, United States); and Chon Abraham (College of William and Mary, United States). The topic is related to the work of the ITU-T Focus Group on Disaster Relief Systems, Network Resilience and Recovery (FG-DR&NRR) and other ITU-T Study Groups dealing with emergency communications.

The second prize of U.S. \$3000 went to Phillip H. Griffin for his article, "Telebiometric Information Security and Safety Management." The article presents several proposals for the security, safety, and management of biometric systems. ITU-T Study Group 17 deals with the security of telebiometrics and has already expressed interest in these proposals.

Both articles are included in this issue. The article that was awarded the third prize of U.S. \$2000 was not ready for this issue.

Instead, a runner-up article by a team from Spain and Korea with E. Ibarrola as the first author is included. Its title is "QoSphere: A New QoS Framework for Future Networks." The article describes work in progress to update the various ITU-T Recommendations in the area of quality of service (QoS) to reflect the significant changes

in the telecommunications sector. The additions take into account contributions from the TM Forum, particularly its Business Process Framework (eTOM). Other contributions come from the European COST program.

The conference papers are available at IEEE Xplore. The full proceedings can be downloaded for free from the ITU site. The URL is http://www.itu.int/en/ITU-T/academia/kaleidoscope/2013/Documents/K-2013_Proceedings.pdf.

There were around 180 participants from 22 countries. Also, 20 people took advantage of the remote participation possibilities. In parallel with the conference, the National Institute of Information and Communications Technology (NICT) of Japan organized a showcase of the latest products and services in Japan on the technological advances that would enhance the sustainability of communities. Areas included sensor networks, big data analysis, using optical and wireless networks for redundancy in emergencies, as well as home management systems. A workshop on education about standardization was held after the conference. It was jointly organized by the ITU, the Institute of Electronics, Information and Communication Engineers (IEICE) of Japan, Aalborg University's Center for TeleInfrastructure (CTIF) and the Global ICT Standardization Forum in India.

The next Kaleidoscope conference will be hosted by Bonn-Bruevic Saint-Petersburg State University of Telecommunications (SPbSUT), Russian Federation, 3-5 June 2014. The theme is "Living in a Converged World—Impossible Without Standards?"

In closing, the editors would like to express their gratitude to the reviewers, listed below in alphabetical order, for their assistance in making the selections and for their generous advice to the prospective authors.

AlAhmad, Mohammed, Jaber University, Kuwait
Alhazmi, Omar, Taibah University, Saudi Arabia
Bakhouya, Mohamed, Université de Technologie de Belfort-Montbéliard, France
Berger, Michael, Technical University of Denmark, Denmark
Bezerra Motta, Gustavo Henrique Matos, Universidade Federal de Paraíba, Brazil
Bifkalvi, Alex, Universitat Pompeu Fabra (UPF), Spain
Brooks, Roger, Cravath, Swaine & Moore, USA
Brown, Stephen, CSA Group, Canada
Carapinha, Jorge, Portugal Telecom, Portugal
Chaudry, Himma, Purdue University, United States
Chen, Zhuojun Joyce, University of Northern Iowa, United States
Cho, Chunglae, ETRI, Korea
Cholda, Piotr, AGH University of Science and Technology, Poland
Crollius, Stephen, Alliane Consulting Group, United States
Egyedi, Tineke, Delft University of Technology, the Netherlands

SERIES EDITORIAL

Fourmaux, Olivier, Université Pierre et Marie Curie (UMPC), France
Kilki, Kalevi, Aalto University, Finland
Lee, Eun-kyu, University of California at Los Angeles, United States
Lemstra, Wolter, Delft University of Technology, the Netherlands
Morrison, Kelly, AT&T, United States
Oliveira, Adriana Esmeraldo, Universidade Federal de Paraíba, Brazil
Oliveira, Jose Manuel, INESC Porto, Portugal
Pelsser, Cristel, NTT, Japan
Rafal, Stankiewicz, AGH University of Science and Technology, Poland
Reichl, Peter, Telecommunications Research Center Vienna, Austria
Van den Bossche, Peter, Vrije Universiteit, Brussel, Belgium
Yang, JuCheng, Tianjin University of Science and Technology, China

BIOGRAPHIES

MOSTAFA HASHEM SHERIFF has been with AT&T since 1983. He has a Ph.D. from the University of California, Los Angeles and an M.S. in the Management of Technology from Stevens Institute of Technology, New Jersey, in 1996. He has participated in ANSI, the ITU, and the ATM Forum. He is the author and editor of several books, including *Protocols for Secure Electronic Commerce*, 2nd ed. (2003), *Managing Projects in Telecommunication Services* (2006), and *Handbook of Enterprise Integration* (2009). He is the Standards Editor for *IEEE Communications Magazine* and an Associate Editor of the *International Journal of IT Standards & Standardization Research*. He is a member of the steering committee of the ITU Kaleidoscope conference series.

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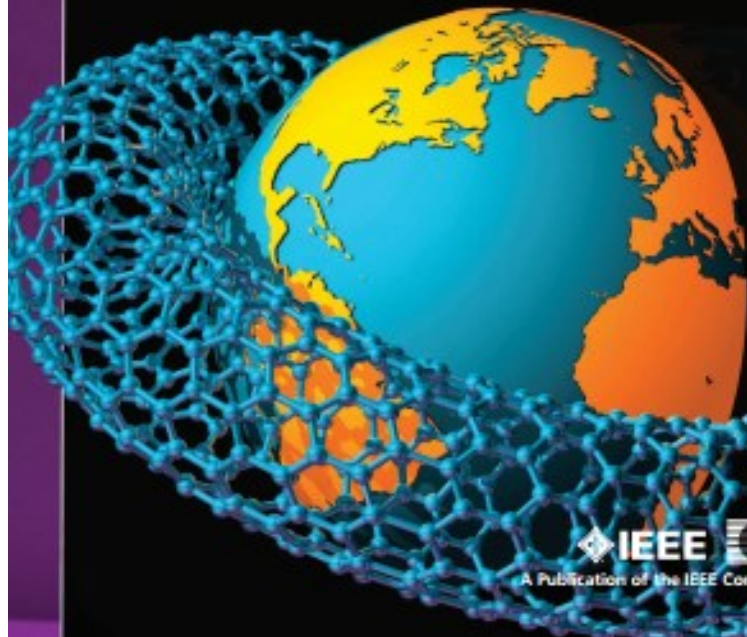
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TOWARD THE "SPACE 2.0" ERA



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IEEE
A Publication of the IEEE Communications Society

Bangkok, Thailand, 14-16 November 2016
ITU Kaleidoscope 2016 - *ICTs for a Sustainable World*

EDITOR'S NOTE

PAPERS FROM THE JUNE 2014 ITU KALEIDOSCOPE CONFERENCE

COMMENTARY

ICT STANDARDS: BUILDING A TRUSTED INFORMATION SOCIETY

BY CHAESUB LEE, DIRECTOR OF THE TELECOMMUNICATION STANDARDIZATION BUREAU,
INTERNATIONAL TELECOMMUNICATION UNION (ITU)

Previously, companies aspects of their products become a standard. In fact, failing, than examples were made its product the default. Customers expect multi-vendor tolerance proprietary inter-driven standards.

Standards must be made any other product. This is time to document the state bring it into suitable existences (SDOs) or perhaps IEEE-SA proponents for

Standards provide a common language, and standards development is a process that builds commitment to consistent use of that language. Benefitting from incredible amounts of standards developed by various communities, society has been able to evolve and progress continuously, moving from an Agricultural Society to an Industrial Society to today's Information Society. Standards have provided the building blocks of the Information Society, with ICT devices generally adhering to an enormous collection of standards developed by a wide range of communities.

Technical standardization has been at the core of ITU's mandate since the organization's inception in 1865, providing stimulus to communication-oriented innovation from the day of the telegraph to today's converged ICT ecosystem. It was in 1994 that the proposal to create a Global Information Infrastructure (GII) for building the Information Society was presented at an ITU governing conference. Today's Information

anniversary in tribute to the extraordinary innovation of the global ICT community and the crucial role that ITU plays as a platform to bring cohesion to this innovation. Our 150th anniversary will be both a celebration of ITU's past achievements as well as an analysis of how ITU can best position itself to serve the future development of the Information Society.

Embedding trust into the Information Society will provide a greater level of certainty, confidence, and predictability in network interactions, expanding their scope and benefits.

To achieve this, ITU will work in harmony with other standards bodies to enhance the level of trust in the current digital ecosystem while also considering the impacts of possible future developments. ITU will continue to support smart, context/content-aware, user-centric technologies, while being cognizant of, and in turn informing, the relevant policy and regulatory debates and frameworks.

national standards should be open to all, as should the global meeting of expertise that drives their development.

Our success in cooperating and collaborating with other bodies such as IEEE-SA is another key measure of the value of ITU-T standards. It is crucial that we take an 'ecosystem' view of ICT standardization. This is gaining in importance every day, driven by the accelerating convergence of technologies and industry sectors.

Standardization experts — asked to consider the implications of 'trust' in the digital ecosystem as well as value chains, taking into account the communications of cyber-physical systems such as billions of networked devices, things, and objects — must preempt relevant technologies' requirements on supporting trustworthy ICT infrastructures. How will we provide the required level of trust for such a ubiquity of connected devices, things, and objects? And in the presence of data collection, storage, processing, analysis, and sharing on

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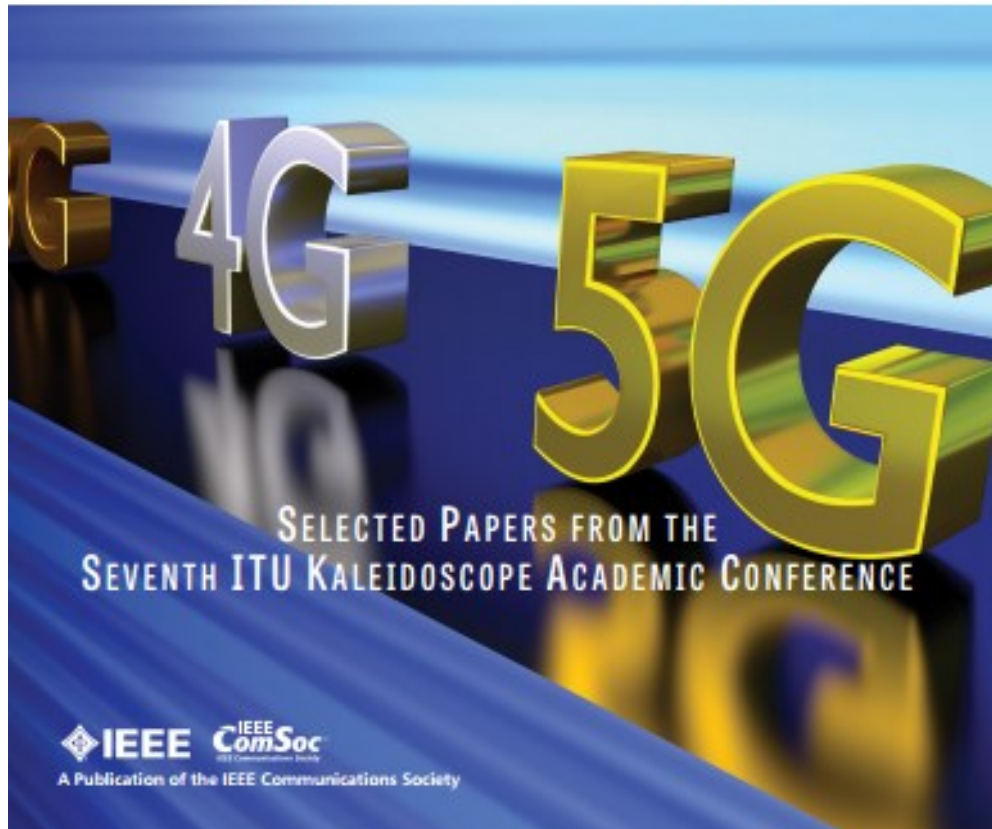
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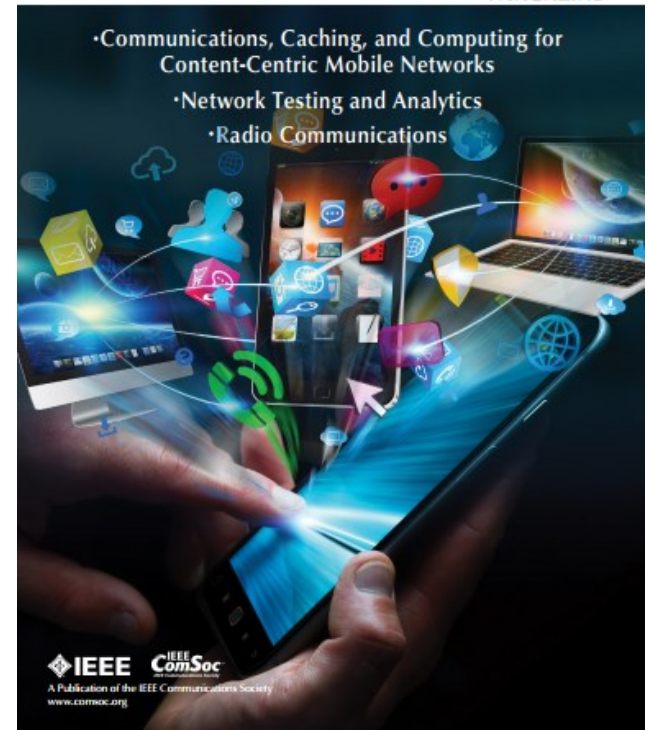


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- Communications, Caching, and Computing for Content-Centric Mobile Networks
- Network Testing and Analytics
- Radio Communications



Bangkok, Thailand, 14-16 November 2016
ITU Kaleidoscope 2016 - *ICTs for a Sustainable World*

GUEST EDITORIAL

SELECTED PAPERS FROM THE SEVENTH ITU KALEIDOSCOPE ACADEMIC CONFERENCE



Mostafa Hashem Sherif



Kai Jakobs



Christoph Dosch



Martin Adolph

This issue of the *Communications Standards Supplement* includes updated versions of selected papers from the seventh International Telecommunications Union (ITU) Kaleidoscope Academic Conference. The conference took place in Barcelona, Spain, 9-11 December 2015, as part of the celebration of the ITU's 150th anniversary. The topic

Technology, Japan) and Tetsuya Kawanishi (Waseda University, Japan) was awarded the first prize of U.S. \$5,000. The authors present five different transport technologies (digital radio over fiber, analog radio over fiber, intermediate frequency over fiber, radio on radio, and seamless fiber-wireless convergence) for future mobile

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- **International Journal of Technology Marketing**
- **International Journal of Standardization Research**
- **Journal of ICT Standardization**

The First ITU-T Kaleidoscope Conference

Innovations in NGN

Geneva, 12-13 May 2008

www.itu.int/itu-t/kaleidoscope

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next Kaleidoscope...**

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International Telecommunication Union



THANK YOU

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