ITU Kaleidoscope 2016
ICTs for a Sustainable World

S1.1 How organisations can assess and improve their green ICT activities in a standard and efficient way.
Albert Hankel; Patricia Lago (VU University Amsterdam, The Netherlands)

S1.2 Mobile signal extension in deep sea - towards a safe and sustainable fisheries.
Dineshkumar Singh; Sanjay Kimbahune (Tata Consultancy Services Ltd., India); Veerendra Veer Singh (Mumbai Research Center of CMFRI, India)

S1.3 Human safety considerations in the emerging ICT environment.
Shailendra K. Hajela (ITU-APT Foundation of India, India)

Session 1, Role of ICT in environmental sustainability
Chair: Frederic Surre, City University of London, United Kingdom, and IEEE Standards Education

Bangkok, Thailand
14-16 November 2016

Highlights from **Paper 1**
"How organisations can assess and improve their green ICT activities in a standard and efficient way."

- Presentation of a Green ICT maturity model that can assist organizations to improve their environmental sustainability;

- Within the limit of the number of organizations, tests have shown that participants were positive on the interest of the model to increase awareness and facilitate improvements;

- One other result of interest is that most participants stated that any green action should also improve other aspect.

Highlights from **Paper 2**
"Mobile signal extension in deep sea - towards a safe and sustainable fisheries."

- Presentation demonstrates that mobile coverage can be extended in the deep sea (35km from the coast) to offer connectivity to fisherman in India;

- During tests with the extended network, it was noted that ICT improves:
  - fisherman safety;
  - improve livelihood;
  - reduce environmental footprint in optimizing fishing and delivery.

Highlights from **Paper 3**
"Human safety considerations in the emerging ICT environment."

- AI and the emergence of man-machine heterogeneous environment presents opportunities and threats;

- Ethics rules should be included at the design stage of AI systems;

- Proposition: constitution of a multidisciplinary experts umbrella group by ITU to deliberate upon and bring out Guidelines for designing super intelligent machines/robots aligned with human interest;

- Another outcome of this group would be a consistent taxonomy of AI methodology and classification of AI systems by sophistication.

Conclusions

- Methodologies to evaluate ICT contribution to an organization sustainability should be researched further and comparison of existing methods developed;

- Extending current ICT networks to remote zones can lead to an increase of quality of life while improving sustainability;

- AI and ever developing autonomous systems present challenges and serious risks that must be addressed in a multidisciplinary approach.

Recommendations

- Reflexion to develop guidelines on Green ICT models to support organization improving their ICT sustainability. May be scope for standards on methodology;

- Constitution of an expert umbrella group on AI and sophisticated autonomous system design grouping most stakeholder under the guidance of ITU (Besides general guidelines in design of such systems, expected outcomes could include eliminating the issues arising out of variations in national laws).

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S2.1 Invited paper: Ageing, well-being and technology: from quality of life improvement to digital rights management. A French perspective.
Nathalie Devillier (Grenoble Ecole de Management, France)

S2.2 Universal Service, quality caps and net neutrality.*
Emilio Carrera Félix (Université Paris II - Panthéon Assas, France)

S2.3 Quality and standardization in technology-enhanced learning.
Irina Tal; Gabriel-Miro Muntean (Dublin City University, Ireland); **Eva Ibarrola** (University of the Basque Country-UPV/EHU, Spain)

Session 2, Service and quality standards
Chair: Mostafa Hashem Sherif (AT&T, USA; and Kaleidoscope Steering Committee member)

**Bangkok, Thailand
14-16 November 2016**

Highlights from **Paper 1**

Invited paper "Ageing, well-being and technology: from quality of life improvement to digital rights management.
A French perspective."

- Gerontechnology is a new academic discipline: the application of technology to help the elderly;
- Silver economy based on gerontechnology:
    - Technical issues
    - Capacity building
    - Legal issues
    - Ethical issues

Highlights from **Paper 2**
"Universal Service, quality caps and net neutrality." *

- A proposal for net neutrality:
  – access to a limited version of broadband service is free or with a reduced subscription
  – paying access s to broadband services with the full set of capabilities
- The price of the limited service is calculated and fixed by regulation;
- Proposal requires the ability to block non-conforming content providers:
  – Applicable in the European Union, China, etc.
  – Not applicable in the Americas

Highlights from **Paper 3**
"Quality and standardization in technology-enhanced learning."

- Technology-enhanced learning (TEL) includes new techniques of "gamification," augmented reality, multiple sensorial media (mulsemedia) and multimedia to improve teaching;

- User Quality of Experience (QoE) is not defined in the context of new media components vs. with traditional multimedia;

- Within the European project NEWTON, several universities and industrial partners are conducting a series of pilot studies to evaluate the effect of new tools and methods on learning;

- The pilot is starting in November 2016.

Conclusions/Recommendations

- Applications of the new communication technologies raises new legal and ethical questions;

- The dominant view is that the negative aspects can be resolved by the market or by further technological innovations;

- The papers in this session show that additional regulations and standards may be necessary.

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S3.1 Space division multiplexing technology: next generation optical communication strategy.*
Kazuhide Nakajima; Takashi Matsui; Kotaro Saito; Taiji Sakamoto; Noriyuki Araki (NTT Corporation, Japan)

S3.2 Resource allocation for device-to-device communications in multi-cell LTE-advanced wireless networks with C-RAN architecture.*
Sajjad Mehri Alamouti; **Ahmad R. Sharafat** (Tarbiat Modares University, Iran)

S3.3 PAPR reduction in SC-FDMA via a novel combined pulse-shaping scheme.
Naser Ahmadi Moghaddam; **Ahmad R. Sharafat** (Tarbiat Modares University, Iran)

S3.4 Accelerating the introduction of spectrum sharing using market-based mechanisms.
Fernando Beltrán (University of Auckland, New Zealand)

Session 3, Spectral efficiency in wireless networks
Chair: Mario Maniewicz (Deputy Director, Radiocommunication Bureau, ITU)

**Bangkok, Thailand
14-16 November 2016**

Highlights from **Paper 1**
"Space division multiplexing technology: next generation optical communication strategy."*

- Capacity demand in 2020 will potentially exceed the limitation imposed by single-mode fiber (SMF);
- The paper describes the potential of Space Division Multiplexing (SDM) technology, with a focus on the multi-core-fiber (MCF), for next generation optical networks:
  - Provides effective infrastructure operation/management of optical infrastructure and lower power consumption;
  - Optimizes three key geometrical parameters of MCF (cladding diameter, cladding thickness and core pitch);
  - Proposes a tier-approach towards a smooth spread of MCF technology;
  - Revises recent progress on splicing technologies.

Highlights from **Paper 2**
"Resource allocation for device-to-device communications in multi-cell LTE-advanced wireless networks with C-RAN architecture." *

- The paper proposes a resource allocation scheme for device-to-device (D2D) pairs in a LTE-A network using cloud radio access network (C-RAN) architecture:
  - Determines the channels and the transmit power levels for each D2D pair by solving and optimization problem;
  - First sub-problem: determine if a D2D pair is admissible to reuse a channel;
  - Second sub-problem: identify the optimal reuse channel for all admissible D2D pairs so that total power is minimized;
  - Simulations show that: i) more users can simultaneously communicate, ii) the total system throughput is increased, iii) D2D access ration is lower than is previous algorithm.

Highlights from **Paper 3**
"PAPR reduction in SC-FDMA via a novel combined pulse-shaping scheme."

- Peak-to-average-power-ratio (PAPR) is a parameter that affects the cost of end-user devices in NGN;

- LTE-Advanced uses Single carrier frequency division multiple access (SC-FDMA);

- The paper proposes a pulse shaping scheme to reduce PAPR in SC-FDMA systems:
  - The proposal combines K pulse shaping schemes;
  - Simulation shows the scheme reduces PARC more than existing schemes;
  - Computational cost and out-of-band emissions are higher, but acceptable.

Highlights from **Paper 4**
"Accelerating the introduction of spectrum sharing using market-based mechanisms."

- Spectrum must be allocated to the right users (effective);
- Spectrum must be assigned to those that value it the most (efficient);
- The paper proposes the use of spectrum sharing in spectrum management:
  - Reallocation, clearing of non-highly used bands and reframing are not enough;
  - Spectrum sharing maximizes the value of spectrum and its benefit to society;
  - It is a market-based mechanism that incentivizes incumbents to share spectrum needed by entrants;
  - Examples: Collective Use of Spectrum (CUS), Licensed Shared Access (LSA), Authorised Shared Access (ASA).

Conclusions

- MCF based SDM optical fiber cable technology can increase the maximum transmission capacity, thus enabling next generation optical networks;

- Optimal resource allocation scheme for D2D users in a multi-cell LTE-A network with C-RAN architecture can increase the capacity of the system, thus improving system performance;

- Pulse shaping schemes can reduce peak-to-average-power-ratio in SC-FDMA systems, thus reducing the hardware cost;

- The use of spectrum sharing in spectrum management can provide effective allocation and efficient assignment of spectrum, thus maximizing the value of spectrum and its benefit to society.

Recommendations

- Investigate the potential and discuss the standardization of new technologies that increase the transmission capacity of optical networks;

- Continue to investigate new technologies that improve the performance of mobile systems and reduce the hardware cost;

- Employ spectrum management techniques that provide effective allocation and efficient assignment of spectrum.

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S4.1 Invited paper: 5G in rural and low-income areas: are we ready?
Luca Chiaraviglio; Nicola Blefari-Melazzi (CNIT/University of Rome Tor Vergata, Italy); William Liu; Jairo A. Gutierrez (AUT, New Zealand); Jaap Van De Beek (Lulea University of Technology, Sweden); Robert Birke; Lydia Chen (IBM Research, Switzerland); Filip Idzikowski (Faculty of Electronics and Telecommunications, Poznan University of Technology, Poland); Daniel Kilper (The University of Arizona, USA); Paolo Monti (KTH Royal Institute of Technology, Sweden); Jinsong Wu (University of Chile, Chile)

S4.2 Design of scalable directory service for future IoT applications.
Ved P. Kafle; Yusuke Fukushima; Pedro Martinez-Julia; Hiroaki Harai (National Institute of Information and Communications Technology, Japan)

S4.3 A stack4things-based platform for mobile CrowdSensing services.
Salvatore Distefano (Kazan Federal University, Russia); Antonio Puliafito; **Giovanni Merlino**; Francesco Longo; Dario Bruneo (Università di Messina, Italy)

S4.4 A popularity-based caching strategy for the future Internet.
Suhaidi Hassan; Ikram Ud Din; Adib Habbal; Nur Haryani Zakaria (Universiti Utara Malaysia, Malaysia)

S4.5 Multi-path chunked video exchanges over OF@TEIN SDN cloud playground.
Phyo May Thet; **Chaodit Aswakul** (Chulalongkorn University, Thailand); JongWon Kim (Gwangju Institute of Science & Technology, Korea)

Session 4, Network evolution
Chair: Martin Adolph (Engineer, ITU)

Bangkok, Thailand
14-16 November 2016

Highlights from **Paper 1**
Invited paper "5G in rural and low-income areas: are we ready?"

- Will 5G increase the digital divide between connected and unconnected?

- How to architect future 5G systems to meet the requirements of rural areas and low-income countries?

- Proposed a set of pillars to follow, as well as a reference architecture;

- As next step, plan to evaluate the costs for adopting the proposed solution, and to address different technological aspects.

Highlights from **Paper 2**
"Design of scalable directory service for future IoT applications."

- Directory service for IoT systems:
  – Scalable to hold billions of records (info about devices)
  – Lookup latency of few milliseconds
  – Update latency of few seconds
- Future work:
  – Modeling of required resources to guarantee performance
  – Implementation with NoSQL database (to store and lookup heterogeneous names), NFV and SDN tools
  – Study of energy footprint
  – Standardization of research outcome in ITU-T SG13/20

Highlights from **Paper 3**
"A stack4things-based platform for mobile CrowdSensing services."

- Presented a taxonomy and model for mobile crowd sensing (MCS);

- Introduced relationship between MCS, IoT and edge computing;

- Adapted an existing IaaS framework for IoT to serve as a service-oriented platform for MCS;

- Demonstrated pothole detection and monitoring app and web portal.

Highlights from **Paper 4**
"A popularity-based caching strategy for the future Internet."

- ITU-T Recommendation Y.3033: Every network segment in data aware networking is recommended to support a caching component;

- Proposal of a caching strategy for caching popular contents to improve the performance of ICN caching in terms of cache hit rate and stretch ratio;

- Performance evaluation of Cache Popular Content Everywhere (CPCE) strategy and comparison with default ICN strategies CEE, and Betweenness-Centrality;

- CPCE produced better results than the default ICN strategies.

Highlights from **Paper 5**
"Multi-path chunked video exchanges over OF@TEIN SDN cloud playground."

- Transmission of video in a softwarized environment;
- Tested the combination of traditional Tsunami protocol and proposed multi-path file transferring function;
- 4K video streaming within CHULA SmartX Box network;
- Implemented X11 desktop environment and access method for remote OpenStack VMs in order to use GUI applications with fast access.

Conclusions/Recommendations

- Session discussed enabling technologies and use case scenarios for future networks and 5G systems:
  - Network softwarization and IaaS
  - Information-centric networking and caching strategies
  - Directory services and identification in IoT
  - Video streaming and IoT applications
- Highlighted the need for an inclusive approach to identify requirements and design network architectures;
- Identified related standardization activities and areas for future work.

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S5.1 Implementation of tele-rehabilitation system combined with video call center.*
Kotaro Suzuki; Yoshitoshi Murata (Iwate Prefectural University, Japan)

S5.2 Intricacies of implementing an ITU-T X.1303 cross-agency situational-awareness platform in Maldives, Myanmar, and the Philippines.*
Biplov Bhandari; Angga Bayu Marthafifsa; Manzul Kumar Hazarika (Asian Institute of Technology, Thailand); Francis Boon; **Nuwan Waidyanatha**; Lutz Frommberger (Sahana Software Foundation, USA)

S5.3 A community-driven information system to develop next generation collaborative and responsive rural community (NCoRe).
Jayanta Basak; Rishikesan Parthiban; **Somprakash Bandyopadhyay** (Indian Institute of Management Calcutta, India); Siuli Roy (Heritage Institute of Technology, India)

S5.4 Toward authenticated caller ID transmission: the need for a standardized authentication scheme in Q.731.3 calling line identification presentation.*
Huahong Tu; Adam Doupé; Ziming Zhao; Gail-Joon Ahn (Arizona State University, USA)

Session 5, Services and implementation-related issues
Chair: Ved P. Kafle (NICT, Japan)

Bangkok, Thailand
14-16 November 2016

Highlights from **Paper 1**
"Implementation of tele-rehabilitation system combined with video call center."*
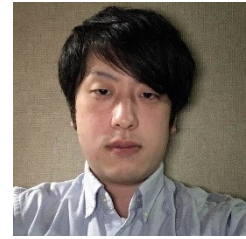
- Japan's low birthrate and rapidly aging population causing medical expenses to take up ever more of the national budget and leading to a shortage of young physiotherapists;
- Presented a tele-rehabilitation system based on a new innovative concept to solve above problems:
  - A video call center operator provides training to patients instead of a physiotherapist;
  - A physiotherapist supervises multiple operators;
  - The system focuses on cerebrovascular patients requiring rehabilitation.
- Described their implemented system and its effectiveness in addressing the shortage of physiotherapists.

Highlights from **Paper 2**
"Intricacies of implementing an ITU-T X.1303 cross-agency situational-awareness platform in Maldives, Myanmar, and the Philippines." *

- This paper discussed issues of inter-agency rivalries and interconnection disparities in implementing early warning system in case of natural disasters;

- It discussed the country context implementation challenges and strategies fostered through the introduction of the CAP content standard;

- The project is applying situational-awareness development methodology with a design, build, test, and redesign strategy for implementing the cross-agency situational- awareness and warning system in the respective countries.

Highlights from **Paper 3**
"A community-driven information system to develop next generation collaborative and responsive rural community (NCoRe)."

NCoRe objectives

- Empower Self-Help Groups of Indian Villages to interact and collaborate among themselves and with other rural development authority's (sub-clusters, clusters, government agencies, NGOs etc.) to share their problems and search for solutions;

- Enable the involvement of SHGs to participate in their local governance;

- Support them to access various skill development programs, entrepreneurship training to improve their livelihood;

- Guide them to establish market linkage to sell their products, get raw materials and to get financial assistance;

- Engage them to form a resilient community for better disaster management.

Highlights from **Paper 4**
"Toward authenticated caller ID transmission: the need for a standardized authentication scheme in Q.731.3 calling line identification presentation." *
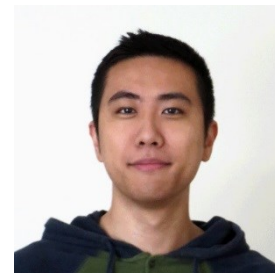
- Telephone spam/scam has more than doubled in the last two years and 75% of fraud attempts are now communicated over the phone in the US;

- The core issue of telephone spam/scam is the ability of a malicious caller to spoof the caller ID in such a way that fraud and abuse can occur;

- This paper proposed a caller ID authentication scheme for Q.731.3 calling line identification presentation which enables the presentation of a security indicator during a telephone call request.

Conclusions/Recommendations

- Presentation of four high quality papers related with innovative use-cases of ICT in addressing social problems, e.g. remote physiotherapy, disaster early warning, helping rural women groups, caller ID authentication;

- Existing standards were referred, showing their shortcomings;

- Proposals were made to augment the standards with new capabilities, some experimentally verified;

- Recommended to refer to more latest related works of ITU Focus Group, e.g. e-health, disaster warning system, bring the enhanced content to relevant ITU Study Groups.

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S6.1 Certified security systems for sustainable cities of the 21st century.
Simone Wurster (Berlin University of Technology, Germany); Irene Kamara (Vrije Universiteit Brussel, Belgium); Thordis Sveinsdottir (Trilateral Research & Consulting, United Kingdom)

S6.2 WiFi networks on drones.
Antonio Guillen-Perez, Maria-Dolores Cano; Juan Carlos Sanchez-Aarnoutse; Joan Garcia-Haro (Universidad Politécnica de Cartagena, Spain); **Ramon Sanchez-Iborra** (Polytechnic University of Cartagena, Spain / Federico Santa María Technical University, Chile)

Session 6, Sustainability and smartness
Chair: Keping Yu (Waseda University, Japan)

Bangkok, Thailand
14-16 November 2016

Highlights from **Paper 1**
"Certified security systems for sustainable cities of the 21st century"
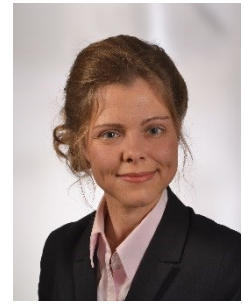
- **Motivation**: There are currently no certification schemes that meet pan-European needs and no consideration for privacy, so it strongly need a certification scheme, especially in Closed Circuit Television (CCTV) field.
- The CRISP project mission is to develop an innovative evaluation and certification methodology for security systems, which:
  - Contributes to measures that increase citizen trust in security technologies through evaluating social impacts of security systems and certification of systems that comply with the protection of fundamental rights;
  - Contributes to a more harmonised playing field for the European security industry, through acceptance of security systems across Europe, with no need for re-certification in each country;
  - Supports the goal to provide protection in an efficient manner.

Highlights from **Paper 2**
"WiFi networks on drones."

- **Objective**: To address the increasing demand for network connectivity, this paper describes and analyzes the WiFi networks on drones to extend the capacity or coverage of wireless systems.

- **Proposal**: Presenting a comprehensive characterization study of an experimental system to deploy an aerial WiFi network.

- **Experiment**: Trade-off between infrastructure (AP) and ad-hoc modes:
  - AP provides greater signal level and throughput
  - Ad-hoc provides better energy efficiency

Conclusions/Recommendations

- At the end of CRISP project, possible transformation of the CEN Workshop Agreement (CWA) into a standard will be explored, as well as the development of other security related standardization outputs:
    - More Standardizations are needed for additional kinds of security products and systems
    - Goal: introduction of the CRISP scheme soon
- More standardization is needed for the development of aerial networks.

We encourage Kaleidoscope participants to provide comments on:

- Did Kaleidoscope 2016 meet expectations and why?
- Possible topics/organisation of the next Kaleidoscope conference
- Reviewers
- Better recognition of the conference