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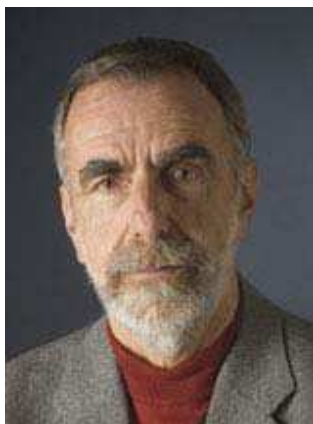
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The Green ICT Initiative: An IEEE-Wide Focus Building Upon ComSoc's Leadership



Sergio Benedetto



Jaafar Elmirghani



Charles Despins

This month's President's Page is devoted to the IEEE Green Information and Communications Technology (ICT) initiative. By its very nature, Green ICT is a theme, not only of interest but also offering numerous opportunities, for virtually every IEEE Society and Council. Through this initiative, ComSoc seeks an IEEE-wide outreach to achieve even greater recognition for IEEE's mission of advancing technology for humanity.

The Green ICT initiative is jointly chaired by two ComSoc volunteers. Jaafar Elmirghani is Director of the Institute of Integrated Information Systems within the School of Electronic and Electrical Engineering, University of Leeds, United Kingdom. Charles Despins is President & CEO of Prompt, an ICT research consortium based in Montreal, Canada, as well as a faculty member at the Université du Québec. As shown by their bios at the end of this text, both of them bring a wealth of highly complementary industrial and academic experience to drive the initiative.

As a new endeavour formally launched at the beginning of this year, the Green ICT initiative is unveiling its web portal (greenict.ieee.org) this month at IEEE ICC 2015 in London. In view of Green ICT's breadth, the portal is meant to be a focal point for activities and the latest news on this theme throughout IEEE Societies, Councils, and other technology initiatives. Such activities can include publications, conferences and workshops, standards, or educational offerings.

The term "Green ICT" can often be perceived as controversial and conjuring images of a strict focus on environmental impacts to the detriment of other important issues for humanity. To the contrary, ICTs are well known enablers of productivity and economic development, as well as quality of life improvements and positive social impacts (when properly applied). The environmental benefits of ICT position it as one of the most important drivers of sustainable development in the 21st century. In a world where the economy and the environment are too often seen as incompatible, Information and Communications Technologies are in fact one of the few tool humanity can leverage to reconcile economic, social, and environmental benefits, i.e. the three pillars of sustainability..

WHAT IS GREEN ICT?

Green ICT generally refers to the design and application of information and communications technologies (ICT) in order to create environmental benefits. Moreover, as ICTs are finding applications in almost every sphere of human activity, the foreseen impact of "greening by ICT" is considered to be even ultimately greater than "greening ICT" itself. The environmental benefits associated with Green ICT can be measured through the following metrics:

Improved Energy Efficiency: This metric is well known to ICT engineers, and the ICT industry has been focusing on it, notably to reduce operational expenditures (OPEX) in the context of the huge traffic increases on communications networks, but also in various application areas of ICT (e.g. intelligent transportation systems, smart grids, etc.).

Reduction of Carbon (and Polluting Atmospheric) Emissions: ICT is currently estimated to offer the potential to eliminate throughout society seven times¹ the size of its own carbon footprint. As energy efficiency does not always lead directly to carbon emission reductions, strategies will be required to integrate renewable energy sources in the design of networks in order to make the latter and the myriad of applications supported by networks as low-carbon as possible. The environmental and social advantages resulting from low-carbon ICTs could further be monetized by the ICT industry if and when prices on carbon and polluting emissions proliferate throughout the world.

Life-Cycle Management: Targeting improvements in energy efficiency and reduction of carbon emissions is important not only in the operational phase of information and communications technologies, but also in their manufacturing and disposal phases. The rapid growth of the industry has notably led to an increase in e-waste.

Underlying the concept of Green ICT is the notion of convergence, with all the application sectors that can be greened by ICT, and also specifically between the ICT industry and the energy industry (which can be considered as one of these sectors). Just as our mastery of energy has transformed our way of life since the industrial revolution, our mastery of information is putting us in the midst of another similar revolution, transforming every facet of life, changing business models, and creating new opportunities that can significantly benefit humanity. ICT and energy are now fundamental enablers of our 21st century societies; a holistic approach to the design of ICT and energy infrastructures is a key element to fully leverage ICTs for sustainability.

This notion of convergence implies that Green ICT is in fact a very multi-disciplinary theme bringing together expertise not only from the various ICT sub-sectors (components and systems) but also from all those sectors that can be greened by ICT, e.g. healthcare, transport, buildings, etc. As an example, one can consider the numerous

convergent Green ICT issues in the communications-energy-transport triumvirate, particularly when electric vehicles are brought into the mix along with Big Data, Internet of Things, and Cloud technologies.

THE GREEN ICT INITIATIVE

Although they may not always be labeled as such, the huge interest in various sub-themes of Green ICT is spurring a growing number of activities in IEEE (and in other global organizations), which speaks eloquently to the relevance of the theme. Nonetheless, this explosion of interest is a double-edged sword as it can also lead to the creation of technical interest “silos”. While encouraging the development of various activities on the theme, the Green ICT initiative will therefore seek to develop holistic awareness on this topic, avoid duplication or overlap of activities, and provide a forum to build a cross-society and cross initiative IEEE consensus on outreach to other organizations. Through its interface with various IEEE societies and other technology initiatives (e.g. Cloud Computing, IoT, Smart Cities, etc.), the Green ICT initiative will foster the incorporation of green metrics and standards in design concepts for various technical domains. The initiative will also bring together expertise from different fields, in conferences and publications, with a view to foster holistic design and standardization approaches.

In view of the preceding, the Green ICT initiative mission statement has been defined as:

Build a holistic approach to sustainability through ICT by incorporating green metrics throughout IEEE technical domains.

The Green ICT initiative has in focus a set of priority areas that target participation from multiple Societies, Councils, and other IEEE technology initiatives.

Publications: The IEEE Green ICT initiative will target the creation of an IEEE Green ICT Transactions and Magazine, with broad IEEE Society and Council sponsorship, targeting holistic and multidisciplinary approaches to the incorporation of green metrics in all IEEE fields of interest. To incubate the new Transactions, IEEE ComSoc has started a new series on Green Communications and Networking in the IEEE Journal on Selected Areas in Communications. The first call for papers closed in March 2015 and was extremely popular and highly oversubscribed. The second call for papers has a closing date in July 2015. The Series has recruited an Editor-in-Chief and a number of experienced area editors and associate editors. The new IEEE Green ICT Magazine is expected to be a forum that brings together the different IEEE societies, industry, and academia.

Conferences and Events: The development of IEEE conferences, workshops, and symposia that take an integrated view of greening ICT and greening by ICT is one of the key objectives of the initiative. It will build collaboration with established industrial and policy bodies in this area, including GreenTouch and GeSi. Within IEEE ComSoc the first Green track at ICC/GLOBECOM was launched at GLOBECOM 2011 within the Selected Areas in Communications Symposium. This track has since grown significantly, and at GLOBECOM 2014 in Austin was elevated to a full Symposium. ComSoc started GreenComm, an entirely online event currently in its fifth edition as a pioneering development. ComSoc's Technical Committee on Green Communications and Computing (TCGCC) and Technical Committee on Transmission, Access and Optical Systems (TAOS) have also been very active on Green ICT. The Green ICT initiative, led by ComSoc, will build on this heritage and develop a pan-IEEE Green ICT conference that enables researchers and practitioners to address Green ICT within the full scope of IEEE.

Standards: The development of standards to properly assess the full environmental impacts (energy consumption, carbon and polluting emissions, e-waste, etc.) of ICTs throughout their life cycle presents a substantial challenge. As an example, in the realm of atmospheric emissions, common methodologies for carbon emissions, such as ISO 14064 used for thermal power plants, heavy manufacturing, etc., are difficult to apply in the ICT sector, notably as both steady network operators and spontaneous end users are involved. Building upon various sensing data both internal to ICT systems and external (e.g. electrical utilities), ICT carbon and polluting emission “foot-printing” typically incorporates² approaches at various levels of granularity and at various time intervals throughout the life cycle (manufacturing, operation, disposal). Real-time foot-printing can inform end-users of their environmental impact when using an ICT service or application; it can also help ICT network operators to optimize server management when these are located in areas with varying mixes of power generation sources.

Various international organizations are developing such standards, but these laudable activities remain fragmented. Beyond promoting the use of these methodologies in the R&D and design activities of the technical communities in various IEEE societies, a significant opportunity exists for IEEE as a neutral, fast-moving standards organization. Following a Green ICT standards SWOT analysis, an IEEE Green certification label could be developed.

Education: Green ICT training activities in the form of tutorials have been offered at major IEEE conferences, versions of which will be made available later to the wider IEEE membership through the initiative web portal. The initiative will also organize workshops targeting different application domains and industry sectors through white papers and interactive educational material. A number of tutorials have been delivered so far, for example at ICC 2013, SoftCOM 2013, ICC 2014, ICC 2015, and panels at CCEM 2014, COMPSAC 2014, ICCE 2014, ICC 2014, ICCE 2014, INTELECT 2015, CCNC2015, and ICC 2015. More are planned in the coming months in order to stimulate interest on Green ICT and to raise awareness of the breadth of the theme.

Outreach and Advocacy: A web portal has been designed to stimulate participation in the initiative from different IEEE technical societies. The portal will notably seek to foster intersociety exchanges and collaboration on the incorporation of green metrics in engineering design and research. The portal will also be used as an outreach tool to individuals and organizations outside IEEE's traditional communities. This will help grow IEEE's membership base. The portal is being launched at IEEE ICC 2015.

IEEE SOCIETIES AND STEERING COMMITTEE

Led by the IEEE Communications Society, 16 key IEEE stakeholders have expressed interest in this new initiative. These are: Communications Society, Aerospace and Electronic Systems Society, Computer Society, Consumer Electronics Society, Consumer Electronics & Product Safety Engineering Society, Council on Electronic Design Automation, Council on Superconductivity, Educational Activities, Member and Geographic Activities (MGA), Micro-wave Theory and Techniques Society, Oceanic Engineering Society, Photonics Society, Power and Energy Society, Standards Association, Technical Activities, and Vehicular Technology Society.

A steering committee has also been established, and in addition to the initiative's two co-Chairs, the steering group includes (in alphabetical order):

- Susan Brooks, IEEE ComSoc Executive Director, USA.
- Mohamed Chériet, Synchromedia Lab Director, Professor and Canada Research Chair, École de Technologie Supérieure (Université du Québec), Canada.
- Tarek El-Bawab, IEEE ComSoc Director of Conference Operations, Jackson State University, USA.
- Rob Fish, Vice-President, Standards Activities, ComSoc, and President, NETovations Group LLC, USA.
- Kathy Grise, Senior Program Director, Future Directions, IEEE Technical Activities, USA.
- Kerry Hinton, Principal Research Fellow, Centre for Energy-Efficient Telecommunications (CEET), University of Melbourne, Australia.
- Dan Kilper, Director of the Center for Integrated Access Networks, University of Arizona, USA.
- Thierry Klein, Chair of the GreenTouch Technical Committee and Network Energy Research Program Leader, Bell Labs Alcatel-Lucent, USA.
- Louise Krug, Senior Researcher, Carbon Reduction Strategy, British Telecom, United Kingdom.
- Fabrice Labeau, President, IEEE Vehicular Technology Society, and Associate Professor, McGill University, Canada.
- Magnus Olsson, Senior Researcher, Energy Performance, Ericsson Research, Sweden.
- Sarah Kate Wilson, Vice-President, Publications, IEEE ComSoc, and Associate Professor, Santa Clara University, USA.
- Ke Wu, President-Elect, IEEE Microwave Theory and Techniques Society, and Professor and Canada Research Chair, École Polytechnique de Montréal, Canada.

THE GREEN ICT INITIATIVE: A CALL TO ACTION THROUGHOUT IEEE

IEEE's mission statement defines its core purpose as fostering technological innovation and excellence for the benefit of humanity. When viewed through the lens of the triple bottom line (economic, environmental, social) of

sustainability, the Green ICT initiative thus offers a compelling opportunity for IEEE to demonstrate the full impact of the technological innovation that it supports. ComSoc is highly pleased to develop the Green ICT initiative and calls upon all its members to leverage the web portal to publicize all Green ICT activities (events, news, publications, technical committee developments, etc.). But as stated earlier, the success of the initiative will ultimately hinge on IEEE-wide participation. This call to action therefore goes out to all IEEE Societies, Councils and Initiatives. Green ICT ... it's everybody's business! If this broad participation in IEEE can be achieved, outreach and advocacy, beyond IEEE's technological communities, could then serve as a lever to generate even broader interest in IEEE's activities as well as to diversify its membership base.

THE GREEN ICT INITIATIVE CO-CHAIRS BIOGRAPHIES

PROF. JAAFAR ELMIRGHANI [M'91] is the Director of the Institute of Integrated Information Systems within the School of Electronic and Electrical Engineering, University of Leeds, UK. He joined Leeds in 2007. Prior to that (2000–2007) as the chair in optical communications at the University of Wales Swansea he founded, developed, and directed the Institute of Advanced Telecommunications and the Technium Digital (TD), a technology incubator/spin-off hub. He received the Ph.D. from the University of Huddersfield UK in 1994 and the D.Sc. in communication systems and networks from the University of Leeds, UK, in 2014. He is a Fellow of IET and a Fellow of the Institute of Physics. He has co-authored *Photonic Switching Technology: Systems and Networks* (Wiley), and has published over 400 papers. He has research interests in optical systems and networks. He was Chairman of the IEEE ComSoc Transmission Access and Optical Systems Technical Committee and was Chairman of the IEEE ComSoc Signal Processing and Communications Electronics Technical Committee, and an editor of *IEEE Communications Magazine*. He was the founding Chair of the Advanced Signal Processing for Communication Symposium, which started at IEEE GLOBECOM'99 and has continued since at every ICC and GLOBECOM. Prof. Elmirghani was also the founding Chair of the first IEEE ICC/GLOBECOM optical symposium at GLOBECOM'00, the Future Photonic Network Technologies, Architectures and Protocols Symposium. He was the founding Chair of the first Green Track at ICC/GLOBECOM at GLOBECOM 2011. He received the IEEE Communications Society Hal Sobol Award, the IEEE ComSoc Chapter Achievement award for excellence in chapter activities (both in 2005); the University of Wales Swansea Outstanding Research Achievement Award in 2006; the IEEE Communications Society Signal Processing and Communication Electronics outstanding service award in 2009; and a best paper award at IEEE ICC'2013 in Green Communications. He is currently an editor of *IEEE Communications Surveys and Tutorials* and *IEEE Journal on Selected Areas in Communications* series on Green Communications and Networking. He is Co-Chair of the GreenTouch Wired, Core and Access Networks Working Group and has been awarded in excess of £22 million in grants to date from EPSRC, the EU, and industry, and is an IEEE ComSoc Distinguished Lecturer for the term 2013–2016.

CHARLES DESPINS' [M'82] career has spanned 30 years in both the academic and industry segments of the information and communications technologies (ICT) field. He has held various posts in the private sector, namely at CAE Electronics, Microcell Telecommunications (Canadian cellular operator), and at Bell Nordiq Group (a network operator in rural and northern areas of Canada) as vice-president and chief technology officer. He has also worked as a consultant for wireless network deployments in India and China. Since January 2003 he has been President and CEO of Prompt inc., an ICT university-industry research and development consortium developing various collaborative, public-private partnership research activities tackling a broad range of ICT themes, including a recent four-year Green ICT project that brought together 40 organizations to develop more than 65 new Green ICT products, processes, and services. He is also a faculty member (on leave) at École de Technologie Supérieure (Université du Québec) in Montreal, with research interests in wireless communications, as well as a guest lecturer at the Desautels faculty of Management at McGill University in Montreal. He holds a bachelor's degree in electrical engineering from McGill University in Montreal, Canada, as well as M.Sc. and Ph.D. degrees, also in electrical engineering, from Carleton University in Ottawa, Canada. He is a Fellow (2005) of the Engineering Institute of Canada and a recipient (2006) of the Outstanding Engineer award from IEEE Canada. He was also the recipient of the 1993 Best-Paper-of-the-Year Award in IEEE Transactions on Vehicular Technology. He is currently a frequent advocate on issues regarding the opportunities ICT offer to achieve sustainability.

¹ <http://gesi.org>, *Smarter 2020 report*

² *Equation project* (www.equationict.com), *LCA team project report, private communication, December 2014.*