Article:
Freeman, H, Elmirghani, JMH and Despins, C (2017) The President's Page: IEEE Green ICT. IEEE Communications Magazine, 55 (9). pp. 4-6. ISSN 0163-6804

https://doi.org/10.1109/MCOM.2017.8030373

IEEE Green ICT

The IEEE sets up IEEE-wide initiatives via its Future Directions Committee (FDC) to ensure that the organization is prepared to address future needs, is ahead of and capitalizes on technology trends to maximise its impact and fulfil its mission of advancing technology for the benefit of humanity. Recent IEEE initiatives have focused on cloud computing, smart cities, transportation electrification and Green Information and Communications Technology (Green ICT).

The IEEE Green ICT initiative is currently in its third year, the final year funded by the IEEE New Initiatives Committee (NIC). NIC has provided approximately $1m over the 3 years to support the activities of the initiative. Upon graduating from the NIC, the IEEE Green ICT initiative will be remain led by ComSoc with the active involvement of the other IEEE Societies.

Led by Co-Chairs Jaafar Elmirghani and Charles Despins, the IEEE Green ICT initiative has achieved outstanding results against its objectives and desired outcomes over its first 2.5 years.

Jaafar M. H. Elmirghani is full Professor and Chair in Communication Networks and Systems, and the Director of the Institute of Communication and Power Networks within the School of Electronic and Electrical Engineering, University of Leeds, UK. He has co-authored Photonic Switching Technology: Systems and Networks, (Wiley) and has published over 450 papers. He has research interests in communication systems and networks. Prof. Elmirghani is Fellow of the IET, Chartered Engineer and Fellow of the Institute of Physics. He was Chairman of IEEE ComSoc Transmission Access and Optical Systems (TAOS) technical committee and was Chairman of IEEE ComSoc, Signal Processing, and Communications Electronics (SPCE) technical committee, and an editor of IEEE Communications Magazine. He was awarded the IEEE ComSoc 2005 Hal Sobol award, 2 IEEE ComSoc outstanding service awards (SPCE 2009 and TAOS 2015), the 2015 GreenTouch 1000x award, IET 2016 Premium Award for work on Green Communications and shared the 2016 Edison Award in the collective disruption category with a team of 6 from GreenTouch for their joint work on the GreenMeter.

Charles Despins' career has spanned more than 30 years in both the academic and industry segments of the information and communications technologies (ICT) sector. In addition to his academic work, he has held various posts in the private sector, namely at Bell Nordiq Group as vice-president and chief technology officer, as a consultant for wireless network deployments in India and China and for 13 years, as President and CEO of Prompt Inc., an ICT research and development consortium. He is currently Dean of Research at École de Technologie Supérieure (Université du Québec) in Montreal, Canada. Dr. Despins is a Fellow of the Engineering Institute of Canada and a recipient (2006) of the Outstanding Engineer award from IEEE Canada. He is a former recipient of the "Best Paper of the Year" award in IEEE Transactions on Vehicular Technology. He is currently a frequent advocate on issues regarding the opportunities ICT offers to achieve sustainability in the 21st century.

The Challenge

ICT has a carbon footprint comparable to the global aviation industry, each responsible for about 2% of the world's carbon emissions. A study by the Global e-Sustainability initiative (GeSi) shows that of 25% of ICT emissions are attributed to Telecoms, 18% to Data Centers, and 57% to peripheral devices. Telecom companies are now the single largest users of energy in their countries, well ahead of the manufacturing industry. For example, Telecom Italia uses about 1% of the energy in Italy.

To understand the driving force behind the growth in ICT power consumption, we have to understand the traffic trends. Internet traffic used to grow at about 300% per year just before the turn of the millennium; it was expected to grow at even higher rates, which did not happen as a result of the dot-com bubble burst in 2000. Internet traffic, nonetheless, is now still growing at 30% to 40% per year! The aviation industry growth is almost flat in comparison.

At 40% growth per year, traffic doubles every 2 years, multiplies by 30x in 10 years; and multiplies by 1000x in 20 years. So if we were to improve the energy efficiency of ICT hardware, software and networks by a factor of 1000, then in 20 years, we will consume the same amount of power as today, but accommodate 1000x more traffic. Hence the GreenTouch (one of the IEEE Green ICT Initiative partners) vision to improve energy efficiency by a factor of 1000. This is essential as traffic grows faster at present than improvement in technology (energy efficiency); as such, business as usual is not sufficient and new initiatives are needed to tackle the challenge.

To see which strands to tackle in telecom, we need to understand the traffic trends. Voice is the slowest growing, wireless data is the fastest growing traffic strand and Internet video is the largest traffic strand by volume followed by peer to peer (P2P) traffic.

Therefore, to Green the Internet, we have to green video, P2P and wireless data mainly.
In addition to greening ICT in the manner outlined, a greater opportunity exists in the use of ICT to Green other sectors including transport (by reducing journeys for example), manufacturing and agriculture (both by introducing more efficient processes through sensing, processing and actuation for example), and a host of other verticals such as healthcare and energy distribution via smart grid. The use of ICT to green other sectors (greening by ICT) has the potential to reduce the global carbon footprint by an amount equal to ten times ICT's own carbon footprint, as shown by the SMARTer 2030 report, i.e. a 20% reduction in the global carbon footprint can be achieved through the use of ICT to green verticals.

The initiative

The IEEE Green ICT initiative through its many IEEE member Societies addresses two main challenges: Greening ICT and Greening by ICT. The "sustainability through technology" challenge will remain relevant for a long time, is essential for the future of the planet and is not simply a temporary "hot" technology trend. The initiative is currently hosted by the IEEE Communications Society, which is the lead society with participation by many IEEE societies including Computer Society, Vehicular Technology Society, Power and Energy Society,

Industrial Electronics Society, Microwave Theory and Techniques Society and the Society on Social Implications of Technology.

The challenge spans multiple disciplines where greening one part of ICT may lead to adverse effects elsewhere. For example, greening telecom by shifting processing to Data Centers may have adverse effects on Data Centers. Therefore, seamless collaboration is needed across IEEE societies.

The Green ICT Initiative's mission therefore is to "Build a holistic approach to sustainability by incorporating green metrics throughout IEEE technical domains". Its specific objectives are to (a) Foster inter-Society collaboration to build such a holistic approach to sustainability (b) Diversify IEEE membership through outreach to non-traditional IEEE communities (c) Grow IEEE's influence and visibility in international forums. Viewed through the triple bottom line of sustainability (economic, environmental, social), the IEEE Green ICT Initiative therefore offers a compelling opportunity for IEEE to demonstrate the full impact of the technology innovation it supports.

The IEEE Green ICT Initiative desired outcomes from the outset included (i) Establishing and enhancing conferences and workshops to share knowledge about Greening of/by ICT (ii) Establishing new publications to promote multidisciplinary approaches to incorporating Green ICT Metrics in IEEE fields (iii) Developing IEEE standards to formalize IEEE expertise and leadership in tangible ways (iv) Developing training and awareness material to improve IEEE member knowledge and engagement (v) Engaging a broader Green ICT community through rich portal content.

Conferences and workshops

In the IEEE Communications Society, the Transmission Access and Optical Systems (TAOS) technical committee started the first ICC/GLOBECOM track on Green communications and networking through the efforts of Prof. Elmirghani, starting in 2009, which led to the first green track in ICC/GLOBECOM at GLOBECOM 2011. This effort has grown since with the Green Communications and Networking track elevated to a full Symposium at ICC 2016 through the efforts of TAOS and the IEEE Green ICT initiative.

Over the past 3 years the initiative has co-organized many tracks, sessions, panels and tutorials at every ICC and GLOBECOM. It has also organized similar activities at the leading conferences of other IEEE societies to foster inter-society collaboration including at ISTAS 2015-2017, VTC 2016 and VTC 2017, Intelect 2015-2017, GreenComm 2015-2017, ICUWB 2015, ICUNC 2015, ICTON2015-2017, Future Internet and Smart Cities, 2015, EuCNC 2015, GreenTouch showcase 2015, CCNC 2015-2017 and OFC 2015-2017.

The IEEE Green ICT initiative has started a new Summit on Green ICT for which a first roadmapping event took place at ICC 2017. The inaugural Summit on Greening through Information & Communications Technology ,"The GtICT Summit," will take place in Paris on October 3rd 2017. Its aims are to identify key technological, commercial, and public policy challenges and solutions to achieve sustainability through ICT. Prof. Charles Despins delivered a number of webinars and talks in English and French to promote the summit. The summit will include a World Café approach focused stimulating

dialogue across disciplines, a plenary on how to ensure that Smart is also Sustainable, together with views from government, from ICT verticals, and an IEEE Young Professional Green ICT Idea Competition on greening ICT and greening by ICT, http://greenict.ieee.org/summit/gtict-summit-2017.

Publications

Building on the successful ICC/GLOBECOM Green Communications and Networking track and then symposium, the initiative, with colleagues in ComSoc was instrumental in introducing an IEEE Journal on Selected Area in Communications Series on Green Communications and Networking. The first issue, in December 2015, received 143 submissions; 39 papers were accepted with 552 total pages (by far the largest JSAC special issue in recent history – 15-17 papers in a typical issue), and 22 papers were transferred to the second issue. Issue 2, in June 2016, received 125 submissions; 23 papers were accepted for Issue 2 (in addition to 22 transferred from submissions to Issue 1) and as such, about 50 papers were published in Issue 2 with about 720-760 total pages. Issue 3, in December 2016 received 130 submissions. The effort led to the approval of the new IEEE Transactions on Green Communications and Networking where the first issue of the New Transactions was published in January 2017.

At ICC 2017, the IEEE Green ICT initiative received approval from the IEEE Communications Society Publications Council and Board of Governors for a phase I submission of a new Sustainable ICT Magazine where ComSoc is the lead financial and technical sponsor.
The IEEE INSTITUTE dedicated its March 2016 issue to the IEEE Green ICT initiative. IEEE Spectrum published feature articles on the initiative, for example in February 2017. Members of the initiative contributed to the GreenTouch Final Results: the Green Meter Research Study White Paper, 2015 together with numerous articles in industrial magazines and venues, http://greenict.ieee.org/blog.

Standards

To maximise industrial engagement and impact, the initiative set up a very successful standardization program. It organized two rapid reaction workshops to mobilize the community, first in November 2015 in London and then in July 2016 in Chicago with participation by several key players including Nokia, Ericsson, GSMA, Huawei and Qualcomm. The 9 project authorization requests were approved by the IEEE Communications Society Standards Development Board in October 2016 and by the IEEE Standards Association in December 2016. Work on the standards including final sponsor ballots is due to conclude by September 2018. The nine standards are organized under three working groups:

GICT - GICT Emissions Working Group
IEEE P1922.1, is a standard for a method for calculating anticipated emissions caused by virtual machine migration and placement.
IEEE P1922.2 is a standard for a method to calculate near real-time emissions of information and communication technology infrastructure.

EECH - Energy Efficient Comm Hardware Working Group

IEEE P1923.1 is a standard for computation of energy efficiency upper bound for apparatus processing communication signal waveforms.
IEEE P1924.1 is a recommended practice for developing energy efficient power-proportional digital architectures.

EEICT - COM/SDB/Energy Efficient ICT Working Group
IEEE P1925.1 is a standard for Energy Efficient Dynamic Line Rate Transmission System.
IEEE P1926.1 is a standard for a Functional Architecture of Distributed Energy Efficient Big Data Processing.
IEEE P1927.1 is a standard for Services Provided by the Energy-efficient Orchestration and Management of Virtualized Distributed Data Centers Interconnected by a Virtualized Network.
IEEE P1928.1 is a standard for a Mechanism for Energy Efficient Virtual Machine Placement.
IEEE P1929.1 is an Architectural Framework for Energy Efficient Content Distribution which specifies a framework for designing energy efficient content distribution services, such as migration, placement, and replication, over networks.

Training

The initiative organized a number of short courses at ICC and GLOBECOM delivered by Prof. Elmirghani which include (i) “Greening the Internet,” ICC’13 (ii) “Energy Efficient Core and Content Distribution Networks,” SoftCOM’2013 (iii) "Greening Core, Data Center and Content Distribution Networks," ICC 2014 (iv) “Greening Cloud Networks,” ICC'15 (v) “Greening Big Data Networks,” ICC'16 (vi) “Greening Cloud and Virtualised Communication Networks,” GLOBECOM'17. Prof. Fabrizio Granelli delivered the online training course “Designing the Green Internet” offered by ComSoc. The initiative co-organized several distinguished lecturer tours focusing on Green ICT. As part of the standardization effort, the initiative organized and delivered 4 webinars, one by each of the standards working groups and a broader webinar to promote and provide training in the areas of the standards.

Engage a broader Green ICT community through rich portal content portal and the initiative Technical Community.

The IEEE Green ICT community already has over 4000 members. This is a call to participate in all the IEEE Green ICT initiative activities. Please see http://greenict.ieee.org, and contact the initiative Co-Chairs. Sustainability concerns all of IEEE!