GREEN COMMUNICATION AND NETWORKING: A NEW HORIZON

M PUJITHA 1,J RANJITH 2, B LAXMIKANTHA 3
4.DHARAVATH BHADRU, 5.T.VEERA BABU
1Assistant Professor, Department of Computer Engineering,
Ellenki college of Engineering and Technonlogy, patelguda (vi), near BHEL ameenpur (m),
Sangareddy Dist. Telangana 502319

.

GREEN communication and networking is essential to the sustainable development of not only ICT industry itself,

but also the whole economic value chain. Taking 5G mobile communication network as an example, which has been widely recognized as the foundation and the key enabling technology of digitalized smart society, the total energy consumption of

the stand-alone approach might be 10+ folds compared with the existing 4G networks. As a result, if without breakthroughs

in the greening technologies, the smart society would never be sustainable if not impossible.

Based on this request and also the strong push from the industry, IEEE Communication Society launched a special series on Green Communications and Networking in IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS

(JSAC) in 2015 and then kicked off the new journal IEEE TRANSACTIONS ON GREEN COMMUNICATIONS AND

NETWORKING (TGCN) in 2017, together with the IEEE Vehicular Technology Society and the IEEE Signal Processing Society. Since then, the journal has grown rapidly and all papers published since its first issue in March 2017 have been indexed by Scopus. The goal of the journal is to advance and promote significant technology advances in wireline, optical, and wireless communications and networks to realize sustain- able, energy-efficient, energy-aware, and environment-friendly communications and networking.

However, what does “green” really mean? Different people may have quite different understandings. The most common understanding might be high “energy-efficiency” (EE) which is defined as the ratio of the total amount of data delivered and the total energy consumed. Clearly, this is not appropri- ate and sufficient enough, because increasing EE does not necessarily lead to the reduction of total energy consump- tion if the amount of data to be delivered increases faster than the EE. Furthermore, in the systems with renewable energy supplies, EE does not mean everything either because there might be energy outage and energy overflow if the har- vested energy cannot be exploited smartly. On the contrary, “green” should mean more about energy-sustainability and environment-friendliness, i.e., the reduction of total energy consumption. In this regard, we will intentionally use “green” more in

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-3, ISSUE-12, 2016
DOI: 10.21276/ijcesr.2016.3.12.7

the sequel but limit the use of "energy-efficiency" in order not to mislead the authors and readers.

Since the traffic demand is anyhow increasing continu- ously, the fundamental challenge in greening communication and networks then turns to be: can we and how can Send More Information bits with Less Energy (SMILE)? This is and industry. Although Shannon has established a theoretical relationship between maximum information rate and the min-imum energy needed to convey the information over AWGN channels, more sophisticated relationship between energy and information is still unknown. Broadly speaking, this is also one of the fundamental questions in Energy Informatics for Smart Interaction of Energy and Information (EINSTEIN), which is quite a new discipline dealing with the theory and technologies of how to match energy to information flows and how to exploit information in energy flows. Authors, in par- ticular from academia, are therefore encouraged to work on these fundamental problems and submit your original results to this journal.

In order to make this "impossible" (i.e., SMILE) possible, we need to take a holistic approach rather than focus only on the transmission layer or radio access network (RAN) part. Based on the analyses of the energy supply and energy con- sumption situation in various parts of the information systems, it has been convinced that there is a great potential to reduce energy wastes by making information systems more adap- tive to traffic demands and QoS requirements. For examples, the under-utilized base stations (BSs) can be turned off or switched to sleep mode if the neighboring or upper-layer BSs can accommodate the traffic by cell zooming or other traffic steering methods. The service mode can also be turned down to low-resolution if user's QoS requirement has been stepped down. In energy-harvested communication systems, the energy can be used more carefully (e.g., provide basic service only) if weather is not good in order to avoid energy outage, but should be utilized more aggressively (e.g., provide more caching and push) if weather is very good in order to avoid energy over- flow. This is indeed a big area in which many rooms are still left for further exploration.

Meanwhile, we also need to take a new horizon to realize SMILE and EINSTEIN. In addition to ultra-dense deploy- ment of base stations (BSs), it is foreseen that 6G needs to further deploy a large number of edge computing facil-ities to support task offloading and machine learning (ML) algorithms for smarter, ultra-reliable and low-latency commu- nications (uRLLC). To this end, not only the radio access networks (RAN) face with high energy cost, the comput- ing on edge devices and servers will also have huge energy barriers. As a result, a new horizon of green artificial intelli- gence (AI) and a holistic approach for green communication and computing co-design need to be taken in order to make future 6G networks cost-effective and energy-sustainable. This is a brand-new research field need to be invested more human resources. For instance, in order to save the computing energywhile not sacrificing communication energy, a network-aided and mobility-enhanced edge intelligence (MEET) framework has been proposed. But, how to implement it is still an open problem.

Based on the above-mentioned observations, we have extended and restructured the technical scopes of the IEEE TGCN into 4 areas with the topics included but not limited to the follows:

Area 1: Green Internet & Service Provisioning

- Routing algorithms & Internet architecture
- Data center networking & in-networking processing
- Optical communications &

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-3, ISSUE-12, 2016
DOI: 10.21276/ijcesr.2016.3.12.7

networking
- Power-line and visible light communications
- Energy-efficient networking and protocols
- Communications and networking devices and systems
- Communications and networking for environmental pro- tection monitoring

Area 2: Green Wireless Communications & Networking
- Green radio and cellular networks
- WiFi and home/body-area networks
- Mobile sensor and ad-hoc networks
- OFDM and MIMO transmission
- Coding and modulation
- Radio resource management and optimization

Area 3: Green Internet of Things & Energy-harvesting Communications
- Machine-type communications and Internet of things
- Smart-grid communications & mobile crowdsourcing
- Energy-harvesting communications
- Connected and automated vehicles
- Aerial networking for drones and space information networks
- Backscatter communications
- Energy-sustainable healthcare systems

Area 4: Green Computing & Artificial Intelligence
- Data storage and chip design
- Cloud computing and machine learning
- Edge computing, learning & inference
- Data processing and big data analytics
- AI-enabled green communications and networking
- Communication-and-computation resource management
- Quantum computing and communication
- Blockchain

ISSN (PRINT): 2393-8374, (ONLINE): 2394-0697, VOLUME-3, ISSUE-12, 2016
DOI: 10.21276/ijcesr.2016.3.12.7