Green Network Protocols and Algorithms

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The Past decade has witnessed a fast growth in wireless networks that provide connectivity and information to the end users. Along with this network expansion, the necessity of sufficient bandwidth and efficient quality of service is increasingly demanded. Network expansion greedily contributes a large factor of energy consumption and resulted in high environment footprint. It is recently been reported that Information and Communication technology (ICT) sector is responsible for producing 2 % to 3 % of total emission of greenhouse gases. Moreover, according to the GreenTouch initiative, the estimated CO_2 emissions from mobile, wire-line and LAN communications is about 25 % to 31 % of total ICT's global CO_2 emission.

Thus, it is increasingly necessary to alleviate energy consumption as it is not only becoming scarce and expensive but also causing a dramatic climate change. Green protocols and algorithms are required to reinvent scalable and sustainable network by maximizing energy efficiency and reduce total cost of ownership. Alleviating the energy consumption of network and communication infrastructure by developing power-efficient techniques is a pressing need for researchers in academia and industry.

This special issue has tried to collect the recent advances and achievements in the field of green communication and networking. The issue includes 12 articles that address a wide scope in the field of green network protocols and algorithms, including the development of energy-efficient protocols for wireless networks, energy-efficient multimedia solutions, energy efficient routing algorithms and new recommendations and techniques for green networking and communication.

We present a summary of the accepted papers:

Chengming Li et al. developed a scheme popularity inspired caching and adaptive rate (AR) to improve the energy-efficiency and quality of service during packet forwarding for Content-Centric Networking. The proposed scheme leverages parallelism and stochastic features of ant colony optimization algorithm for supporting Quality of Service aware forwarding of Interests. The simulation results show that the proposal improve the stability, robustness and energy-efficiency of Content-Centric Networking.

Anas Daghistani et al. proposed Green-Frag, an energy-efficient adaptive partial packet recovery mechanism. Their developed algorithm dynamically partitions the frame into smaller blocks to avoid dropping the whole frame due to a single bit error. Also, Green-Frag is able to tolerate high interference and save energy by varying the transmit power based on channel quality and interference pattern.

Zuhal Can and Murat Demirbas discussed the feasibility of employing energy-conserving approaches on both smartphones and WSN nodes in order to collect WSN data for urban data collection applications. The approach is based on the mobility behavior of the smartphone users. They evaluated and compared on-demand and continuous data collection protocols on several WSN islands with different size and connectivity regarding to data collection efficiency, obtaining better data delivery ratio and latency in continuous data collection protocols. They found that the size and connectivity of islands affect the data collection efficiency.

Chih-Heng Ke et al. developed a frame-based mapping mechanism (FBM) to process I/P/B video frame packets which drops arriving packets if the preceding packets in the same video frame have been dropped. When fragmented packets of a single frame are allocated to different access categories queues, out-of-order delivery may occur. The extensive simulation shows that the energy of a device is not wasted in the transmission of useless video data in wireless LAN.

Mahmoud Sami et al. integrated cooperative communication and physical layer network coding in wireless ad hoc networks. More precisely, they developed a joint relay selection and power allocation algorithm based on location information and the nodes' residual energy. Their evaluation indicates that the proposed algorithms outperform existing green solutions.

Seyed Iman PourEmami, Bahador Bakhshi proposed a multi-objective mixed integer linear programming model to trade-off between power consumption and blocking probability of lightpath connection requests in WDM networks with dedicated path protection mechanism. Moreover, a heuristic routing algorithm is proposed to find working and backup lightpaths per request. They evaluated the optimization model and the heuristic algorithms in two network topologies under different traffic loads. The results of both, the optimization model and the heuristic algorithm, show the superiority of the proposed algorithm in comparison with existing solutions.

M. Bakhouya et al. evaluated and compared an Adaptive Information Dissemination (AID) algorithm with existing broadcasting protocols in MANETs in terms of energy efficiency. In AID, each node can dynamically adjust the values of its local parameters using information from neighbouring nodes without requiring any additional information such as distance measurements or exact location-determination of nodes. Simulation results report that AID is more energy efficient than existing approaches.

Mohammad Reza Jabbarpour et al. address the vehicle traffic congestion problem by developing a green Vehicle Traffic Routing System (VTRS) that reduces fuel consumption and consequently CO emissions via ant-based algorithm combined with fuel consumption model. This VTRS is an ant-based Vehicle Congestion Avoidance System (AVCAS) that uses Signalized Intersection Design and Research Aid (SIDRA) fuel consumption and emission model in its vehicle routing procedure. The approach is called AVCAS+SIDRA which utilizes various criterion such as average travel time, speed, distance, vehicle density along with road map segmentation to reduce fuel consumption as much as possible by finding the least congested shortest paths in order to reduce the vehicle traffic congestion and their pollutant emissions. Through simulation authors have shown that their proposed method is better than existing solutions.

Ruiqi Ding and Gabriel-Miro Muntean proposed a novel scheme named Adaptive Multimedia Delivery over wireless networks (EDCAM), a hybrid innovative approach which combines multimedia quality adaptation and content sharing mechanisms, to save energy at client devices. Simulation results show how the proposed EDCAM solution results in significant improvements in terms of energy efficiency in comparison with other solutions, while maintaining at high levels both the performance of multimedia content delivery and the perceived quality at the user side.

Miguel Rodriguez-Perez et al. developed an algorithm based on the ant colonization Algorithm to compute, in a decentralized manner, the routing tables in order to minimize the global energy consumption. The authors show in their simulations that the algorithm is also able to track changes in the offered load and react to them in real time.

Gangyong Jia et al. proposed a periodically active rank scheduling (PARS) to optimize power efficiency for (DDR Random Access Memory) DRAM in smart phones. The scheduling features are three folds: First, they partition all threads in the system into groups. Second, they modify the page allocation policy in order to achieve that threads in the same group occupy the same rank but different banks of DRAM. Finally, sequentially schedule threads in one group after another while only active running group's ranks to retain other ranks with low power status. Experiments show that PARS periodically activates one rank after another to optimize memory power efficiency.

Muhammad Faheem et al. propose an energy efficient cluster formation algorithm called Active Node Cluster Formation (ANCF). The aim of ANCF algorithm is to distribute heavy data traffic and high energy consumption load evenly in the network by offering unequal size of clusters in the network deployment. They also proposed a lightweight sensing mechanism called Active Node Sensing Algorithm (ANSA). The aim of ANSA algorithm is to avoid high sensing overlapping data redundancy by appointing a set of active nodes in each

cluster with satisfy coverage near to the event. Moreover, they propose an Active Node Routing Algorithm (ANRA) to address complex inter and intra cluster routing issues in highly dense deployment based on the node dominating values. Their experiments reveal that the proposed scheme outperforms existing routing techniques in terms of energy efficiency, end-to-end delay and data redundancy, congestion management and setup robustness.

We are pleased to share the selected works for this special issue with all the readers of the Journal of Network and Computer Applications (JNCA). We believe that this special issue provides last advances on network Protocols and Algorithms for green communications and networking. Through this special issue, JNCA contributes the understanding of sustainable technology for green networking and communication.

To conclude this special Issue, we would like to express our sincere gratitude to all the authors that submitted papers to this special Issue. We would also like to thank the reviewers for their timely comprehensive reviews and constructive comments. Finally, we wish to give special thanks to Mohammed Atiquzzaman, Editor-in-Chief of JNCA, for his support on the special issue.

Chengming Lia, Wenjing Liu, Lei Wang, Mingchu Li, Koji Okamura,Energy-Efficient Quality of Service Aware Forwarding scheme for Content-Centric Networking

Anas Daghistani, Abderrahman Ben Khalifa, Ahmad Showail, and Basem Shihada, Green Partial Packet Recovery in Wireless Sensor Networks

Zuhal Can and Murat Demirbas, Smartphone-based data collection from wireless sensor networks in an urban environment

Chih-Heng Ke, Chong-Yi Yang, Jiann-Liang Chen, Kayhan Zrar Ghafoor, Jaime Lloret, Frame-based Mapping Mechanism for Energy-Efficient MPEG-4 Video Transmission over IEEE 802.11e Networks with Better Quality of Delivery

Mahmoud Sami, Nor Kamariah Noordin, Fazirulhysiam Hashim, Shamala Subramaniam, Ayyoub Akbari-Moghanjoughi, Energy-Aware Cross-Layer Cooperative MAC Protocol for Wireless Ad Hoc Networks

Seyed Iman PourEmami, Bahador Bakhshi, On the Trade-Off between Power-Efficiency and Blocking Probability in Fault-Tolerant WDM Networks

M. Bakhouya, J. Gaber, Pascal Lorenz,Energy Evaluation of AID Protocol in Mobile Ad Hoc Networks

Mohammad Reza Jabbarpour, Rafidah Md Noor, Rashid Hafeez Khokhar,Green Vehicle Traffic Routing System using Ant-based Algorithm

Ruiqi Ding, Cristina Hava Muntean, and Gabriel-Miro Muntean, Energy-efficient Device-differentiated Cooperative Adaptive Multimedia Delivery Solution in Wireless Networks

Miguel Rodríguez Pérez, Sergio Herrería-Alonso, Manuel Fernandez-Veiga, Candido Lopez-Garcia, An Ant Colonization Routing Algorithm to Minimize Network Power Consumption

Gangyong Jia, Guangjie Han, Jinfang Jiang, Joel J.P.C. Rodrigues, PARS: A Scheduling of Periodically Active Rank to Optimize Power Efficiency for Main Memory

Muhammad Faheem, Muhammad Zahid Abbas, Gurkan Tuna, V. Cagri Gungor, EDHRP: Energy Efficient Event Driven Hybrid Routing Protocol For Densely Deployed Wireless Sensor Networks