Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

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BEng (Beijing University of Posts and Telecommunications, 2015)

**"Optimal Energy Management Strategies in Wireless Data and Energy Cooperative Communications"**

Department of Electrical and Computer Engineering

Thursday, May 10
1:00 P.M.
Engineering Office Wing
Room 430

Supervisory Committee:
Dr. Xiaodai Dong, Department of Electrical and Computer Engineering, University of Victoria
(Co-Supervisor)
Dr. Wu-Sheng Lu, Department of Electrical and Computer Engineering, UVic (Co-Supervisor)

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Chair of Oral Examination:
Dr. Nicholas Bradley, Department of English, UVic

Dr. Stephen Evans, Acting Dean, Faculty of Graduate Studies

# Abstract

This dissertation first presents a new cooperative wireless communication network strategy that incorporates energy cooperation and data cooperation. The model establishment, design goal formulations, and algorithms for throughput maximization of the proposed protocol are presented and illustrated using a three-node network with two energy harvesting (EH) user nodes and a destination node. Transmission models are established from the performance analysis for a total of four scenarios. Based on the models, we seek to find optimal energy management strategies by jointly optimizing time allocation for each user, power allocations over these time intervals, and data throughputs at user nodes so as to maximize the sum-throughput or, alternatively, the minimum throughput of the two users in all scenarios. An accelerated Newton barrier algorithm and an alternative algorithm based on local quadratic approximation of the transmission models are developed to solve the aforementioned optimization problems. Then the dissertation extends the cooperative strategy to multi-source wireless communication network, where N source users communicate with the destination via one relay that harvests energy from the RF signals transmitted by the sources through time-division multiple access (TDMA).We characterize the *Energy-Throughput* (E-T) tradeoff regions between the maximum achievable average throughput of the sources and the total amount of saved energy in three circumstances. For the case $N = 1$, all harvested energy will be used to forward the message. For the case $N > 1$, we compare two transmission strategies: one is common PS ratio strategy that the relay adopts the same PS ratio for all sources; the other is individual PS ratio strategy that each source uses an individual PS ratio. Numerical experiments under practical settings provide supportive evidences to our performance analysis.