Energy Efficient Wi-Fi Management for Smart Devices

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Introduction and Motivation

- **Motivation**
  - Existing Wi-Fi energy management scheme only analyzing the network layer communication patterns
  - Impossible to perform application-specific energy management
  - Combine the existing energy management scheme with application layer management!

- **Research Goals**
  - Propose an application-aware Wi-Fi energy management solution
  - Only require device side deployment
  - Should be realizable for many mobile devices

Related Work

- **Related Work**
  - Resource scheduling: scheduling the major hardware component such as CPU, LCD and Wi-Fi comm. module to perform energy saving. Protocol level modification is required, and not application-aware
  - Resource offloading: offloading resource intensive task to high performance computer to perform energy saving. Additional effort is required for developer to support resource offloading

Analysis of Wi-Fi Energy Consumption

- **Relation of Energy, Time & Data Rate**
  - Energy expenditure is decided by data transmit time
  - Beneficial to maximize the data rate to gain more energy efficiency

- **Application Characteristics**
  - Delay sensitivity: categorize applications into Delay Sensitive Application & Delay Tolerant Application
  - Expected throughput: better schedule application transmission
  - Burst cycle: better determine expected throughput
  - Session preservation: determine the delayable time

Dynamic Wi-Fi on-off Control

- **Concept of Proposed Method**
  - Turn off Wi-Fi communication when available throughput cannot support application requirement

- **Design of Method**
  - Introduce control parameters for making better on-off decision
  - Delay Sensitive Application: larger threshold
  - Delay Tolerant Application: smaller threshold

Application Packing

- **Concept of Proposed Method**
  - "Pack" the Delay Tolerant Application together to maximize the utilization of the available capacity

Application Alignment

- **Concept of Proposed Method**
  - "Align" the Delay Tolerant Application into the comm. pattern of Delay Sensitive Application

Application Comm. Mgmt.

- **Communication Management Methods**
  - Process manipulation scheme: originally designed for efficient CPU resource sharing and scheduling. Quickly recovered from suspend mode, but lack of user interactivity
  - Traffic shaping scheme: exploit the firewall policy to control the traffic, better user interactivity, but slow recoverability from suspend mode

Conclusion & Future Work

- **Conclusion**
  - Investigated the key attributes impacting Wi-Fi energy consumption
  - Proposed, implemented and validated three application-aware device-side energy mgmt. schemes

- **Future Work**
  - Production-quality implementation, field experiments
  - Extend the proposed approach to 4G comm. module