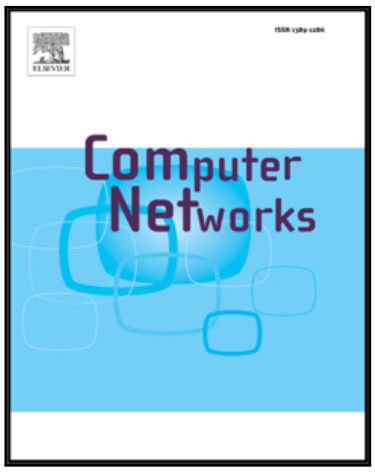

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***Abstract*—Smartphone becomes an indispensable gadget in our daily life. Prolonging battery life on smartphone can extend the usability of the phone without being recharged, especially for accessing streaming video, which is a paramount service in the mobile Internet era. Many researchers have proposed energy efficient streaming methods, including bandwidth control and packet scheduling. Such studies have focused on reducing the energy consumption of central processing units (CPUs) and wireless networks; however, screens may drain substantial energy on smartphone. In this study, an energy efficient streaming system is proposed, combining adaptive coding and a backlight control mechanism. A non-parametric signal prediction is used to predict the network condition and then some adaptive encoding parameters are subsequently adjusted to fit the network capability. A histogram equalization is applied to compensate for the loss of image contrast after reducing the backlight. To validate the proposed concept, some experiments were conducted and the corresponding results show that the proposed streaming system can effectively reduce energy consumption on smartphone, while accessing the video streaming service.**

***Index Terms:* brightness reduction ratio (BRR), moving average, non-parametric prediction, power consumption, received signal strength indicator (RSSI), signal strength, adaptive streaming**

I. INTRODUCTION

Video streaming has become a popular smartphone service. Most contemporary users watch videos online, and certain user live-stream videos. A survey conducted by Cisco indicated that mobile data traffic is growing at a substantial speed, and video content is expected to account for approximately 70% of mobile data traffic by 2019 [1]. However, [2] indicates that the primary energy consuming smartphone components are the screen, WiFi/3G, and central processing unit (CPU). Thus, watching a streaming video quickly drains the power of a smartphone, and reducing energy consumption is a vital consideration. In order to make the consumption of energy lower we propose to use two schemes. The first is to use adaptive streaming and the second is to use adaptive backlight control.

Many video websites such as YouTube, provide users with dynamic customizable video quality, namely, adaptive streaming. Compared with high-quality video, low-quality video requires less energy (whether accessed using a CPU or wireless transmission), and uses less computation and transfers less data over wireless networks. To provide adaptive streaming, we must have the information about signal quality in client device, which we can get by using received signal strength indicator (RSSI). RSSI can easily be retrieved from network environment information on a smartphone, and its value is influenced by transmission power, connection environment, and distance from the device to wireless access points.

Furthermore, if the user tries to use smartphone to watch streaming video on the move, the network condition may be fluctuated drastically, resulting in a poor user experience. To deal with the situation, we propose a prediction-based adaptive streaming method to generate proper video streaming based on the current network situation by observing the RSSI trend in order to predict its future signal quality. Previous studies have shown that using network-based services that exhibit poor connections require additional energy [3]. Thus, when the network quality deteriorates, the proposed system dynamically reduces the streaming quality to save energy; when the network quality is sufficient, the video quality is increased.

Another issue for an energy efficient streaming system is the streaming scheme. The idea of the adaptive streaming is the most intuitive approach to save the energy when streaming. The adaptive streaming scheme should be able to provide a proper video quality according to the network condition [3]. Furthermore, considering the mobility of the smartphone, a network prediction scheme would be used to predict the network condition for conducting a suitable video stream. The RSSI value is the key indicator of the continuously changed network condition when the user is moving. The detailed descriptions and algorithms of the network prediction based adaptive streaming scheme are introduced in section V.

For the second proposed scheme, the idea of the energy-saving scheme derived from the past studies is used to propose an energy-efficient streaming system for smartphones [3], [4]. The proposed scheme focuses on the screen energy consumption since the screen is the most energy-draining component of the smartphone [2]. The intuitive and simple approach to save energy