**An Analysis of Power Consumption In A Smartphone**

Modern consumer electronics draw power from batteries that are limited in size and capacity, which makes understanding where and how energy is used of paramount importance. Detailed analysis of power consumption on the Openmonko Neo Freerunner measured not only overall system power, but also the breakdown of power consumption by individual hardware components. A big challenge arises because conversion efficiency is unknown, it is difficult to calculate the additional power lost when converting from supply voltage to component voltage. As a result, the authors differentiate between “total power,” measured at the battery, and “aggregate power,” measured as the sum of individual component measurements. In terms of macro-benchmarks, the majority of power consumption is attributed to the GSM module, graphics driver, and backlight. The authors concluded that the most effective power management approach is to shut down unused components and disable their power supplies.

**Smartphone Energy Drain In The Wild: Analysis and Implications**  
 In order to understand where and how energy drain is happening, the authors conduct extensive measurement and modeling of energy usage of Galaxy S3/S4 phones. The authors encounter two major challenges: 1) measuring the hardware components running on phones in the wild, which is addressed by developing a hybrid that combines utilization-based and FSM-based models, and 2) collecting triggers for running such a model on phones under normal usage circumstances without incurring a large logging overhead, which is addressed using a free app deployed to the Google Play Store. Analyzing the Galaxy S3 and S4 devices in the wild while covering 800 apps, the authors found that most energy consumption comes in the form of backlighting the screen, cellular paging, and 3G/4G energy/tail energy.

**Optimizing 360 Video Delivery Over Cellular Networks**

Because users can only view a portion of a 360 video at a time, fetching entire video frames wastes bandwidth. In order to optimize 360 video delivery over cellular networks, the authors measure how 360 videos are currently delivered, and propose a cellular-friendly streaming scheme that delivers video frames based on head movement prediction. We are faced with some challenges: 1) a mechanism to download a sub-area of a video chunk (solved through calculation of target area and modification of HTTP request parameters), 2) predict a user’s head movement (using OpenTrack, an open-source head tracking software), and 3) incur minimal changes to both the client and the server (integrating with DASH and HTTP). The optimizations resulted in up to 80% reduction in bandwidth capacity.

**Furion: Engineering High-Quality Immersive Virtual Reality on Today’s Mobile Devices** Furion aims to enable high-quality, immersive mobile VR under current limitations without waiting for future hardware and next-generation wireless networks. The authors attempt to enrich VR QoE (e.g. rendering new environments without fetching new frames on-demand, prefetching the needed pre-rendered environment frames just in time to be used), by 1) prefetching pre-rendered panoramic frames to be cropped, and 2) using video compression to drastically cut down on frame size as well as using multiple cores to decompress. With these creative optimizations, Furion shows that it is possible to support high-quality VR applications using current technology with 60 FPS and under 14ms, 1ms, and 12ms latency to controller, rotation, and movement interactions.

These potpourri papers are interesting to me because they dive into problems that help advance the development of the internet of things (which, in my opinion, will be the defining topic of the next century). From battery efficiency to AR/VR, all the papers in this area pushed me to find out more about what problems need to be addressed and what direction we should move in terms of tech development.